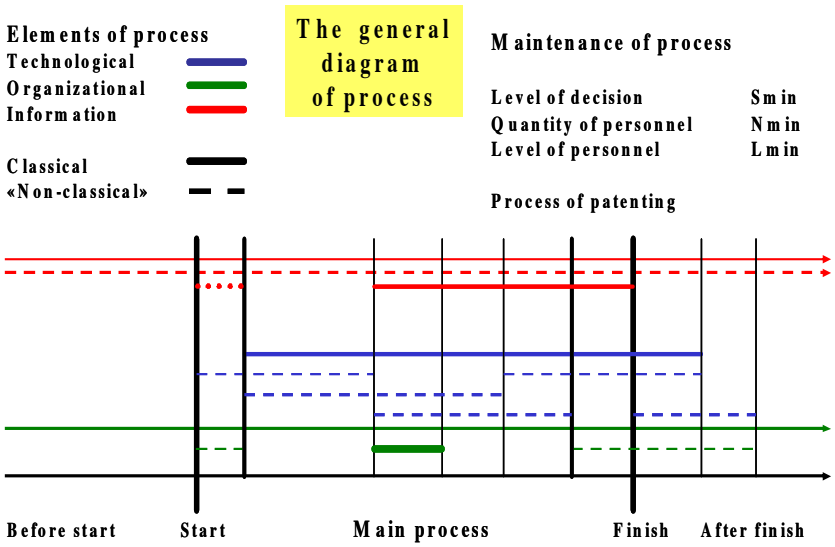
European Commission
FP7-REGPOT-CT-2011-285912 - project FOTONIKA-LV
FOTONIKA-LV
LATVIJAS UNIVERSITĀTES ZINĀTNISKO INSTITŪTU ASOCIĀCIJA

Classical TRIZ

Project s Manual

Short English Editing



2015

Classical TRIZ

Project's Manual

Short English Editing

Scientific Editing
by
Alexander Theodor
Narbut

2015

Supported by FP7 project
Unlocking and Boosting Research Potential
for Photonics in Latvia –
Towards Effective Integration
in the European Research Area (FOTONIKA-LV)

FP7-REGPOT-CT-2011-285912

ISBN 978-9984-45-994-3

INTRODUCTION

The main purpose of this book – to show the general scheme of the implementation of the TRIZ projects.
Also, this book presents the basic TRIZ instruments that are needed for projects.
Addition is examples of patents which was obtained as a result of TRIZ projects.

This book is not complete.
Many tools for TRIZ Projects are tested now.
They will be published later.

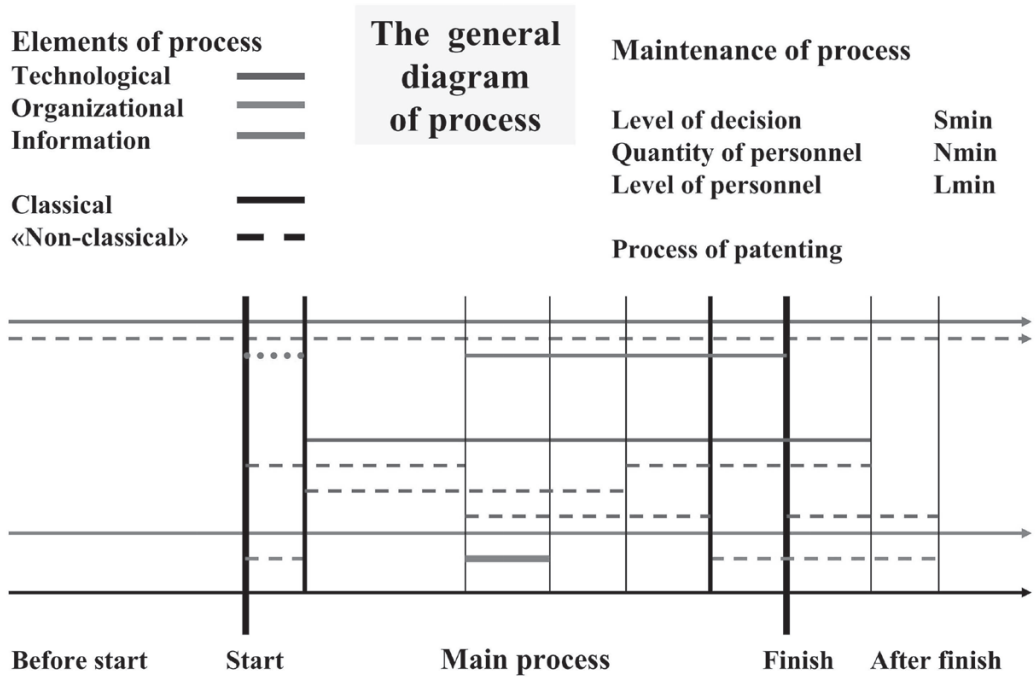
This book was prepared by the group
«COMCON*TRIZ & FRT Corporation»
for research and educational purposes only.

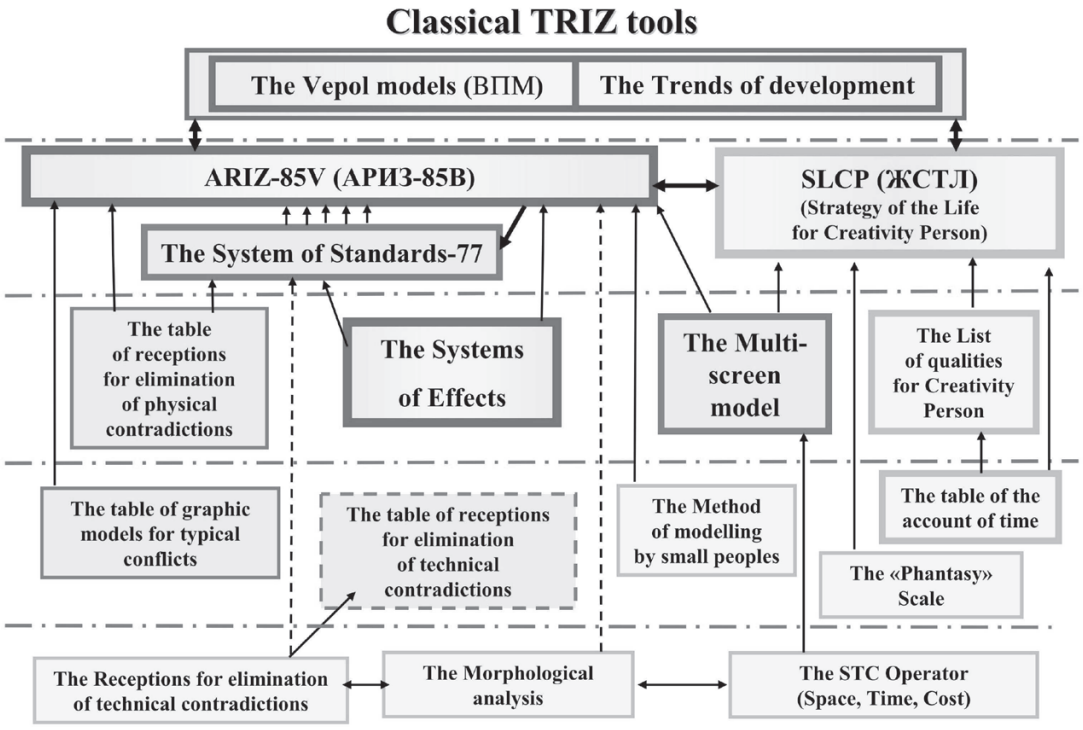
This book is not intended for sale.

Your questions and suggestions you can send to:
editor@FRTRIZ.com

Scientific Editor

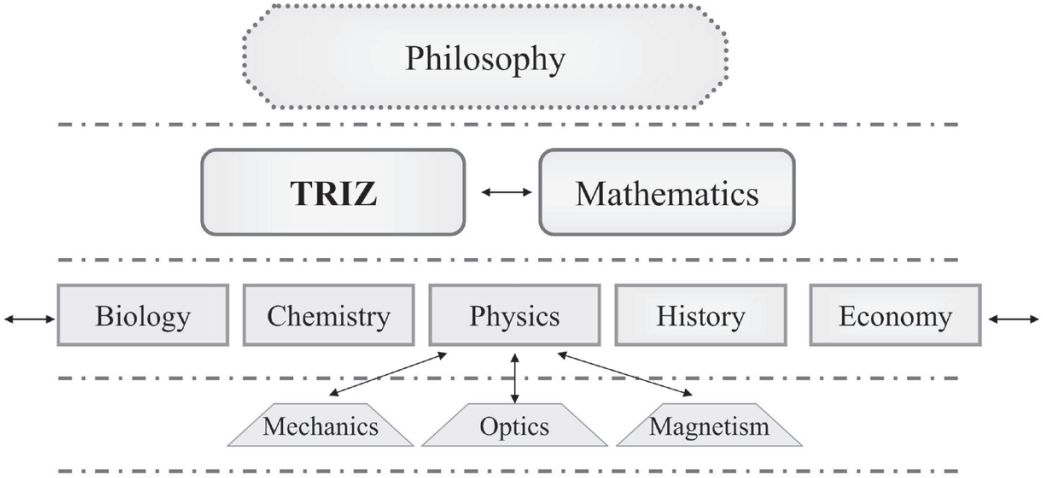
Riga, April, 2015


Elements of process
Technological
Organizational
Information
Classical
«Non-classical»
The general diagram of process
Maintenance of process
Level of decision Smin
Quantity of personnel Nmin
Level of personnel Lmin
Process of patenting
Before start
Start
Main process
Finish
After finish


Classical TRIZ tools
The Vepol models (ВПМ)
The Trends of development
ARIZ-85V (АРИЗ-85В)
SLCP (ЖСТЛ)
(Strategy of the Life for Creativity Person)
The System of Standards-77
The table of receptions for elimination of physical contradictions
The Systems of Effects
The Multi-screen model
The List of qualities for Creativity Person
The table of graphic models for typical conflicts
The table of receptions for elimination of technical contradictions
The Method of modelling by small peoples
The table of the account of time
The «Phantasy» Scale
The Receptions for elimination of technical contradictions
The Morphological analysis
The STC Operator (Space, Time, Cost)

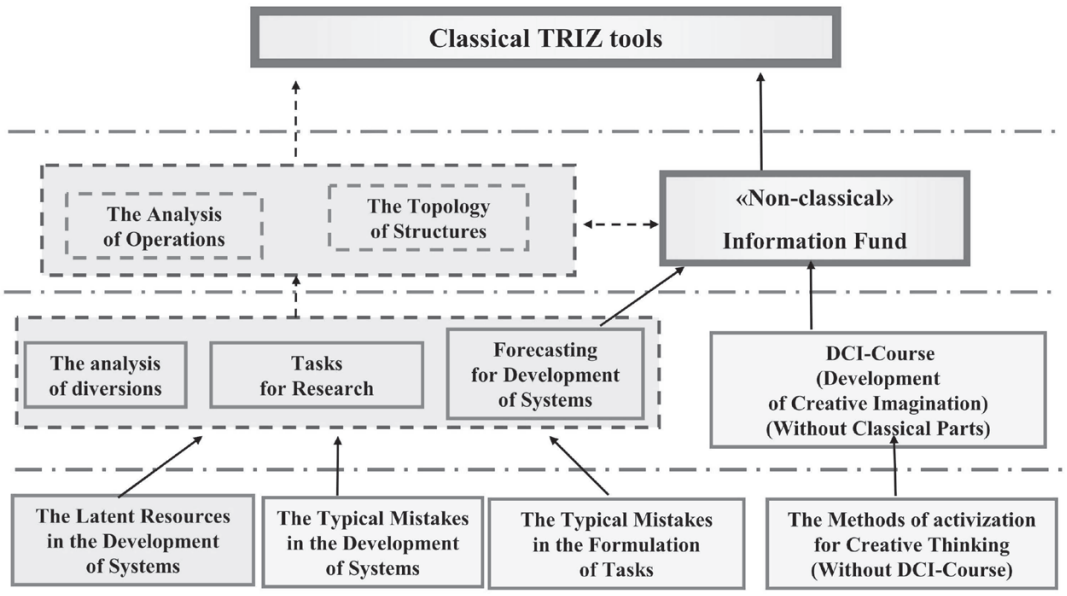
Place of the TRIZ

in the System of Sciences



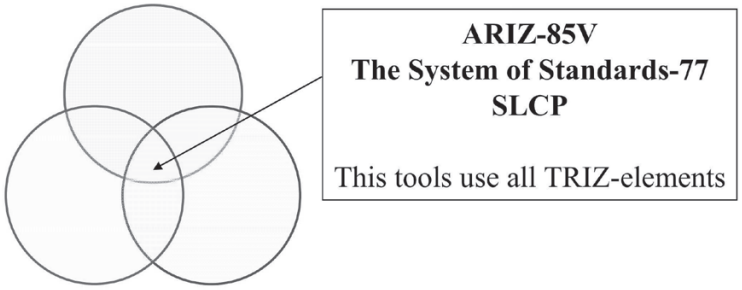
TRIZ unites the general, philosophical approach for a problem with the concrete approaches of fundamental sciences and applied sciences

«Non-classical» TRIZ tools



General structure of the TRIZ

System of the Information Funds

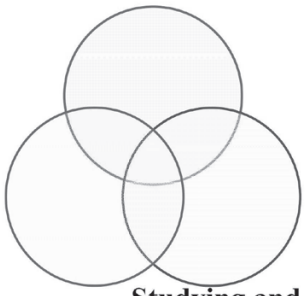


All elements of TRIZ are connected among themselves and unprofitable to use them separately.

ARIZ-85V, the System of Standards-77, SLCP – it's the major TRIZ tools.

Structure for use of TRIZ

Application of TRIZ



Researches in TRIZ **Studying and training in TRIZ**

Best application of TRIZ - it is researches and studying in TRIZ also.
Best researches in TRIZ - it is application and studying in TRIZ also.
Best studying in TRIZ - it is application and researches in TRIZ also.

