This is the first of a series on the history and methods of problem solving that created both Classical TRIZ and OTSM, the "General Theory of Powerful Thinking."

Why TRIZ and OTSM?
What are TRIZ and OTSM?

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Attempts to improve problem solving skills and methods: short historical overview.

One of the very first steps to being human is getting the first solution to a problem and reflecting on it, generalizing the idea, in order to be able to apply this idea next time for identical situation.

This is very important - to reflect and remember the result of our trial and errors approach for problem solving. The first humans did these trials and errors by their hands with elements of real world.

Humans are able to transfer this experience to other members of their community and especially to the next generation. And in frame of OTSM[1] approach we named this kind of solution - Typical Solution.

As soon as typical solution appears we are able to share it in our society. Then other people are able to copy and implement it. This is the start of the educational system. Very first teachers appear and very first educational methodology starts to develop.

This is a very important point for our subject. It is not enough to understand how to solve a problem, but it is also very important to reflect it as an idea and to transfer this idea of solution to other people. In frame of OTSM approach we call this idea of solution – Typical Conceptual Solution.

But in order to transfer Typical Conceptual Solution to another person we should solve one more problem - how to transfer Idea of a solution? How to share ideas efficiently? From the era of very first human this question forever follows any new Typical Solution, and later any methodology for getting Typical Conceptual Solution.

For many years Typical Conceptual Solutions appear in our culture as a result of trial and error problem solving, using elements of the real world. Then people learned to do

[1] OTSM is one of branches of the of TRIZ evolution tree. More detailed information is presented later in this article.

mental experiments - mental trials end errors. Humans started to think about problem solving, not just making trials and errors and correcting them in the real world.

Up to the 20th century, the trial and error method, both in the real world and as mental (computer in 20th century) experiments, was the only way of creating Typical Solutions.. But something has happened in 20th century in history of creativity and in the evolution of our world and our culture. In this paper we will try to share our point of view on this dramatic history of human culture evolution. What has the history of problem solving evolution brought us, how it has happened and why?

Before 20th century: Trials and Errors method: first attempts to increase its efficiency.

As we mentioned above Typical Solution appears as a result of trials end errors, as a result of reflection and finally as a result of education system appearance. What we learn in our family, in kindergarten at school and university? We learn Experience of previous generations that is presented in the shape of Typical Conceptual Solutions for various problems. Somebody could say that we learn science…. Yes. We agree. But why and how does science appear? First of all it is result of trials and errors. Second, science appears in order to make result of our activity more predictable. That means that in order to get the result we want, we could reduce amount of trials and errors and predict results more accurately, more of the time.

What does the Typical Conceptual Solution brings us? The same – because of we know Typical Solutions, we do not need to repeat many trials and errors. We can make the result more predictable.

Science generalizes and systemizes typical solutions and procedures, then develops educational technology to transfer this knowledge to a new generation of human. Of course, this is not everything that science has been doing for centuries but for our subject we will pay attention just for this aspect of science. Therefore science and Typical Solution help us to get predictable results. But what does it mean – Make result more predictable? This point is also important for our subject and we will come back to this point later.

History:

At this very moment we should return to the trial and error method. First of all, because for millions years it was the only method to get Typical Solution. We are not going to provide here all details. We will mention just some most important point in history that link to our subject.

Ancient Greece and China

Very first evidence we have is that between 400 and 300 years BC at least two people start to think how to increase efficiency of getting Typical Conceptual Solutions. In other words they have started to ask: how can we solve a problem that does not have typical solution yet? Who were they? Where did these two people live? Why did they start to think about same subject almost simultaneously? Why did it has happened at this "moment" of History?

Too many questions and very few answers!

One of them was Pappus of Alexandria in Ancient Greece. The other one is Chinese philosopher Hui Shih (born 380 BC , Sung, in modern Honan, China). We have modest evidence about Pappus and Hui Shih.

Pappus was interested in solving mathematical problems. He distinguishes between two kind of analysis, theoretical and problematical analysis. Theoretical analysis is concerned with finding proof. From theorem A that has to be proven, other theorems are successfully derived until a known theorem B is reached. If B is false, A is false too. If B is true, then it has to be checked whether every step in the chain is convertible in order for A to be true.

But Problematical Analysis is concerned with searching for a geometrical object satisfying certain conditions. This is the problem of constructing a certain figure from given data. In the frame of Classical TRIZ and OTSM we could make the interpretation that we should find a way to transform the initial problem situation into a situation that satisfies our needs and also satisfies certain conditions of our specific situation.