Main task and questions

Before start

1. Formation Information Facility
classical and "non-classical") - common to all systems.

2. Formation artist - general requirements (LSCP, including QCP).

Start

1. Formation Information Facility
classical and "non-classical") - common to all systems.

2. Formation artist - general requirements (LSCP, including QCP).

3. Use technology tools (classical and "non-classical").

4. Use organizational tools (classical and "non-classical").

For explanation for levels of solutions

How to receive the necessary level of the solution.

What tools are necessary for this purpose.

What quantity and level of personnel are necessary for this purpose.

Key parameter of system needs to be normalized

The size of the profit from realization of system
needs to be normalized.

The project: (Name)

Requirements to the project.

1. The customer

1.1. Division.
1.2.1. A name of the employee which accepts work.
1.2.2. The phone.
1.2.3. Email.
1.3.1. A name of the employee which gives the additional information.
1.3.2. The phone.
1.3.3. Email.

2. The description of system

2.1. The main purpose of system.
2.2. Basic elements of system.
2.3. Key parameters of all system and its elements (switching - cost).
2.4. In what these parameters are measured.
2.5. What values (size) of these parameters are available now.

3. Requirements to the system

3.1. What parameters should be changed.
3.2. What values of parameters are necessary for receiving.
3.3. It is impossible to change what values of other parameters (necessary restrictions).

4. Execution time of the project

4.1. Date of reception of the information on items 1, 2, 3.
4.2. Dates of reception of the additional information and preliminary discussion of decisions.
4.3. Date of final presentation.

Explanation for levels of solutions

How to receive the necessary level of the solution.

What tools are necessary for this purpose.

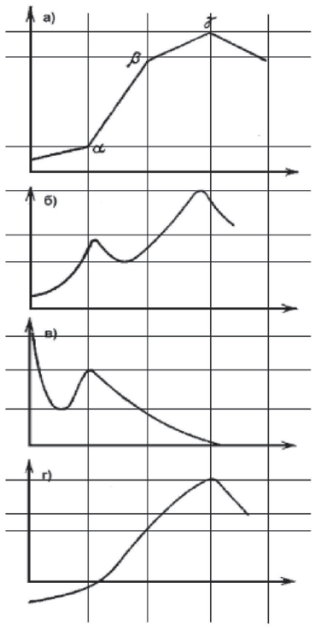
What quantity and level of personnel are necessary for this purpose.

Key parameter of system needs to be normalized

Levels of solutions are discrete.

The quantity of solutions needs to be normalized.

The size of the profit from realization of system needs to be normalized.



History of the TRIZ Instruments

Science was created in antique Greece. The great, but modest Aristotle considered the person by name Thales as the first among all scientists. This is the same Thales from Miletus who turned philosophy, mathematics and astronomy into real sciences. Certainly, many things were known hundreds of years before Miletus Ionian School, but Thales and his students started using not only observations and not only reasonings to apply to reception of new knowledge. They were the first who used ***proofs.***

The new approach, new techniques for intellectual work not only allowed to discover something new, but also permitted to accurately evaluate, determine and sometimes even predict new events. Thales was the one to teach his friends sailors to use the Polar Star as an orientation point. He was the one to find out how to measure the distance from the ship to the shore. Even the solar eclipse was for the first time predicted by Thales.

Thales' main interest was the science itself and the process of justifying it. He also discussed the justification process with his own students. For the science and for his students, whose number grew with each year, Thales left all other activities, such as traveling, structural design and military art, although in all these areas he achieved excellent results.

As it commonly happens, the new work was not immediately recognized. Exercising ***pure science***, which is what Thales was doing, often causes misunderstanding and calls forth mockery and even hostility from others. New students, who were only starting their studies, had the hardest time. It was difficult for them to prove to others and to themselves that what they were doing really was time worthy. Under such conditions, it was hard to think about science. Eventually, it got to a point when scolding went too far…

When the time came, Thales successfully solved that problem. He proved that exercising science might indeed be very useful; moreover, it could give a financially profitable result. But more about this later.

This book talks about one of many sciences. Of course, it does not cover all of it, for no science can be fully covered with just one book. Here, we only talk about ***history of basic instruments of TRIZ***.

The title of the theories is an abbreviation for ***Theory*** for ***Solving Innovative Problems***. Then came the difficulties present in every science. What is a ***mechanic***? Fixing a bike is job for a specialized mechanic. To design plans of a big ship is also a job for a mechanic. Calculating the flight trajectory from Earth to Saturn is practically pure mechanics. Nevertheless, it is clear that these jobs are very different from one another. In each case, a high order qualification is required, but they are all different kinds of qualification.

TRIZ also requires different kinds of qualification. There are many types of innovative problems whose solutions depend on relatively simple instruments. But ***a hard problem can be understood only after its solution is known***. Thus, it is impossible to identify the necessary instruments and their use right away. Moreover, many problems change halfway through the solution process, – and often enough they do not become easier.

There is one solution: You must prepare yourself for hard work from the very beginning. ***Every Student can become a Master.***

This does not mean that every Student must become a Master. Moreover, it is simply not possible, because there is plenty of work for every level of qualification. It is not possible to create a strong army consisting of only generals. There must be officers, even more sergeants and the most privateers. Yet, a good soldier must understand his general, because only then he can accomplish what is required of him. This is the way any group functions. This is the way of life.

Thales from Miletus took a very trivial approach. Together with his students, he developed a plan in order to justify the value of science. And then he followed it.

At first, it started with astronomical observations and calculations. They showed that next year will have very rich crops of olives. After that, the science team mobilized all the financial resources and purchased almost all the machines for producing olive oil from Miletus and its surrounding areas. Of course, there was a high risk factor associated, but in less than a year these machines were overloaded with daily work, and Phales with his students became some of the richest people in Asia Minor.

There was nothing non-trivial with this plan. All it required was to do exactly what the science predicted. Also, one must discover, understand and learn to properly use this science. It is not important what task you have at hand, what is important is how accurately, skillfully and professionally you are doing it.

TRIZ – is the theory for the practical work.
This is new chance for you.

The science can not be useless.

First step into the new science

The first step into the New Science of TRIZ was made in the summer of 1956. An article «Psychology of innovative creativity» was published in soviet journal «Psychology Questions» #6, 1956, p.37-49. The authors by G.S. Altshuller*) and R.B Shapiro*) (Baku city).

The process of solving innovative problems, as well as the process of developing new technical systems, was always of interest. Moreover, the notion technique (technology) does not only refer to automobiles, ships or cellular phones. It also describes actions taking by a football player or a boxer, playing violin and painting a composition.

Technique – it is all the instruments
that a man designed for altering nature.

Certainly, articles and books about how techniques developed and evolved have been published before. However, they described one sided process: either purely psychological, social or purely naturalistic. The world of technique, undoubtedly, was created by the world of humans from the world of nature, but it is a separate world in itself. It has specific objects, which can be described with specific models that are governed by specific laws.

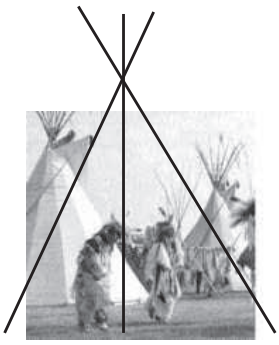
G.S.Altshuller and R.B.Shapiro were the first to talk about this in their article. With this work they opened a door into a new science

*) *The phonetic transcription of surnames:* [al'tʃu:ller], [ʃapi:ro].

Analogues situations are present in other sciences as well. For example, the formulas that A.Einstein used to describe his Special Theory of Relativity were known long before and were published by different scientist. Yet, A.Einstein was the first to point out the importance of these formulas, which in turn discovered new laws of nature (speed of light is constant in all frames of reference). So A.Einstein is considered the scientist who discovered the Theory of Relativity.

TRIZ - it is a science, which studies the development of techniques as co-action of humans and nature.

The co-action of nature, humans and technique can be demonstrated with the problem of three intertwined rings. With a careful look, one can see that only together the three rings form a system. If even one of the three elements is removed the system falls apart. Each of the rings 'retains individuality', since it is not tied or connected to the others, but only together they form a reliable and stable system.



This is similar to the three poles that are used for a base of **a tipi.**[*)] Each pole is held up by the other two and cannot stand on its own.

One of the characteristics of TRIZ is the detection and application of **contradictions**, simultaneous «presence-absence» of some action.

[*)] ***A tipi*** *– a version of* ***a wigwam****, dwelling of aboriginals of America.*

So going back to the original publication, the following quotation demonstrates the vital changes that authors made:

«*...The study of psychology of the innovative creativity cannot be done separately from studies of general laws of technique development. The objective of the inventor should be directed towards creating new inventions, the inventor is part of the technical progress. Hence, the mentality of the innovative creativity is understood only with extensive knowledge of the laws of technique development. The above mentioned certainly does not indicate that the researcher must only be involved in studying the mechanism of the technical progress. Unique psychology of the innovative creativity, as with any scientific discipline lies in the necessity to simultaneously take into consideration objective interconnections among technical development and subjective, psychological factors. First of all, the psychology of the innovative creativity is a subsection of psychology. Thus, the centre of its attention is the psychological actions taken by the inventor, inventor who perfects and completes the technique. The psychology of the innovative process is a bridge between the subjective world of human psychology and the objective world of technology and so it must take into account in the studies of the innovative process the laws of technique development.*

The process of developing a new invention has two sides: the materialistic and psychological. In order to identify the materialistic side of the invention it is necessary to know the history of how the technique developed and understand the basic laws of a technical process. Studying such history material and analysis of specific inventions happen to be one of the most important sources of psychology of technical process.

In order to identify the psychological laws of invention systematic observation of the process of the innovative work by the inventor is necessary, as well as generalizing the innovator experience and experimental examination of the innovative creation process through experiment conduction in conditions closest to genuine ones...»

Take a closer look at the last paragraph. It introduced some terms that are important to experimental research of creative processes. It is natural to expect some tool to be developed for such research, but first some of the important basic principles of creative work must be formed:

«*...Every creative solution of a new technical problem, regardless of which area it belongs to, has three core moments:*

1. The posing of the problem and identifying the contradiction, which prevents solving the problem using a common, well known approach.

2. Eliminating the cause of the contradiction with the goal of achieving a new – more involved – technical effect.

3. Introducing other elements of the perfected system in accordance with the changed elements (the system takes on a new form, corresponding to the new purpose).

In consensus with this, the creative solving process of technical problems typically includes three – different according to their goal and method – stages, which can be conditionally called analytical, operational and synthetic.»

So now there exists an instrument for practical work:

«*Based on everything described previously, the creative process scheme can be presented as follows:*

I. Analytical Stage

1. Select a problem.
2. Determine the goal of the problem.
3. Identify the contradiction preventing the solution.
4. Determine the cause of the contradiction.

II. Operational Stage

1. Examine the typical solution approaches:

a) in nature
b) in technology

2. Search for new solution approaches through modifying:

a) within the limits of the system
b) in the surrounding environment
c) among the connected systems

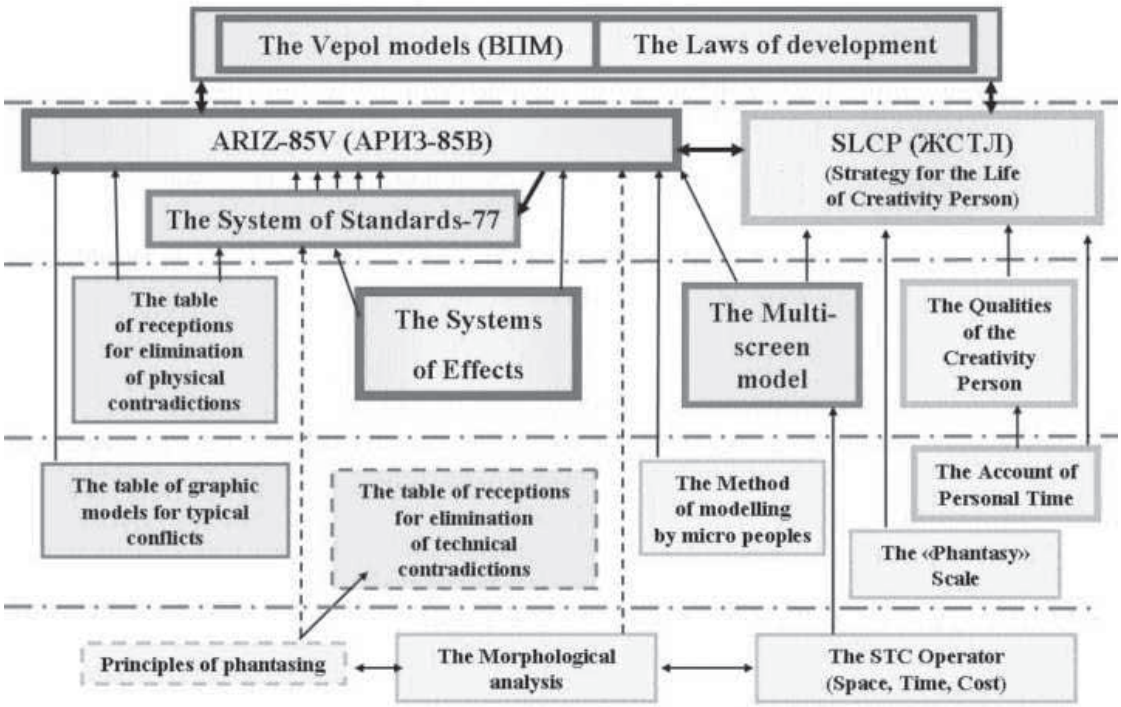
III. Synthetic Phase

1. Introduce the functionally favourable changes into the system.
2. Introduce the functionally favourable changes into the methods of using the system.
3. Assess the applicability of the principle to the solutions of other creative problems.
4. Evaluate the new invention.»

This citation describes the very first ARIZ (Algorithm for Solving Innovative Problems). This classification appears in G.S.Altshuller's works a few years later, but even in the original publication it is a real working instrument. Of course it differs from the modern model ARIZ - 85V in the same way the plane built by brothers Wright differs from a modern aircraft. Nevertheless, it has (even if they are not very prominent) all the important elements of an instrument: process of identifying and eliminating contradictions, control over the psychological factors, and usage of previously obtained information.

From the very beginning of TRIZ, ARIZ was and still remains its most important instrument. As science develops, the old instruments change and some new ones are introduced; however, not all of them are equally effective.

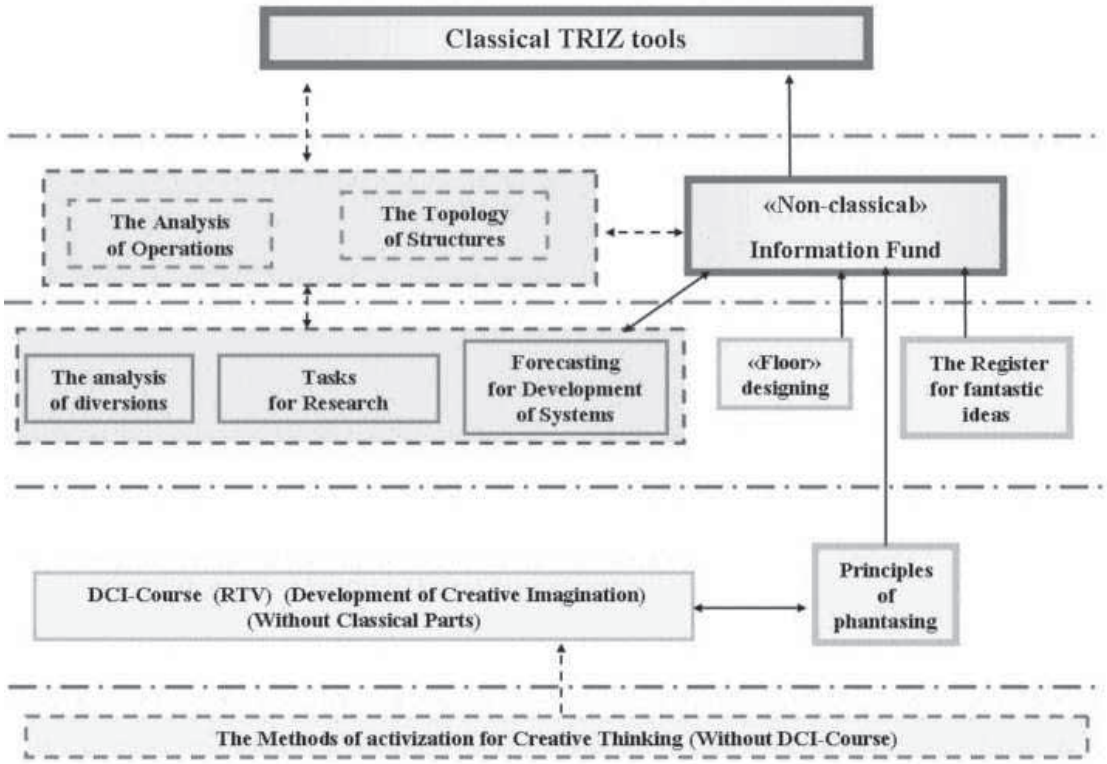
Some of the instruments always give positive results (that is if they are used properly). They are **«classical» instruments of TRIZ**. As a rule, this effectiveness (besides other factors) is ensured by successful application to many problems in different TRIZ-groups. Other instruments, even when used correctly, cannot guarantee such reliable results. They are **«non-classical» instruments of TRIZ**. They may be new and so must undergo active crosschecking to eventually become «classical». Although it is possible that they are the old, merited, formerly «classical» instruments, which reached their improvement quota and migrated into the other group.



This chart demonstrates the correlation between the «classical» instruments of TRIZ. Blue frame corresponds to technological instruments, green - organizational instruments, red - informational instru-

ments. A more detailed explanation of the differences between these instruments will be given in later sections. A **broken frame** indicates that this instrument is starting to lose its effectiveness and becomes a "candidate" for transfer to the other group. **Broken arrows** between instruments also indicated insufficient effectiveness.

The red horizontal dashed-dotted line separates different levels of instruments. The most important instruments are higher up on the chart. Hence, strictly speaking from the chart it follows that **laws of development** and **Vepol models** are more important than **ARIZ.** It is true that these elements are very important, but they are no longer considered to be just instruments. They are now intended for identifying new directions in science, where as solving problems is a job for a fundamental instrument, such as ARIZ.

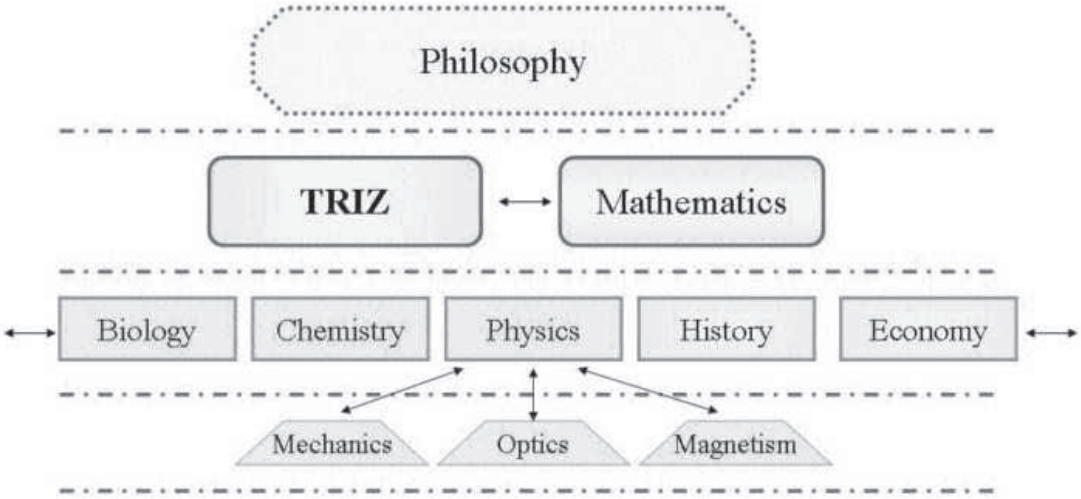


The «non-classical» instruments chart has quite a few **broken lines**. Most of these elements require a serious and time consuming confirmation.

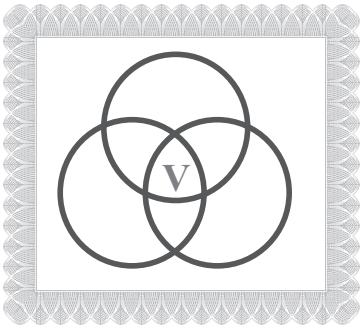
An exception is methods of activization of innovative imagination, which did not become part of the CID (Creative Imagination Development). These **quasi-instruments** have no future in TRIZ.

TRIZ - it is an applied dialect,
mathematical philosophy.

Such an understanding of this science did not come with the first day. Far too many years, for different people, TRIZ remained simply a convenient method of solving problems. The proper place of science of TRIZ in the complete hierarchy of science will be understood only after one is familiar with its fundamental instruments. So the chart given below is for now only a chart and it will be justified later...



This book is a very short version of the history of instruments of TRIZ, a guide for first time introduction. The next step into this science would be solving a spectrum of different problems, but first, lets discuss the backbone present in every science – ***information funds***.



Information Funds

Any self-respecting investigation begins with information gathering. TRIZ is no exception. Moreover, this particular science devotes a lot of attention to collecting and organizing information..

This could not be any other way. TRIZ is a science about development of technical systems and how this development can be controlled. In order to have full control it is necessary to know the ***laws of development***; to see and understand ***the system models***. This can be achieved only through studying an enormous amount of information about these technical systems.

One could say that TRIZ got lucky. Altshuller began his work when he was employed at the patent burro (invention inspection burro) in Caspian flotilla of the Soviet Navy. When Einstein was doing similar work he got the idea for the Theory of Relativity. Altshuller got his ideas for TRIZ.

It was soon understood that work at a patent burro requires more than just well written papers for the invention. More often than not the new invention had to be improved or even completely redesigned. New technique of creating the same invention is needed. But first, one must collect and analyze a lot of information about a variety of already existing solutions.

The basis of the information fund, information cards, may be very simple. On one side of a sheet of paper write down the initial state of the system, and on the other write down what is obtained in the process of solution, that is changes, improvements, development and etc. Also, indicate the purpose of these changes, or reasoning behind them.

While there is a few of these cards, it is simply a collection of isolated solutions with no connection between them. Then from the large mass of information the shape of a particular system gradually comes through.

Altshuller wrote that from 1961 to 1969 he selected and analyzed more than 40 thousand high class invention. To achieve this he had to work though almost the whole patent fund that USSR had at the time. But the product of his work was worth the efforts.

As it turns out, all the inventions can be classified into five levels. The first (lowest) level uses an already existing solution. The next one picks out one solution out of a few available ones. The third corresponds to the initial solution being significantly modified. Then follows the case when a completely new solution arises, and finally, on the fifth level a completely new course of actions comes to life. The choice of a problem and the development of a solution also can be classified in terms of different levels.

Eventually one can see some similarities between the methods which give the strongest solutions. They are ***the methods of eliminating technical contradictions*** and can be considered to be the first, although not very effective at the time, instruments of TRIZ. Already then Altshuller noticed statistical dependence of using such methods and constructed the first ***tables*** for their application.

Of course, these were still some of the simplest instruments of TRIZ, now they cannot even be considered ***«classical»*** to the full extent. Nevertheless, this work made the important step and began the formulation of the first ***systematic information funds*** of TRIZ. Gradually, the enormous body of potent data began forming an organized structure of the new science.

The Account of Personal Time

Time is our greatest treasure. Time rewards everyone equally, it cannot be bought or lost and hence, there is never enough of it.

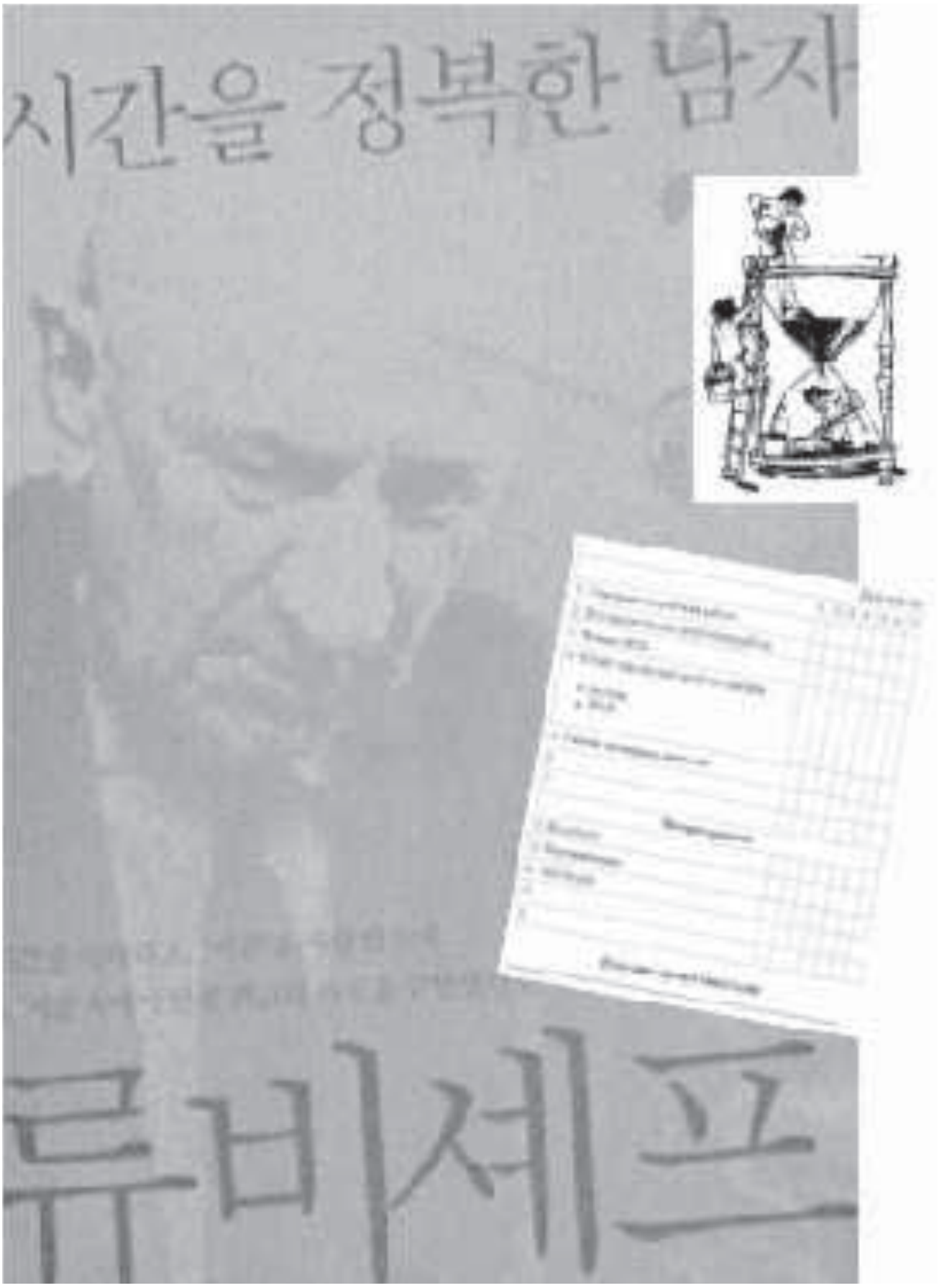
Collection of the information, analysis and systemization of the information cards are all time consuming processes. Tens of thousands of selected inventions mean years of constant daily cumbersome work. Such work requires not only determination and talent but also precise organization, or ***account of personal time***.