What is interesting about Hui Shih that we could say that he was very first TRIZ expert. He use very similar technique and was a professional problem solver. He applied understanding of contradictions in order to solve problem and mostly use it in order to solve social and political problems.

This is the only short information we get from history about these two people who tried to increase efficiency of solving Not Typical Problem. In frame of OTSM approach we use this name for two situations:

1. The problem that does not have typical solution yet,
2. The Typical Solution exists but it is unknown for a problem solver - the person who have to solve the problem here and now.

What is sufficient for our subject and further discussion that we should make clear distinguishes between Typical Problems and Not typical Problems. Typical Problem is a problem that has known Typical Solution. Not Typical Problem is a problem that doesn't have typical solution known for problem solver or any other person in the world as well. Often you could see other name for Not Typical Problem – Creative Problem, - problem that needs creativity to be solved. But for numbers of reason we avoid using this name for Not Typical Problem.

1.1.1 Roger Bacon and Rene Descartes

Rene Descartes (born in 1596 March 31) and Roger Bacon (born in 1220) may be the best known people who dedicated part of their life to improve method of solving Not Typical Problems. Let have a look at Encyclopedia Britannica:

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Bacon, Roger

born *c.* 1220, , Ilchester, Somerset, or Bisley, Gloucester?, Eng. died 1292, Oxford?

By name Doctor Mirabilis (Latin: "Wonderful Teacher") English Franciscan philosopher and educational reformer who was a major medieval proponent of experimental science **Bacon** studied mathematics, astronomy, optics, alchemy, and languages. He was the first European to describe in detail the process of making gunpowder, and he proposed flying machines and motorized ships and carriages. **Bacon** (as he himself complacently remarked) displayed a prodigious energy and zeal in the pursuit of experimental science; indeed, his studies were talked about everywhere and eventually won him a place in popular literature as a kind of wonder worker. **Bacon** therefore represents a historically precocious expression of the empirical spirit of experimental science, even though his actual practice of it seems to have been exaggerated.

Descartes, René

born March 31, 1596, La Haye, Touraine, Fr. died February 11, 1650, Stockholm, Swed.

Latin Renatius Cartesius French mathematician, scientist, and philosopher. Because he was one of the first to oppose scholastic Aristotelianism, he has been called the father of modern philosophy. He began by methodically doubting knowledge based on authority, the senses, and reason, then found certainty in the intuition that, when he is thinking, he exists; this he expressed in the famous statement "I think, therefore I am." He developed a dualistic system in which he distinguished radically between mind, the essence of which is thinking, and matter, the essence of which is extension in three dimensions. **Descartes**'s metaphysical system is intuitionist, derived by reason from innate ideas, but his physics and physiology, based on sensory knowledge, are mechanistic and empiricist.

What is interesting that both of them considered the educational process very important. By the , sometime between 1277 and 1279, Bacon was condemned to prison by his fellow Franciscans because of certain "suspected novelties" in his teaching. As we know from research of Genrich Altshuller and Igor Vertkin, as more novelty brings a creative person to question the culture of mankind, the more in danger he or she is. Rene Descartes also was "too innovative" as we could say today. Descartes understood that he

was in danger. So he was thinking hard before publish results of his work and sometimes postponed publications of his ideas. Some of them were published just after his death.

Most known books connected to our subject written by Descartes are: The World. Discourse on Method, Rules for the direction of the mind [[Descartes R]].

Most known books of Bacon are: General Principles of Natural Philosophy, General Principles of Mathematical Science, Compendium of Philosophy

What is also interesting about these two personalities is that Bacon stresses the use of experiment, but Descartes pays more attention to reasoning. Now it is well known that theory without practical application has the same weakness as practice without theoretical reflection. But several hundreds years ago it was not so obvious. Even more it was dangerous to discuss all of this openly. Just remind yourself Galileo or Giordano Bruno…

This is a good example of the pace of change of the mentality of human during history. It took several hundreds years in order to accept ideas that Experiment and Theory are equally important. And it took just a few tens years to accept Altshuller's ideas about Law of Evolution of Engineering system. The ideas were developed in 1949, and published after his release from prison in 1956. By the way, Altshuller was in prison because of "suspected novelties"…

Today we have similar situation about Laws of evolution of Business and Management systems. During several last years the author had many discussions with scientists in management and business organizations. Almost all of them refuse to recognize existing laws of evolution of the system in which they carry out their research. Then question appears: how it is possible to develop science without discovering law of evolution of the given type of system? Without discovering Laws that link parameters of the systems by cause-effect links? It looks like management science today is just in front of the door of scientific approach. That is why we have so much confusion about the practical application proposed by this science. And that is why sometimes it is difficult to apply TRIZ for management problems. It happened because of there is not background knowledge about laws that drive transformation and evolution of management science. The methodology of Classical TRIZ and OTSM will help a lot in order to increase efficiency of the analysis of management problems. More of this application of TRIZ and OTSM could bring valuable results even in the situation when we have a lack of background knowledge. It is well known that Classical TRIZ and especially OTSM could not replace specific knowledge, but could help dramatically improve the specific knowledge representation in order to simplify process of building solution. In OTSM we are not looking for the solution, but we gradually build it based on initial problem situation and background knowledge of the specific fields.