Since 1975 the account of personal time is a must for everyone who studies or applies TRIZ. This account of time is done using a technique first introduced by Alexander Alexandrovich Lubishchev, hence, it is often called ***Lubishchev System***. This is described in more detail in a book by Daniel Granin «This Strange Life»..*)

The idea behind the account of time is to constantly keep track of used personal time. Every day is digested by the minute, as to what the time was spent on. However, this is only the first step in creating the information fund about personal time. Afterwards, comes the analysis process.

The time spent on main (scientific) work, on additional supportive work, on reading various literatures and obtaining other information is recorded in separate sections in a specifically designed cumulative chart.

*) *This book is translated to some languages, including on Korean.*


시간을 정복한 남자
큐비셰프

Just as important is to account for lost time. Here, one indicates the time that was not spent productively: repeated work, waiting time or «empty» conversations...

Such track keeping over a few days, weeks and months shows the correlation between positive, productive time usage and unproductive losses. These losses may be in the future turned into a particular «reserve» of time and partially or even fully use it for main (scientific) work.

The cumulative table over a week must contain a list of all read books and articles along with their short abstract overview.

It is interesting to see the practical application of this system. Here is what Altshuller has to say about it:

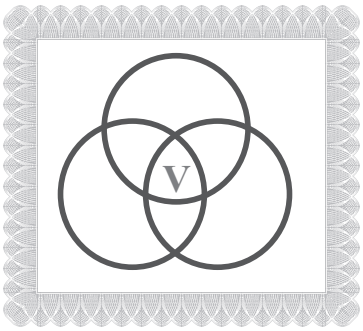
«For quite some time I was following a bad system. It started back in school, in grade 9 when I started to keep track of read pages. Eventually I brought the plan from 100 to 300 pages per day. I discovered that too much quantity over quality; there was too much «light» reading. I switched to recording the number of hours… and the system worked right away. So I had to give some thought to what is «useful time» and what are «losses», and they cannot be identified without formulating the life goals and without a system of plans.

Very soon it was clear that the system does not allow taking away or adding time. So you either have to give up the system and admit your defeat (and then you cannot profess to anything), or start fighting the time losses… and go deeper into the system. I kept track of time (even the details of this track keeping was similar to the form proposed by Lubischev) for about 15 years, until 1956. This also included the 4 and half years up north. During the good years, the wasted time added up to 12-13 hours per day, which is a lot. Up north it was on average 7 hours a day and this was incommensurably more difficult the usual 12-13 hours. After this I have no sympathy for complains about lack of time. I stopped keep-

*ing track when I felt that I no longer need to write things down. I developed a quality to simply **feel** the flow of time. I know how much one or another job «costs». I can feel to what extent the time is productive and if this extent is not great enough I associate it with physical discomfort.»*

By itself, keeping track of time is an organization instrument. At first glance it does not have a direct effect on the process of solving problems, but only helps to control one's action (via psychological factors).

Accurate account of personal time makes it difficult and even impossible to waste time. An individual unwillingly feels necessity to plan ahead the use of time, and thus, plan ahead his or her work. At the beginning such planning forecasts the next few days or weeks, but with time the planning extends to months and years ahead. Eventually it comes to a moment when the whole life needs to be planned out. Though for this the Lubishchev system is not enough, but the whole complex of ***qualities of a creative person*** must be used.

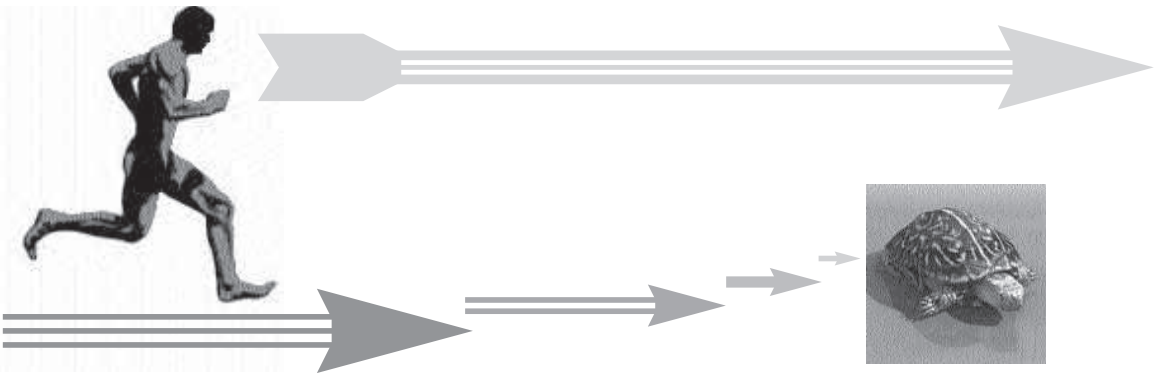


Qualities of the Creative Person

The fastest runner cannot overtake the slowest turtle. By the time the runner gets to where the turtle is now, the turtle moves up ahead by at least some amount. So if all the runner is doing is catching up with the turtle, it is not possible for him to overtake it.

The solution to this contradiction was found back in ancient times. It is important to set a long term goal. This large and serious ***Goal is the most important quality of a creative person***.

The Level of a Creative Person can be easily identified by the goals set in front of that person. The goals of remarkable people go «beyond the horizon» and it takes longer than one lifetime to accomplish them. It is remarkable that today it became impossible to achieve serious and valuable results without setting one's goals so highly.

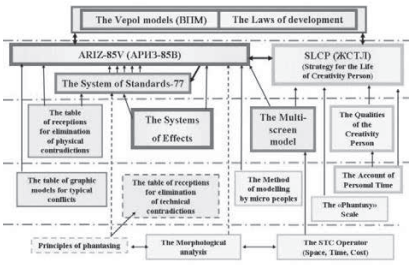


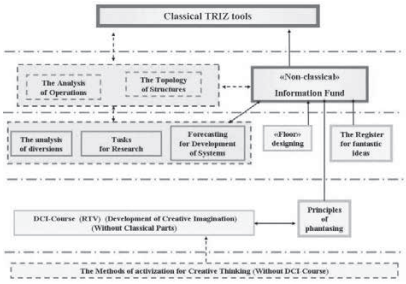
It is still not enough to simply have a great goal. To achieve it one must have a whole ***complex of detailed and well selected plans***; preferably, to span the whole path towards the goal. It is difficult to produce such plans and even harder to consistently carry them accurately. So constant self control and ***account of personal time*** becomes a great aid.

High work efficiency, the ability to perform a large amount of work in a short period of time is a typical requirement. However, for a Creative Person there is another important characteristic: the emphasis is not simply on work efficiency, or «overall productivity», but only on the work, which contributes to the realization of the proposed plans.

The famous science fiction author Jules Verne for many years collected and analysed various scientific information; which he then used to create some of his most interesting novels. He composed a library of 20 thousand notebooks. The information fund collected by Altshuller can be just as impressive, and not only with its size and the quantity of work. This fund was necessary for the foundation and development of TRIZ, and this makes such a fund very valuable.

Still, the Great Goal, detailed plans and even high work efficiency do not guarantee valuable results. One more important quality of a Creative Person is ***the problem solving technique***. It is essential to be able to properly use all instruments of TRIZ - technological, organizational and informational. The ability to see the laws of system development and modelling, contradictions in the systems and ways to overcome them - all this pertains to the problem solving technique and it must be studied very seriously for a long time.





All of the above listed qualities are necessary for creative scientific work, but by themselves they do not guarantee success. There are many obstacles on the path towards the Great Goal and these obstacles must be overcome. As they say, «***stand your ground***», not be afraid to defends one's solutions and be able to realize them in any outcome.

And so only when all of these five qualities are present, and can achieve the necessary ***productivity***. It must be remembered that the results do not come right away and not to the full extent. On the path towards the posed Goal some of the smaller results come first and then later they become more and more significant.

Through careful organization of work one can be producing results many years later. For example, Jules Verne's son used the information fund organized by his father to prepare for press a few novels that the writer was unable to finish.

Going back to the beginning, that is, to the most important quality of a Creative Person, one might ask: Which goal would be considered worthy enough to spend one's whole life striving towards it? Of course, everyone has their own goal, but general signs of a ***Worthy Goal*** (WG) can be identified.

First of all the goal must be positive, oriented towards improvement of life. Unfortunately, in quiet a few cases the goal also has negative and harmful consequences. So while achieving a goal, one must always strive to minimize the damage and maximize the positive effect.

WG must be original. Else, the means of achieving it must be original.

A well posed goal is infinite. It may be expanded like a tree grows from a sprout. Then the trees can be put together to make «a forest»…

As a rule, a truly Worthy Goal is not easily accepted by other people at first; it contradicts the familiar ideas and standard beliefs. Thus, it is very important for the WG to be very specific, so it can be evaluated from the very beginning and the path towards achieving it can be controlled.

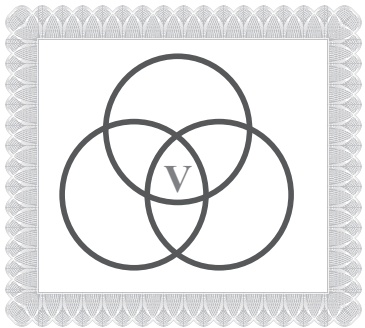
Such a distant and unusual goal has an advantage as well: it does not compete with the goals of other people. So there is no need to haste the progress and carefully follow through with all the steps. This is very important when starting unusual and at first difficult work.

Nevertheless, even with such advantageous conditions, it is still important to demand constant realization of the steps, at least small ones. One a path has been chosen, it must be followed through.

In order to achieve any serious goal it is important to have a large information fund. Sometimes it is possible to use pre-existing information collected by others, though quite frequently one has to spend a lot of time and effort to create personal «information storage».

Finally, the WG can almost always be made independent, that is not requiring high cost and sophisticated equipment for its realization. The core part of the work can be done independently.

Studying and developing in oneself the qualities of a Creative Person has been part of the TRIZ course for many years. The study of grounds for choosing a goal began in 1983. ***The Fund of Worthy Goals*** is constantly reformulated (for both educational and practical purposes). All this allowed identifying certain correlations, which are the base of Strategy for the Life of a Creative Person.



Strategy for Life

Realization of the Qualities of a Creative Person requires a certain technique. This technique is known as LSCP – Life Strategy of Creative Person.

According to the main idea of LSCP, the whole life of a Creative Person (CP) is an ongoing battle with the «External Obstacles» (EO). These «obstacles» may come in form of various objects and actions by those objects: acts of nature, inner problems or external circumstances.

Still, EO is not represented as «absolute evil». EO exist in their own world and abide their own laws. EO interfere with the goal only by not aiding it. For example, rain can prevent arriving on time to an important meeting, however, one mustn't try to fight rain or get offended by it: to prevent being late one must simply take into account the possibility of such interference.

LSCP is written out in form a few dozens of «steps», grouped into four main categories. In each part of his/her life, CP sets specific goals for himself/herself. EO can interfere with realizations of these goals trough its actions (its «steps»). In return, CP plans ahead the counter steps to prevent the negative effect of EO. This is similar to a typical chess game. Moreover, separate stages of this «game» are indeed named using the chess terminology, though some important differences are present.

Debut – the choice of a future «game», the choice of the Goal. How can the circumstances interfere? Evidently this interference can push towards alternative, lesser goals. This is similar to obtaining a narrow specialization with no possibility to broaden it further to «vast science». It is important for a CP to be able to choose and then independently identify and develop his or her Goal.

The Debut of LSCP has two parts, both of which have their own main conflicts. The EO of the first conflict steer one towards typical behaviour, towards standard high school and university education. The aspiration of CP towards more serious goals should force CP to obtain more advanced education and develop independence between the through process and behaviour. The second conflict is the battle for time, or more specifically for the right to manage one's time. EO take this time away and the CP must find ways to save it and use it productively.

The Creative Person prevails if a Worthy Goal is chosen and transition to the next stage is successful.

Mittelspiel (middle of the game) begins from the moment the Goal has been chosen. So now it is important to obtain a minimal result which may be of use to others.

Mittelspiel has three part (and three main conflicts).

The first conflict is again the battle for time. CP strives to maximize the time saved for working towards achieving the Goal. EO still force the CP to spent time on many other unproductive activities.

The second conflict is the incompatibility of social status of the Creative Person and the important Goal that CP is working towards. This is rather common in any type of work.

The third conflict comes from the group that forms around the Creative Person. The group is an asset, but at the same time it creates additional complications.

The Creative Person prevails if the group for realization of the Goal is created (formation of a scientific school) and transition to the next stage is successful.

Endspiel (end of the game) presents the development of the system of Goals. CP accomplishes results even if their life span prevents further work.

This stage has two main parts (and two main conflicts).

The first conflict comes from the fact that it is no longer one school working towards the Goal, but a group of schools. A large number of new people can perform more work, but at the same time there are more possibilities for errors and distortions.

The second conflict is that it takes too much time to reach this stage, sometimes a whole lifetime, and the work is not yet finished.

One again, the Creative Person prevails if transition to the next stage is successful.

Post Endspiel. This is not possible in a game of chess – a game after a game is finished, but in Life Strategy it can happen.

Post Endspiel has two parts (and two main conflicts).

The Creative Person is now physically absent; yet, certain results are still produced due to the steps accomplished earlier.

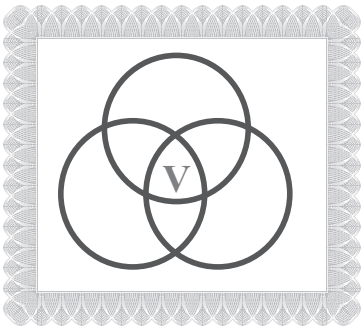
The scientific movement becomes a group of movements («super-motion»). The number of people rapidly increases and even more rapidly decreases the overall quality of work. The «super-motion» takes on a new form of «External Obstacles».

The very first version of LSCP came out in 1985. Finalized versions have been published in various books.*) Every stage of this game is comprised of numerous «steps» taken by both the External Obstacles and the Creative Person. Many cases also introduce additional reinforcing steps. The total is 88, but it should be noted that many of the «steps» can be made several times during different stages of this giant «game» and most importantly, this total cannot be complete. As life evolves, new possible interactions between the Creative Person and the External Obstacles come through. They must be studied and used.

***)** *More in detail about these books look in section* **22** **«The Literature».**

G. S. Altshuller considered LSCP to be one of the most important sections of TRIZ. It is impossible to create a genuine Creative Person without such an instrument and so it is impossible to effectively solve problems. A detailed study of LSCP demands a lot of time (and regular use demands a lifetime), but a brief overview of the main stages of this instrument is necessary even at the introductory level.

Implementation of LSCP requires combined efforts from many instruments of TRIZ. On the other hand, even the basic familiarization with LSCP allows for better understanding of the key instrument of TRIZ – ***Algorithm of Innovative Problem Solving*** (ARIZ).



ARIZ

The most important instrument of TRIZ is the ***Algorithm for Solving Innovative Problems***. All other instruments only assist ARIZ and provide work for it.

One could say that ARIZ was already present in the very first TRIZ publication,[*)] though the term itself did not come until some time later, in 1965. And the familiar acronym along with its numerical index was first used in the first edition of G. S. Altshuller's book «**Innovation Algorithm**».

ARIZ has been actively developing over the years. This development was ensures by the large number of groups, and then later TRIZ schools, which created TRIZ-motion. Every group and school used a certain general strategy to solve a vast amount of problems. The records of these solutions were studied in detail and analysed. This in turn provided specifications and additions to ARIZ.

For example, more than 5 thousands records analysing a variety of about 150 problems were used for the transfer from ARIZ-68 to ARIZ-71. ARIZ's further development used even a larger information fund.

ARIZ-85V is the latest version of ARIZ, which had to go through a complete and detailed examination. So this is the version used in solving practical and study problems. The study problems in this book are also analysed using ARIZ-85V. [**)]

[*)] *More in detail about these books look in section* **01** **«First step into new science».**

[**)] *More in detail about these books look in section* **24** **«Education tasks».**

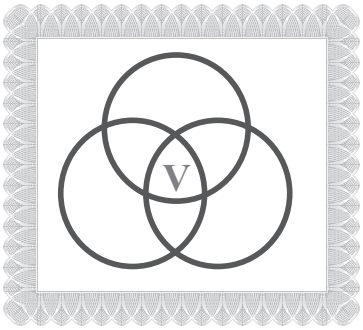
All of the versions of ARIZ, although different in their spans and volume, contain three main elements:

1. ***The Program.*** ARIZ is a logical sequence of actions, which is directed towards finding the solution of a given problem.
2. ***Information Availability.*** ARIZ contains a large amount of information, which is needed for constructing the solution. One part of the information is contained within different instruments, and the other part takes the form of footnotes and references to specific information funds.
3. ***Control over Psychological Factors.*** ARIZ as a whole or as parts of different instruments is intended for controlling psychological factors.

So ARIZ happens to simultaneously be a technological, organisational as well as informational instrument.

Originally ARIZ was used only for solving technological problems, but with further development of TRIZ (mostly the increase of the informational funds) it became possible to use ARIZ for solving problems of different nature, for example, socially-economics problems.

Minimal knowledge of ARIZ (including analysis of study problems) is a must even for most basic beginner stages of studying TRIZ. Application of any other instruments, without the logic of ARIZ, can cause difficulties and it is less likely to get useful results.



Method MMP

Method MMP is the method of modelling with «micro people» or method «Modeling with Micro People».

Task N.6.12.[*)] Many foods must be stored at low temperature in order to be preserved. If the food is stored for a long time, then the owner must have a way of finding out that the temperature has not increases (and the food didn't go bad).

How can this be accomplished? The use of regular thermometers in this case is insufficient.

When applying the method MMP the most important part are the actions taken by the person solving the problem, and the less important part are the problem conditions and properties of the system which must be changed. Hence, the method MMP is an organizational instrument.

This instrument is a must in ARIZ (step 4.1). On the other hand, in order to get the best results with method MMP, one has to first analyze the problem with the first three parts of ARIZ. This analysis brings forwards the technical contradictions of the problem, conflicting pair (item and instrument), the actions of the Eks-element, operational zone and operational time, ideal final result and physical contradictions in the problem. Now, to eliminate the physical contradiction from the operational zone, one has to transform components of the system. This is best achieved with the method MMP.[**)]

[*)] *Tasks of N series are taken from the separate collection prepared by authors.*

[**)] *The explanatory of some terms look in section 25 «**Terms which are used in TRIZ».***

In the task **N.6.12** this can be viewed the following way:

There exists a conditional «thermal field»*), temperature, which can change. It is necessary to know for certain whether the temperature went up or not (above a certain threshold). This can be determined with some sort of instrument (a regular thermometer may be unreliable). Therefore, wherever the «thermal field» is active (and where the food must be preserved) some sort of particles must be present (parts of the instrument or the Eks-element). These are the particles that will be the micro people.

This problem requires the micro people to react to the change in temperature. This reaction may be expressed only through interactions and displacement of the «micro people» because these are the only things that can be shown in a drawing.

There must be at least two drawings: the state at the allowed (low) temperature and the state at the not allowed (high) temperature.

Before
(low temperature)

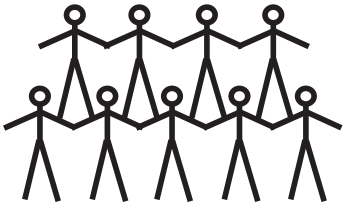
After
(high temperature)

When the temperature rises, the «micro people» stop holding hands and even step away from each other. This is easy to notice and can have both physical and technical correspondence.

However, there is a problem: after some time the temperature may drop again and «micro people» will start holding hands again. How can one know if they ever stopped holding hands?

*) *The modern physics considers four fundamental fields. But for the description of technical systems is allowable to use many other conditional «fields». These quasi-fields which can be the most different by the nature, do the description of systems by more simple, and the solution of tasks easier. Certainly, thus it is necessary to remember always, that these «fields» are conditional.*

Evidently, when the «micro people» let go something irreversible must happen. It is very important that this is expressed only through the actions of the «micro people».



Before
(low temperature only)

After
(after high temperature)

At the low temperature, «micro people» pile up into two layers (two storeys). At each level they are holding hands and so the top layer is standing at the bottom one and does not fall through.

Yet, as soon as the temperature goes up (exceeds the threshold) they let go of the hands and the «micro people» of the top layer fall through to the bottom level

Now if the temperature does decrease again (below the threshold) «micro people» will not be able to form two layers, although they will be holding hands. Such a change in the number of levels («storeys») would be a sign that at some point in time the temperature increased and the food may have gone bad.

The easiest technical solution is to use the available ***resources***, a substance that is already present in the system and can perform the desired task. In the fridge, such a substance may be ice.

If there are pieces of ice piled up into two layers or a little pyramid. Then after the sudden defrosting (undesired temperature rise) there will be only one layer of ice left and it will be instantly noticed.

More rigid rules of using the method MMP are described in ARIZ as follows:

a) build the schematic of the conflict using the method MMP;

b) modify the scheme so that the «micro-people» acted without causing a conflict;

c) move on to the technical scheme.

Remark:

31. The essence of modeling with «micro people» method (method MMP) is schematically presenting the conflicting demands in form of a drawing (or a number of consecutive drawings) of a large number of interacting «micro people» (a group, a few groups, «horde»). The «micro people» should represent only the changing parts of the problem model (instrument or Eks-element).

«Conflicting demands» is a conflict arising from the model of the problem or opposite physical states, specified in step 3.5. It is possible that the latter is preferred, since it would be easier to illustrate the «conflict» in the model of the task, but there are no solid rules governing the transfer from the physical problem (3.5) to MMP.

Step 4.1b can be done by putting two illustrations on the same drawing: the bad action and the good action. If events develop with time, then one should consider having a few consecutive pictures.

Attention!

It is easy to make a common mistake by limiting the drawing to quick and rough sketches. A good drawing should be:

a) Self-explanatory and easily understood without word;

b) Provide additional information about the physical contradiction and point to possible ways of eliminating it.

32. Step 4.1 is secondary. It is needed to give a better understanding of what the particles must do in and around the operational zone before VPR mobilization. The method MMP helps to see the ideal action

(«what needs to be done») without the physics («how to do it»). This removes the psychological inertia and focuses on the creative work. Hence, MMP is a psychological method. Nevertheless, because the modeling with «micro people» accounts for laws of system development, it often leads to a technical problem solution. In this case the solution shouldn't be interrupted and the mobilization of VPR (vepol resources or object-field resources) must be carried through

This is the step 4.1 in ARIZ-85V.

An earlier version ARIZ-82 also used the method MMP (in step 3.5), but back then it was not detailed enough and its use was less accurate. For the first time, the «micro people» appeared in 1977 in the book «***Inspiration by Order***»[*)] (by A.B.Selutskij and G.I.Slugin). G.S.Altshuller wrote the chapter on the course «Development of Creative Imagination» for this book.

A direct and immediate application of the method MMP helps to solve more that simple problems.

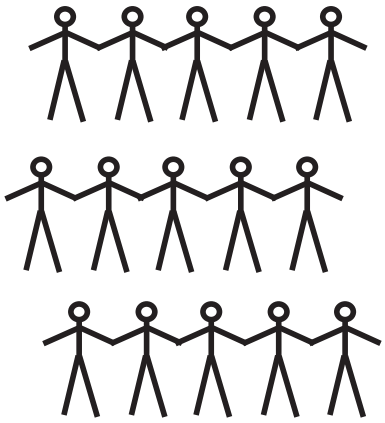
Task N.6.11. Typical lubricant «freezes» when temperature is lowered: its viscosity increase and the lubricating properties decrease.

How can one make the lubricant resistant to the temperature drop?

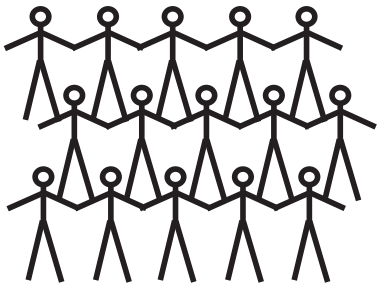
Certainly, at absolute zero any lubricant would freeze (except for greasing from helium), but in practice such low temperatures rarely occur. Sometimes a change in temperature as little as 10 degrees may be very important. And the help of the «micro people» is important here as well.

Let's carefully look at the «Before» and «After» pictures. At high temperatures the layers of the lubricant can easily move (slide); they don't interfere with each other, although in the layer itself they firmly hold hands. This is the «Before» picture. At low temperatures (the «After» picture) the interactions between «micro people» is increased and the layers start to cause interference, prevent motion, and cling together.

[*)] *More in detail about TRIZ books look in section* **22** **«*Literature*»**..



Before
(high temperature)

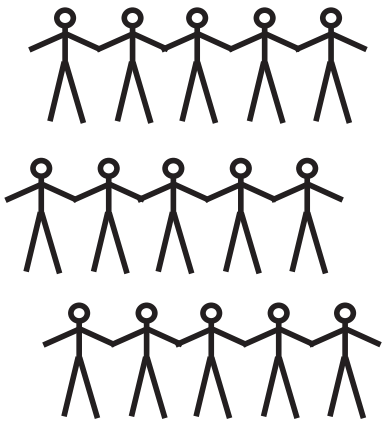


After
(low temperature)

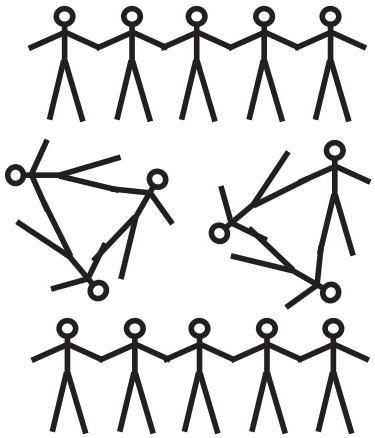
The «micro people» need help. Of course when the temperature is lower they hold on to each other more firmly, but this interaction can be controlled. Let the «micro people» hold hands tighter, but this connection shouldn't prevent the sliding of separate layers.

The result is a rather unusual middle layer: «micro people» are sturdily bound together, but their connection forms rings. Note that the size of a ring may be greater than three. Not only can these rings slide along the adjacent layers, but they can also roll along them. Friction is significantly reduce, which in turn reduces the overall viscosity of the lubricant.

Here, a new problem arises: How can one force the «micro people» into forming rings? Typically they only do whatever is convenient and does not require extra effort. Hence, a new substance must be introduced into the lubricant to «bring order» among the horde of already present particles. That is, this new addition should easily form an ordered structure or already posses such a structure, while still following the ***laws of system development*** and rules for ***Vepol model*** construction.