Beginning of 20th century: Edison's Solution - Research Institute (still trials and errors but lot of propel).

Encyclopedia Britannica:

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Edison, Thomas Alva
born Feb. 11, 1847, Milan, Ohio, U.S. died Oct. 18, 1931, West Orange, N.J.

American inventor who, singly or jointly, held a world record 1,093 patents. In addition, he created the world's first industrial research laboratory.

First Industrial research laboratory – Prototype of research institute may be one of the most important creation of Edison. During several hundred years people gradually increased their ability to carry out physical and mental experiments. Technology of getting new knowledge useful for practice was improved. Edison decided speed it up and prototype of research Institute was settled up. Several researchers and research teams were working together in order to find solutions of real problem. They use still trial and error method. Speed of innovation was dramatically increased. But potential of human to solve problem individually was the same.

In the middle of 20th century: Intensification of getting creative solution. Various methods appear and the numbers keep growing

Here you could find more then one hundreds techniques that are dedicated by their authors to increase productivity of solving Not Typical Problems:
http://www.mycoted.com/creativity/techniques/index.php

We should mention that this is not complete list techniques of this kind.

Until now lot of people (and scientists) consider Creative Skills as an ability to generate many ideas as quickly as possible. The more ideas, the more creative the person is. Maybe this is a good for certain point, but, in case we are going to use these techniques for practice, especially for goal oriented problem solving, this stereotype bring us lot of problems and prevents us from getting more efficient methodology for goal oriented Not Typical problem solving.

Throughout this very short historical introduction we can see clearly that acceleration has been happening in evolution of problem solving methodology and in thinking about problems. First stage took millions of years up to Pappus of Alexandria in Ancient Greece and Chinese philosopher Hui Shih appears in history. Even though Hui Shih was using techniques that resembled those of the 20th century, his experience was not accepted by contemporaries. Mainstream of Chinese philosophy was different then small dialectician school of Chinese philosophers. His approach was not used widely by his community and culture around him.

Next stage took just about one thousand years before Bacon and Descartes proposed two approaches that we can consider as complimentary to each other.

Next stage took just a few hundreds of years before Edison developed the “Research Institute” –several teams that were working in parallel on the same problems and use ideas for problem solving based on ideas of Bacon and Descartes.

And just a few tens of years between “Research Institute” of Edison and many creative problem solving techniques start to appear in the second part of 20th century. It is interesting to understand why this acceleration has happened and where is the limit of this S-curve?

Why did creative problem solving start to grow in the middle of 20th century?

First of all because of speed of innovation was dramatically increased in the first part of 20th century. Could you imagine that individual from year 1900 appear in the 50-60-s? What do you think would he be able understand world around him? Lot of invention and innovation change the world dramatically: Cars, TV, Radio, Airplanes, recorders for audio and video, home appliances, etc.

Lots of engineering innovation brings lots of new “not typical” engineering problems. New demand appeared in the world in the middle of 20th century – ability to solve problem should be dramatically increased.

Lot of scientific research has been started in order to find out how ability to solve Not Typical Problem could be improved. Most researchers try to interview inventors and innovators. But usually it was very difficult to get answers for lot of questions. Many processes in human mind happened unconsciously and people were not able explain how new ideas appear in their mind or the explanation was not useful and transferable to others. It was impossible to develop an educational system after this kind of interview and research. In response for this demand start to appear various techniques dedicated for creative problem solving. Most know authors of these techniques are Gordon, Osborn, De Bono. [Gordon W.J.J. "Sinectics: The Development of Creative Capacity" - New York, 1961. Koestler A., Osborn A.] Most of these techniques were oriented to increase amount of ideas that human mind could produce for certain amount of time.

Behind all of creative problem solving methods was still same method of trials and errors. Creative problem solving methods just help produce more ideas quickly. But this method does not achieve the goal of finding a method for “not typical problem” solving. Process of finding solution was still random. Some people gave up and said that this is the only way to find solution for “not typical problems”-- just work hard and increase speed of trials end errors.