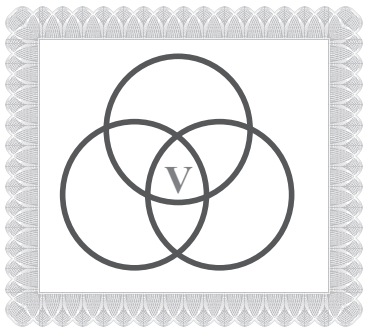
Before
(high temperature)

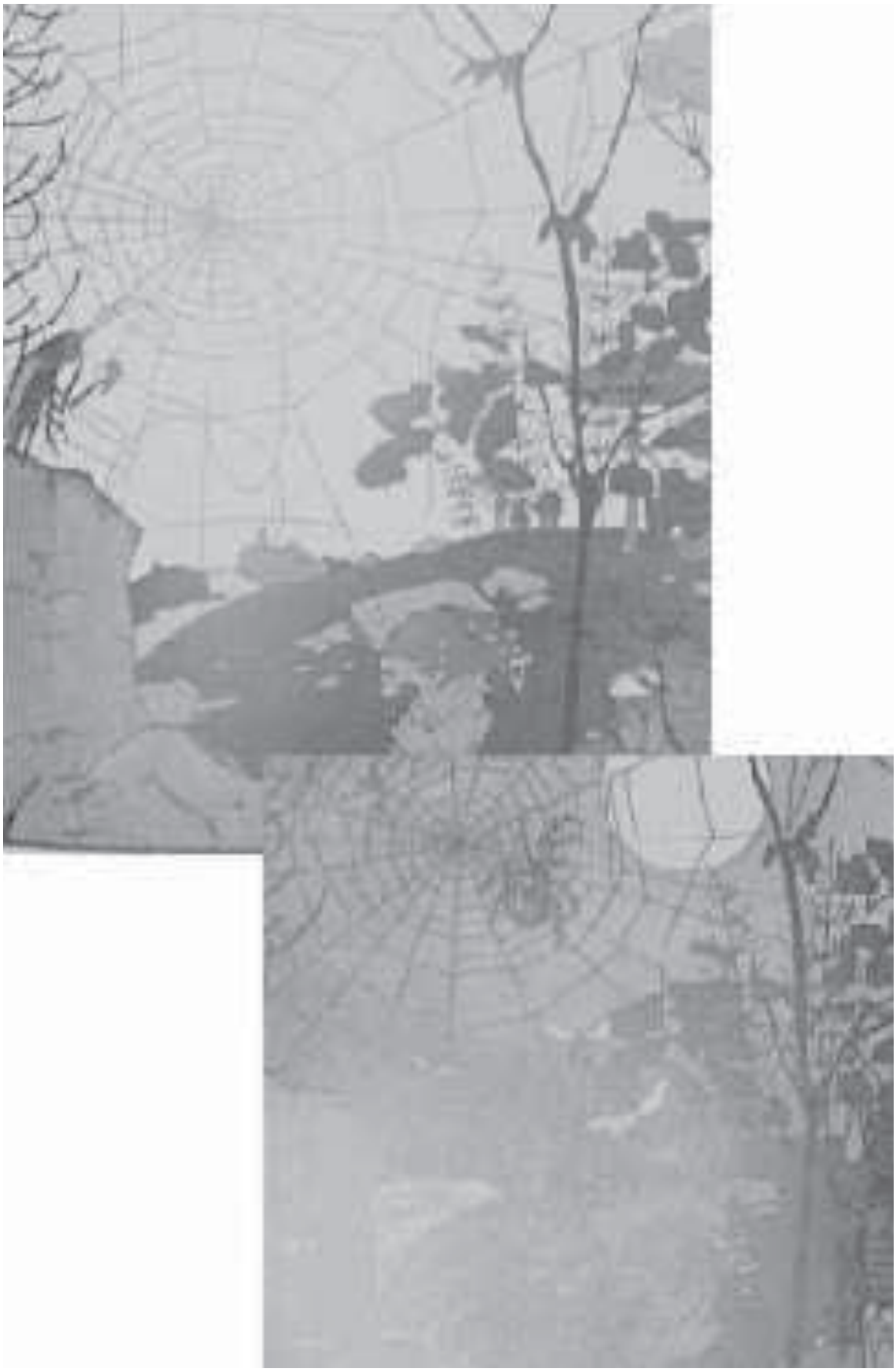


After
(low temperature)

It is not hard to find a whole group of such substances in the ***System of effects*** used by TRIZ. They are aromatic carbon compounds, which are known for their benzene rings. Although this connection may seem crude, benzene rings do play a role of a peculiar roller-bearing at molecular levels, which reduces the friction among separate layers of the viscous liquid.

Thus, the solution of this problem requires the use of aromatic compounds, like methylcyclohexane or toluene…And use of «micro people».





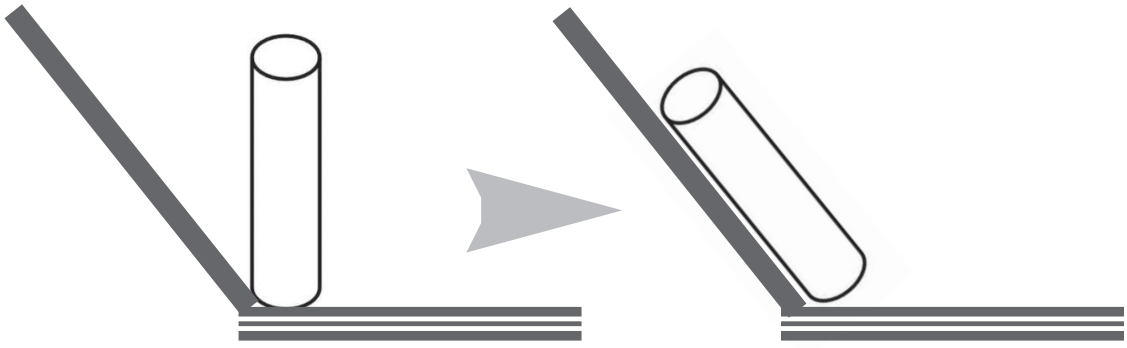
Operator STC

Operator STC (space – time – cost) has grown from the morphological analysis. The main task for this operator – to change usual representation about system.

In most cases the basic attributes (properties, parameters) any system only three. It is the spatial linear size, time of course of processes and cost. Value of each of these attributes precisely can be described some number. For solution of many tasks it is very important to know these numbers. But the paradoxicality, discrepancy of a situation is, that the same exact values very much frequently prevent.

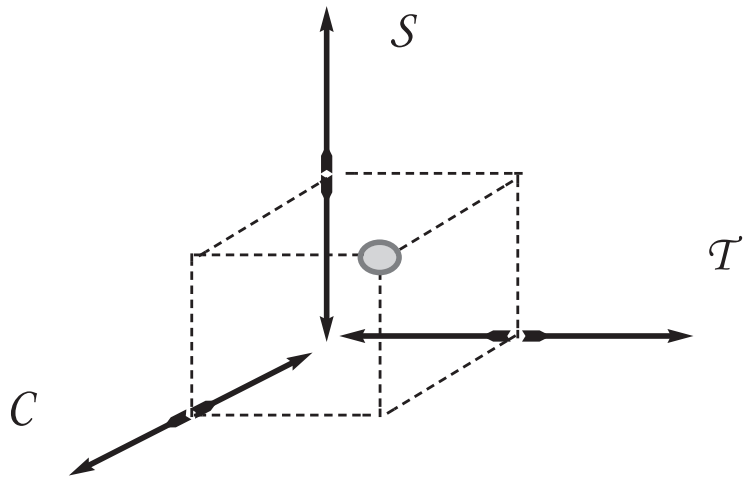
Let's consider such task: (from card file of G.S.Altshuller):

On a slope of mountain accurately it is necessary to put a pipe from concrete. Length of a pipe – 30 meters, diameter – 2 meters. To use complex mechanisms in this case it is impossible. To execute a pipe at once in inclined position too it is impossible. What it is necessary to make?



30 meters is a height of a multi-storey house. Accurately «to put sideways» the whole house – psychologically a complicated problem. Especially, if it is impossible to use special engineering. Therefore – the pipe accurately itself should be lowered on a slope of mountain...

It is necessary to know sizes of two more parameters. The concrete pipe was necessary for hydroelectric power station. On conditions of a real task, on such construction it was allocated two years of time and hundred millions dollars.



The rule of performance of operator STC is the following: we take by turns each of three parameters (space, time, cost) and twice we change its numerical value – from existing size up to zero and from existing size to infinity.

During performance of each of these of six operations it is necessary to check up – as the task has changed. In new conditions its solution can become more difficult and can become easier.

It is very important to not limit itself only to extreme values (zero and infinity). It is necessary to describe a situation for several intermediate values. For example, intervals of time in one day, one month and one year can have essential, qualitative differences. Such differences are connected to occurrence and disappearance of various processes on various «floors» of an axis of time. It concerns all parameters of the operator.

Not less essential requirement is, that all actions with the operator are necessary for writing down in detail. Such records further can be used and during the decision of other tasks, and for updating information funds.

Check up itself – make independently all six records of changes of parameters for a problem(task) about stacking of a pipe. For more exact use of operator STC be guided by such control answer:

The ice place between a pipe and a slope of mountain place ice. This ice «catch» the pipe. Then ice gradually warm up (defreeze) on the part of a slope of mountain. As a result of it ice smoothly falls and simultaneously accurately stacks a pipe on a slope of mountain.

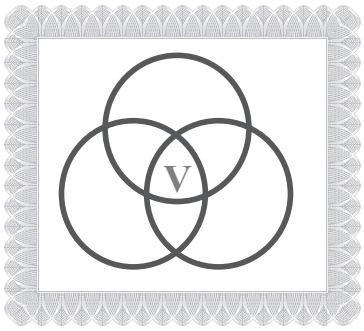
For the better to estimate advantages of operator STC – enter the additional requirement: the decision should be idealer. Ice should appear itself... And then independently to thaw. It is necessary to keep money to construction, but it will be necessary «to pay» for it an expenditure of time and space...

Operator ĐÂÑ many years was used as a separate step in various versions of Algorithm for Solurion of the Invetion's tasks (switching ARIZ-77). Further such step from ARIZ was removed, but thus the idea of change of values of various parameters of system has appeared in other steps of ARIZ. It not only helps to strengthen the received solution, but also allows to present all system more full. Accumulation of the information on application of operator STC was the important element in creation of the ***Multiscreen Scheme***.

At the same time, operator STC («classical» tool of TRIZ) and its separate elements remain the important part of the general «nonclassical» rate of Development of Creative Imagination.

Originally this rate consist of the most different methods of management of psychological factors. It is a lot of such methods, but their quality not always happens sufficient (even for a «nonclassical» level). Therefore during teaching and application TRIZ these methods were in part eliminated, in part transformed, in part replaced new.

As a rule, new elements of rate STC were based on the information funds received at use of «classical» tools of TRIZ. In particular, change of values of various parameters (including the space, time and cost) can see in many ***receptions of imagination***. Use of operator STC and for ***«floor» designing*** is essential.



«Floor» designing

Very simple at first sight «floor» designing is one of basic elements of a rate of Development of Creative Imagination. This rate allowed to use for technical solutions not only patent, the invention information, but also fantastic (including literary) ideas.

The First book about application of a fantasy in invention was published in Tambov (USSR) in 1964 year.*) Then regular updating information fund of fantastic ideas began. The analysis of fund has allowed to formulate such principles of «floor» designing for fantastic ideas:

1. It is necessary to choose inanimate object. To execute the forecast of its development.
2. The object should be fantastic, an artificial origin. The object needs to be considered on all «floors».
3. To formulate the purposes which it is necessary to reach, using the given object. To specify purpose of object.

In the information fund such **list of «floors»** was revealed:

The ground Floor: one fantastic object is used.
The Second floor: such objects (in huge quantity, everywhere) are used many.
The Third floor: the specified purpose is reached without use of this object.
The Fourth floor: situations when absolutely disappears necessity for achievement of the planned purpose are created.

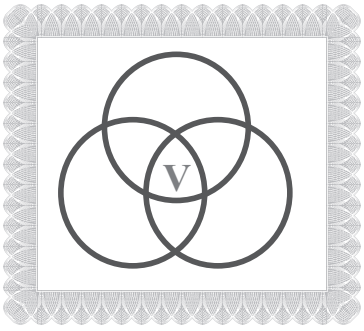
*) *V.N.Zhuravliova.* ***The inventions, ordered by dream.***

«Floor» designing for the first time has allowed to create fantastic ideas systematically, organized, ordered. Also at regular application of this tool the new information fund – fund of use of «floor» designing collected.

Appeared, that this tool is applicable not only for fantastic ideas, but also for real inventions tasks. Moreover, the tool developed, became more detailed, exact and has soon turned to new powerful means of the analysis of systems – the ***Multiscreen circuit.***

At the same time even the initial version of «floor» designing continues to remain one of the strongest ways of creation and development of fantastic ideas. In rate DCI many instruments are shared with «floor» designing.

Therefore acquaintance to the brief systematized list of ***principles of phantasing*** simultaneously is continuation of work with «floors» and preparation for the multiscreen analysis.



Principles of phantasing

Research of the ideas found in a fantasy has allowed to systematize a fantasy. On the one hand it has resulted in creation of «***The Register of science-fiction ideas***». On the other hand - this work has helped to reveal receptions of imagination for designing new technological, èçî áðåòàòåëüñêèõ ideas.

The List of receptions of imagination contains some groups.

The First group is made with ***«floor» designing*** which is the complex(difficult) complex tool.

The Second group represents various updatings the morphological analysis, including ***operator STC*** (space – time – cost).

The Third group is a change of fantastic and real object with the help of receptions of overcoming of technical contradictions.

The Fourth group – ***a method of fantograme*** – is qualitatively new association of the second and third groups.

The Fifth group - updatings of ***principles for overcoming of psychological inertia***.

The Sixth group – a ***scale «Phantasi»***.

The Seventh group – ***the Multiscreen scheme***.

The two first and two last groups of this list are shown separately. In this section the third, fourth and fifth groups of ***principles of phantasing*** are briefly examined.

Principless for overcoming of technical contradictions – one of the first micro-instrumentation of TRIZ. Such receptions some tens were revealed. G.S.Altshuller studied statistics of use of these tools and on the basis of such analysis has constructed the ***Table for application of principles*** for elimination of technical contradictions. Different versions of tables defined various quantity of technical contradictions. The quantity of receptions which were used in the ***table*** was various also. The final version which was included in ARIZ-77, contained 40 principles. In development of TRIZ this table began less effective in comparison with new, stronger tools, therefore in further versions ARIZ it was not used. Some principles of elimination of technical contradictions (especially non-tables which have numbering from «41» to «50») were included in the new tool – ***system of standards***.

On a basis of more simple receptions and G.S.Altshuller's transformed table has constructed ***the phantogrammes***. These are the tables intended for creation of fantastic ideas. Columns and lines of the table represent various universal parameters and principles for transformation of these parameters.

For elementary education G.S.Altshuller recommended such parameters:

1 – substance (a chemical compound, a physical condition);

2 – a microstructure (that is a subsystem of object from considered(examined) set);

3 – object;

4 – super-structure (that is system which includes object from considered set);

5 – a direction of development;

6 – reproduction;

7 – a feed by energy;

8 – a way of movement;

9 – sphere of distribution;
10 – a level of the organization and management;
11 – the purpose, the sense of existence.