End of 20th century: Research Institutes +Methods for Intensification generation of creative idea.

In the second part of 20th century creative problem techniques start to appear in research institutes. It was a hope that combination of creative problem solving techniques and research institutes would be helpful.

But soon after this, engineers and managers were disappointed enough with a result that researchers could get with creative problem solving techniques. Why? Most of users say that this technique is not efficient enough even though sometimes they could get really breakthrough ideas. But the process is unreliable—good and bad results occur at random.

It means we need to discover a way out: new and wild enough in order to destroy our mental inertia and find breakthrough ideas that will help us increase efficiency of goal oriented Not Typical Problem solving, but less random than creative problem solving.

This heretical idea was proposed by the young officer of Caspian Navy patent department – Genrich Altshuller in USSR. In 1946 he poses the question for his research this way: How can we narrow area of research to construct a solution without many trials and errors? Ideally without trials and errors at all! His idea was simple – we do not need lot of ideas. We need just one that fit our needs and could be implemented to solve our specific problem.

Exaggeration is one of instruments of an approach discovered and developed by Altshuller since 1946. Later, in the middle of 70s this approach got name TRIZ. At the same time Altshuller start to think about more general approach he named OTSM. Both of them are Russian acronyms TRIZ for Theory of Inventive Problem solving and OTSM for General Theory of Powerful Thinking. May be some readers start to smile here. Yes they have a reason, especially if those readers are not so much acquainted with Classical TRIZ at least.

In the middle of the 70s few people in the world believed that these two theories could be developed at all. But in the middle of the 80s many people changed their minds. Why? Because of at that time lots of inventive problems were solved and those solutions were implemented. As a result Altshuller's students start to use TRIZ for solving not only engineering problems and but even everyday and private life problems. People start to teach their kids to handle problems and develop multi screen vision of their kids. Result surprise not only parents but school teachers [T.Sidorchuk, N. Khomenko. Thoughtivity for kids. GOAL/QPC 2006]. With TRIZ were solved a lot of real life complex not engineering problems, several discovery were done, some interesting scientific hypotheses were proposed and proved by research.

As a result lot of people start to believe that OTSM was also possible. Some of them started their research in this direction. Next our papers of the series will describe our vision of what is classical TRIZ and show what we have now as OTSM. How Altshuller posed the question for OTSM to be answered and what contradictions were discovered during the attempt to answer this question and how those contradictions were resolved by

OTSM. And, of course, we will start from Altshuller's answer to the question he posed in 1946 for his research, which resulted in TRIZ and how TRIZ resulted in a business game named by Altshuller and his student and colleague Igor Vertkin "Environment against Creative Personality" [G. Altshuller, I.Vertkin. How to became Genius. Minsk, Belarus 1994]. In the form of business game they present result of their research about 1000 Creative personalities of different domains name of whom you can find in the World wide encyclopedias. The authors were looking for an answer to the question that they posed : ***How did those Creative Personalities implement their ideas which were considered as heretical or wild or stupid or just impossible at the beginning…. But then changed the world? TO BE CONTINUED.***

TRIZ Journal editor Ellen Domb and author Nikolai Khomenko discussed this article and others in the planned series at the recent TRIZCON2006 meeting. Photo by Dr. Tatiana Sidorchuk.

List of references:

1. Altshuller G.. *Algorithm of Innovation*. Technical Innovation Center, Inc. 2000
2. Altshuller G. And Suddenly the inventor appear… Technical Innovation Center, Inc. 2000
3. Altshuller G. *To find an Idea*. Novosibirsk 1986.
4. Altshuller G., Vertkin I. *How to became Genius*. Minsk, Belarus 1994
5. Descartes R.. Regles pour la direction de l'esprit.
6. Descartes R.. Discours de la method.
7. Gordon W.J.J. "Sinectics: The Development of Creative Capacity" - New York, 1961.

8. Ideation. Tools of classical TRIZ
9. Koestler, Arthur. The act of creation. New York: Macmillan; 1964.
10. Osborn, A. F. (1948). Your Creative Power: How to use Imagination. New York: Charles Scribner's Sons.
11. Osborn, A. F. (1952). Wake up your mind: 101 Ways to develop creativeness. New York: Charles Scribner's Sons.
12. Osborn, A. F. (1953). Applied Imagination. New York: Charles Scribner's Sons.
13. Sidorchuk T., Khomenko N. Thoughtivity for kids. GOAL/QPC. 2006
14. Sidorchuk T. System of creative assignments as an instrument to develop creativity skill during early ages of personality development. Ph.D. These. 1998.