Principles for the educational purposes were recommended such:
1 – to increase, reduce;
2 – to unit, separate;
3 – «on the contrary» (that is to replace the given property «antiproperty»);
4 – to speed up, be slow;
5 – to displace in time forward to displace in time back;
6 – to change dependence «property – time» or «structure – time»;
7 – to separate function from object;
8 – to replace connection between objects and environment (including replacement of environment);
9 – to change a quantity indicator (constant).

Principles («methods») for elimination of psychological inertia which are used in rate DCI, as a rule are created outside of TRIZ. They concern to «nonclassical» organizational tools and consequently them apply only to educational, training problems.

Most frequently on employment by ÒÐÈÇ use:
The method of focal objects;
The method of associations;
The method of «gold fish» (or «the gin – executor of desires»);
The method by Arnold (search of the Eks-factor on a planet closed by «conditional clouds»).

Scale «Phantasy»

The phantasy is necessary for any creative work. Reading of the science-fiction literature is strong means of development of imagination. But only it is not enough one reading. The literature on a fantasy is necessary for analyzing, investigating. The scale ***«Phantasy»*** is the instrument for such research.

The First, initial versions of this tool have appeared in 60th years of the last century. Further the scale ***«Phantasy»*** varied and in final variant is used thus.

In the beginning each science-fiction product is estimated on such parameters:

Novelty;
Persuasiveness;
Value for studying the person;
Art value.

To these parameters control value judgment is added.

Each of these of five parameters is estimated on a scale from four points:

1 – «it's bad» (there is no novelty and there is no persuasiveness, there is no value);

2 – «it's satisfactory» (the minimal novelty, persuasiveness and value);

3 – «it's good» (the big, significant novelty, persuasiveness, value);

4 – «it's very good» (that is higher than the previous point).

Value judgment can be received thus:
1 – nothing it was pleasant;
2 – any more it was not pleasant, than it was pleasant;
3 – it was pleasant more, than it was not pleasant;
4 – all was pleasant.

Certainly, it only the most simple model of a scale ***«Phantasy»***. For professional use detailed and exact criteria of an estimation of each point are developed.

The Following stage is reception of the ***general estimation***: points on all to five parameters are multiplied.

Having received an estimation for some of science-fiction products it is necessary to collect them in the general table, necessarily having specified not only the general(common) estimation, but also values for all parameters.

The operational Experience with a scale «Phantasy» shows, that exact use by different experts of detailed, detailed criteria does total estimations practically identical. Thus, using for comparison existing tables of estimations of science-fiction products, the own understanding of a fantasy independently is possible to estimate.

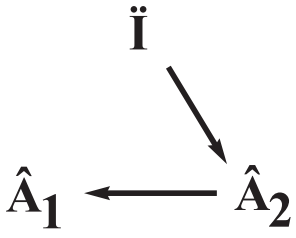
In G.S.Altshullera's opinion, each estimation of the science-fiction story or even one idea represents mental microresearch. Having executed some such microresearches are possible to get a certain experience of analytical, system thinking, very important for TRIZ

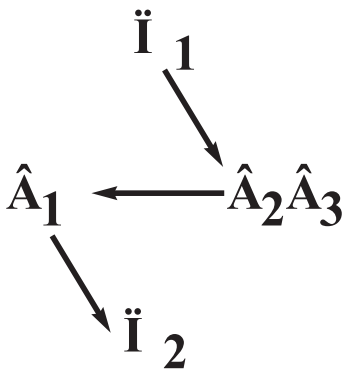
Vepol Models

Each science has the «language». From the elementary particles this language there are most complex, big structures. Such big structures can be much and understand them, not get confused in complex elements – in the beginning it is necessary to understand structures simple.

Vepol models is «language» of TRIZ. According to this «language» any system can be presented as set of elementary models from «substances» and «fields». Thus of «substance» and «fields» in vepol models not always correspond to real substances and fields.

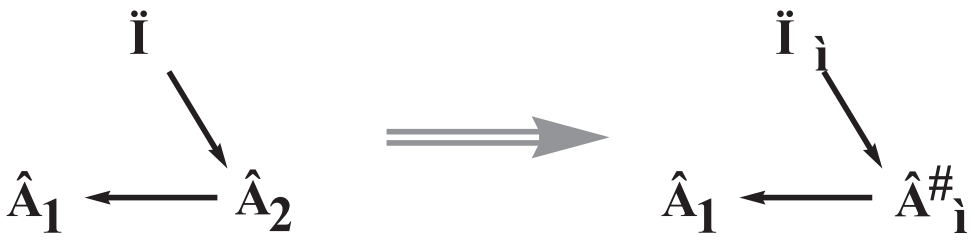
The Minimal system should contain three elements. Usually it is two «substances» (Â) and one «field» (Ï), however there are also other models.





It was originally revealed five key rules of transformation âåï î ëüí û õ models (other name – rules of the vepol analysis). Further the quantity of such rules has increased. New kinds of vepol models also were received: complex, double, chain...

Separate elements of vepol models changed (developed) also. Transition to disperse and structured «substances» was revealed, structured «fields» more effectively worked. The most interesting results are received from application of **fepol** structures at which there is a magnetic field, and one of substances is disperse ferromagnitic.



In G.S.Altshuller's book «**Creativity as the exact science**» is shown 18 typical vepol models and transformations. On the basis of these elementary structures the system of standards for the solution of invention's problems is constructed. Vepol models are used for formation of modern information funds of various effects.

The first works about vepol models were prepared by students of the Azerbaijan institute of invention's creativity under G.S.Al'tshullera's management in 1973.

Vepol models are very closely connected to laws of development of systems. On the one hand – development of vepol models occurs according to these laws. On the other hand – laws take into account vepol character of systems.

Laws of development

In the table of interrelation of «classical»of instruments TRIZ laws of development are near to vepol models – at the uppermost level. Actually it is special «instruments for creation of instruments».

Revealing laws of development is traced since the very first works about TRIZ. These laws were entered into a training course in 1976, and then published in G.S.Altshuller's book «**Creativity as the exact science**».

For technical systems there are laws of viability (G.S.Altshuller named their laws of «statics») and actually laws of development (laws of «kinematics» and «dynamics»).

Laws of viability:

1. The law of completeness of parts of system.

The Necessary condition of basic viability of technical system is presence and the minimal serviceability of the basic parts of system.

2. The law of «power conductivity» systems.

The Necessary condition of basic viability of technical system is through pass of energy by all parts of system.

The Important value has consequence from this law:

That the part of technical system was controlled, it is necessary to provide power conductivity between this part and controls.

3. The law of the coordination of rhythmics of parts of system

The Necessary condition of basic viability of technical system is the coordination of rhythmics (frequency of fluctuations, periodicity) all parts of system.

Laws of development of systems:

4. The law of increase of a degree of ideality of system

Development of all systems goes in a direction of increase of a degree of ideality.

All elements of system are superseded to a subsystem, and functions – to supersystem.

It is the main law of development of systems. Other laws «provide» its action.

5. The law of non-uniformity of development of parts of system

Development of parts of system goes non-uniformly; the more difficultly system, the more non-uniformly development of its parts.

6. The law of transition to supersystem

Having exhausted opportunities of development, the system is included to supersystem as one of parts; thus the further development goes already at a level of supersystem.

7. The law of transition from a macrolevel to a microlevel

Development of working bodies of system goes to mlacrolev, and then at a microlevel.

8. The law of increase a degree of vepoling

Development of technical systems goes in a direction of increase of a degree of vepoling.

Non-vepol systems aspire to become as vepol.

In a vepol systems development goes in such directions:

Mechanical fields pass to electromagnetic;

The degree of dispersiveness of substances is increased;

The number of connections between elements is increased;

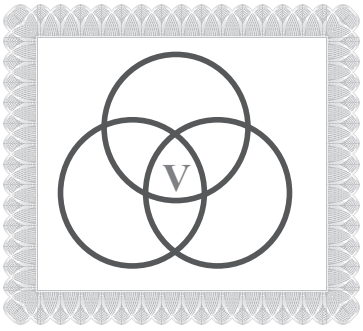
«Responsiveness» between elements is increased.

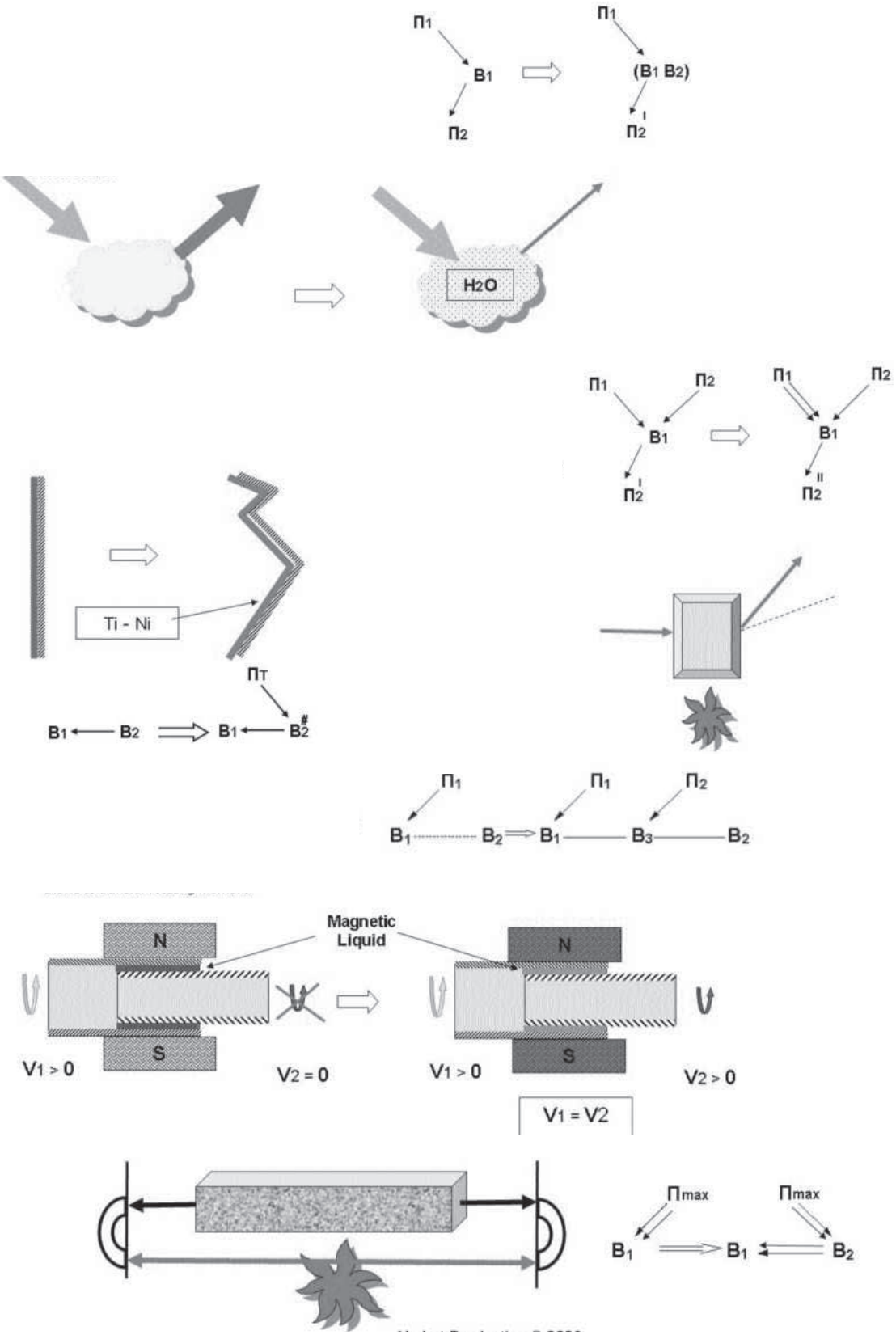
Researches show, that practically all laws of development of technical systems are feasible also for other systems. Only it is necessary to take into account specificity of systems in one of items of the law 8. Instead of «Mechanical fields pass to electromagnetic» (that typically for technical systems) is allowable to specify – «the degree of controllability fields is increased».

In different time numbering of laws of development was various. The version underlining special value of the law of aspiration to ideality here is used.

Graphic lines of development, and also interrelation of lines of development with other parameters of systems (quantity of inventions, levels of inventions, cost of realization) – these questions are considered in more detailed rates.

Laws of development, vepol models and information funds form uniform system by which it is constructed TRIZ.




П1
B1
П2
(B1 B2)
H2O
Ti - Ni
ПТ
B1 B2 B1 B2#
B1 B2 B1 B3 B2
Magnetic Liquid
N
S
V1 > 0
V2 = 0
V1 > 0
V2 > 0
V1 = V2
Пmax
B1 B1 B2

System of Standards

Practically all instruments of TRIZ are intended for revealing and elimination of contradictions in system.

Originally this process was carried out in each task. But further when the disassembled tasks began much, similar contradictions and similar ways of their elimination have started to collect.

The following step became formation of fund of typical models of tasks and standard ways of their solution. Thus revealing and elimination of contradictions was not carried out for each task as this action was executed beforehand.

So standards for the decision inventioms tasks have appeared. In the beginning, in 1975, them was all a little, but they had all necessary elements. In them in common, is interconnected physical effects, the strongest receptions of imagination were used âåï î ëüí û å models.

In 1975 to the book «Creativity as the exact science» was published ten standards and the next years the quantity of new standards grew promptly. By 1985 of them became 77. It is natural, that such quantity could not be simple «warehouse», «heap», therefore standards have formed system. This system operates and now.

Now the system of standards consists of five basic classes, each of which has the internal structure. It is very important, that standards are built according to some laws of development of systems.

Now the ***system of standards*** has such structure:

The Class 1. Construction and destruction of vepol systems.
The Subclass 1.1. Synthesis of vepols.
The Subclass 1.2. Destruction of vepols.

The Class 2. Development of vepol systems.
The Subclass 2.1. Transition to complex vepols.
The Subclass 2.2. Forcing up of vepols.
The Subclass 2.3. Forcing up by the coordination of rhythmics.
The Subclass 2.4. Fepols (in a complex-forced vepols).

The Class 3. Transition to supersystem and to a microlevel.
The Subclass 3.1. Transition to be-systems and to poly-systems.
The Subclass 3.2. Transition to a microlevel.

The Class 4. Standards for detection and measurement of systems.
The Subclass 4.1. Roundabout ways.
The Subclass 4.2. Synthesis of measuring systems.
The Subclass 4.3. Speeding up «measuring» of vepols.
The Subclass 4.4. Transition to fepol's measuring systems.
The Subclass 4.5. A direction of development of measuring systems.

The Class 5. Standards for application of standards.
The Subclass 5.1. Features of introduction of substance.
The Subclass 5.2. Introduction of fields.
The Subclass 5.3. Use of phase transitions.
The Subclass 5.4. Features of application ô è çýô ô åêòî â.
The Subclass 5.5. Experimental standards.

Usually the system of standards (as well as other tools TRIZ) is used not independently, and in a complex with ARIZ. In this case it's efficiency really high. It is very important, that the text of each standard of G.S.Altshuller started with the warning: «**To not apply before studying ARIZ and the vepol analysis**».

System of Effects

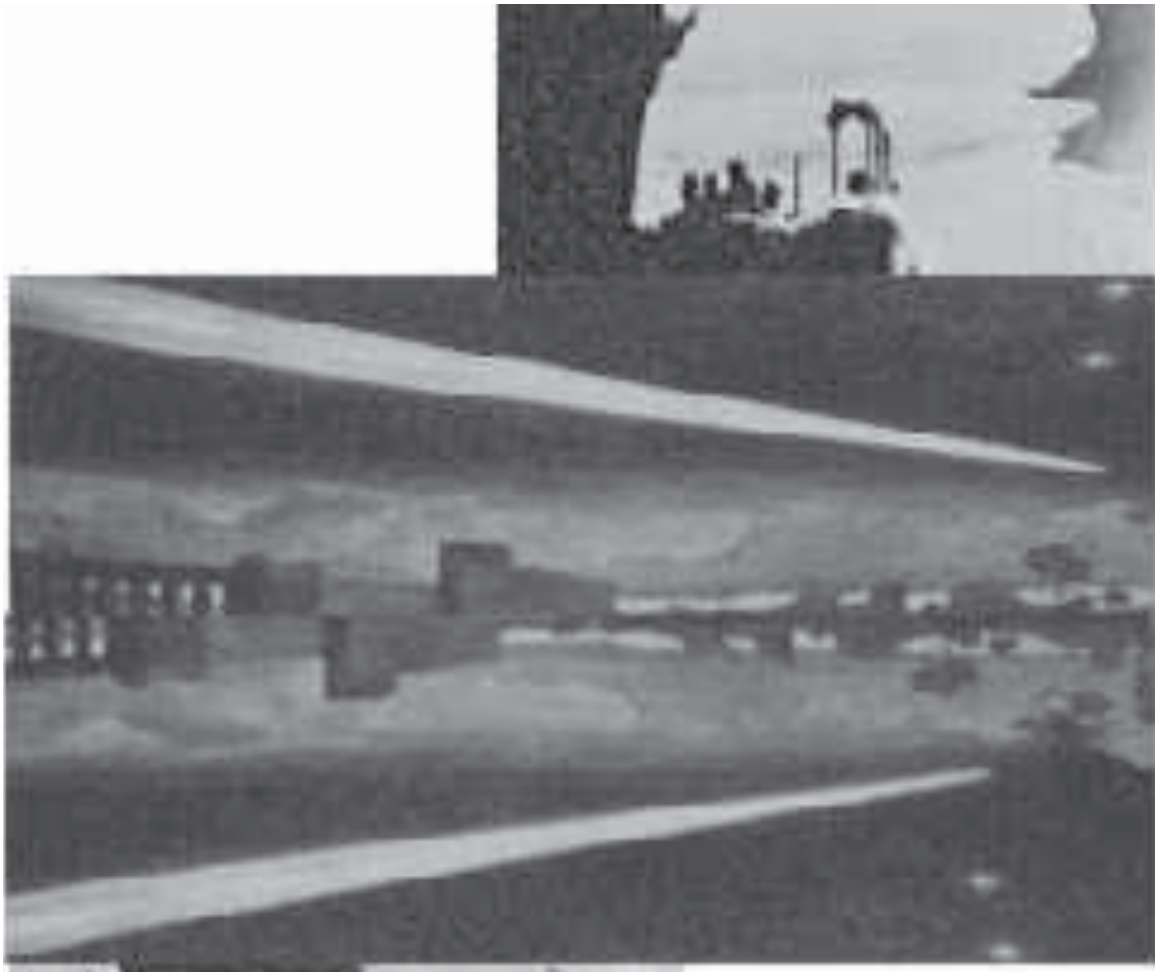
Development of TRIZ analysis of a plenty of tasks allowed to increase information funds constantly. In due course these funds became specialized – on separate, especially important themes.

Very important information funds are funds of effects. In them the information in physics, chemistry, mathematics, and some other sciences is collected, but this information is organized unusually, not how it is done in traditional directories.

Funds of effects show how it is possible to use various scientific knowledge for elimination of contradictions in systems, for the solutions of the inventions tasks.

First such funds have started to be developed since 1969. Some groups of researchers of TRIZ were engaged in collecting and ordering of the information. Further tables for most productive use of various effects were constructed. Effects were examined and described in language of ***laws of development of systems*** and ***vepol models***. The system of effects thus was generated.

In text of ARIZ-85V it is recommended to use the most developed and checked up part of system of effects – «**the Index of physical effects**» which sections were published in the Moscow magazine «**The Technic and the Science**» in 1981 and 1983, and also in the book «**Impudent formulas of creativity**» (publishing house «Karelia», Petrozavodsk, 1987).



The Register for fantastic ideas

The fantasy, creative imagination are very important for the solution of the most different serious problems. Therefore studying of the literature on a fantasy – an obligatory training course in TRIZ. The important element of this rate – revealing and ordering of fantastic ideas.

From the very beginning of development of TRIZ there were no problems with the information about patents – the detailed, systematized descriptions in which inventions were divided into classes and groups on areas of engineering were constantly published. Work of the researcher thus was facilitated even in the sense that it was not necessary to carry out classification itself.

With fantastic ideas all was more difficult. These ideas are a part of a literary work and long time occurred to nobody to allocate of idea from texts, to make their full list, to lead classification.

In many countries already for a long time there were encyclopedias on a fantasy in which their history and structure were described various sub-genre and directions, However even in the most full encyclopedias there were no attempts of the description and classification of concrete ideas.

At G.S.Al'tshullera frequently arose then innovetio ideas adjoining to a fantasy. In such cases long it was necessary to prove, that the invention all the same is real. It was sometimes easier to write and publish the fantastic story, using idea of the invention.

And then G.S.Altshuller has made the decision to not be engaged more applications for the invention, and the beginnings to write fantastic stories. He argued as follows: if successfully it is possible to solve scientific technical problems with help of TRIZ why to not apply an algorithmic method of the solution for problems of scientific and scientific-art?

G.S.Altshuller has submitted last application at the end of 1958. Then has written and has published the first fantastic story. He has quickly reached(achieved) the big popularity. For example, in 1965 of him printed more, than any of other writers in the USSR.

But for G.S.Altshullera the fantasy was not only the literature, but also serious scientific work. He wrote the fantasy and simultaneously was engaged in studying of fantastic ideas of other writers. Together with wife V.N.Zhuravlyova (also the known fantastic writer) he writes the big scientific articles about technical forecasts of different authors.

Studying G.S.Altshuller's fantasy has prepared the big list of ideas and has decided to systematize them. And to break on classes and groups how it was accepted in invention.

The Systematized list of ideas has received the name «***the Register of science-fiction ideas***».

The «***Register***» is not only the list, the list. It is the systematized fund of the most different ideas from the science-fiction literature.

In the «***Register***» science-fiction ideas are divided into eleven classes:

1. Space;
2. Earth;
3. The person;
4. A society;

5. Cybernetics;
6. Other-planets reasonable essences;
7. Fantastic animals and plants;
8. Time and space;
9. Fantastic initial situations;
10. Scientific and technical ideas;
11. Ecology.

All classes are in addition broken on subclasses, groups and subgroups.

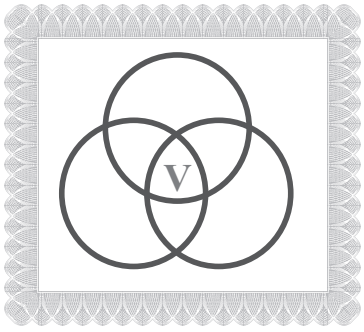
The «***Register***» was created first of all for classification and studying of ideas of science fiction. Therefore here there is no such, for example, popular sub-genre in fantastic literature, as the fantasy, the fairy tale fantasy, an the erotic fantasy.

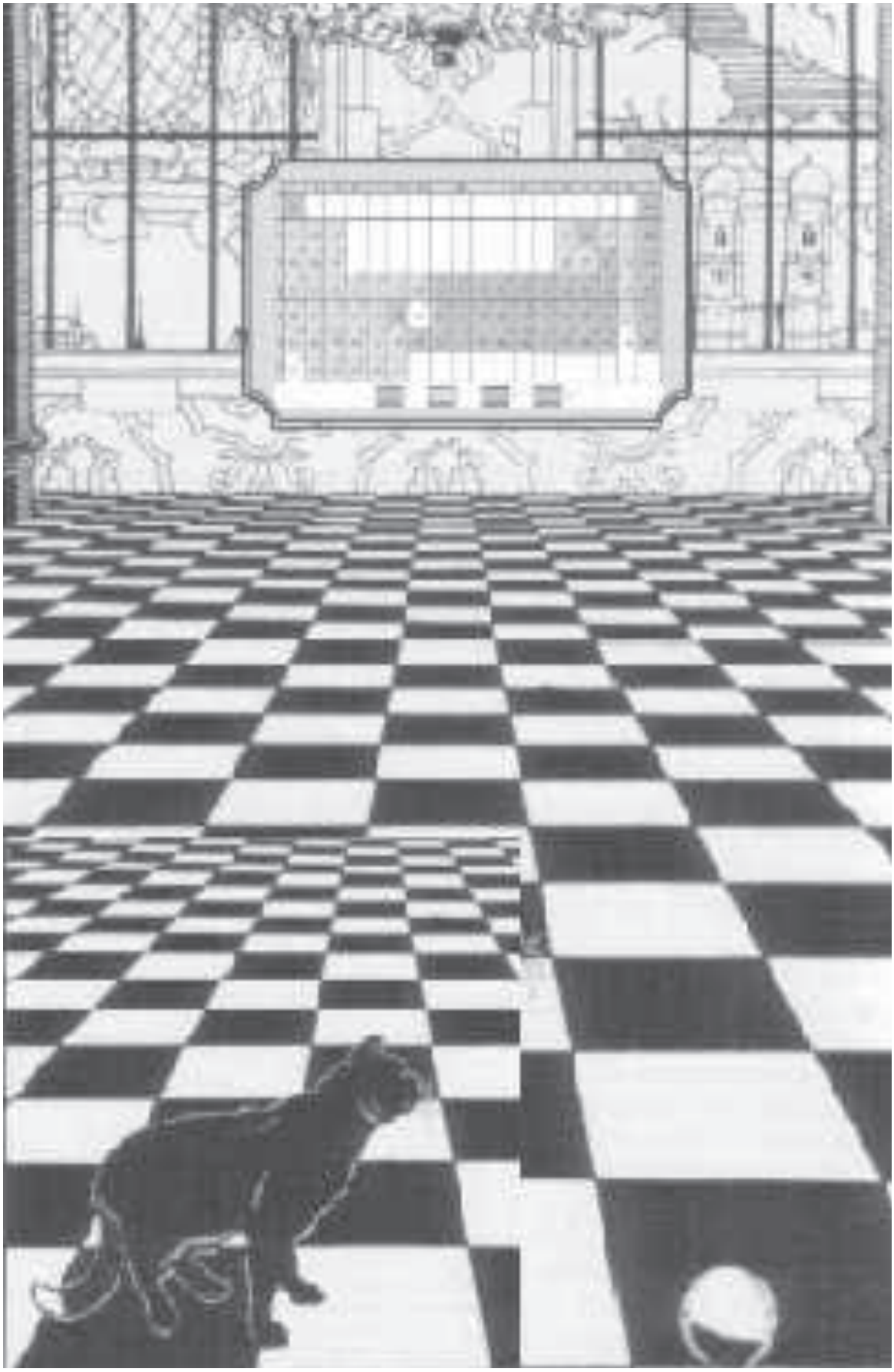
Active work for the «***Register***» has borrowed more than ten years.

The first version was prepared for the publication in 1974 under the name «the Register of fantastic ideas and situations».

The «Register» replenished with ideas till 1980, various groups of TRIZ experts participated in this work.

G.S.Altshuller always hoped, that researches in the field of science fiction will be continued. These researches in his opinion should allow to formulate the general laws of development of intellectual systems.

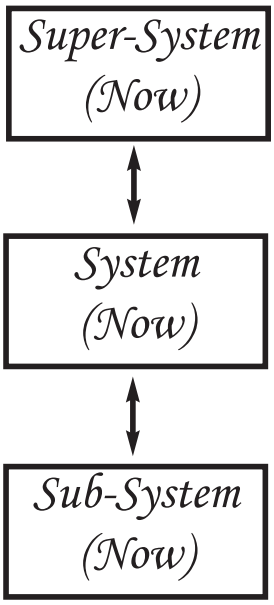




The Multiscreen Scheme

In the table of classical tools TRIZ the ***Multiscreen scheme*** takes the important place – sit directly ensures the functioning of ARIZ and SLCP.

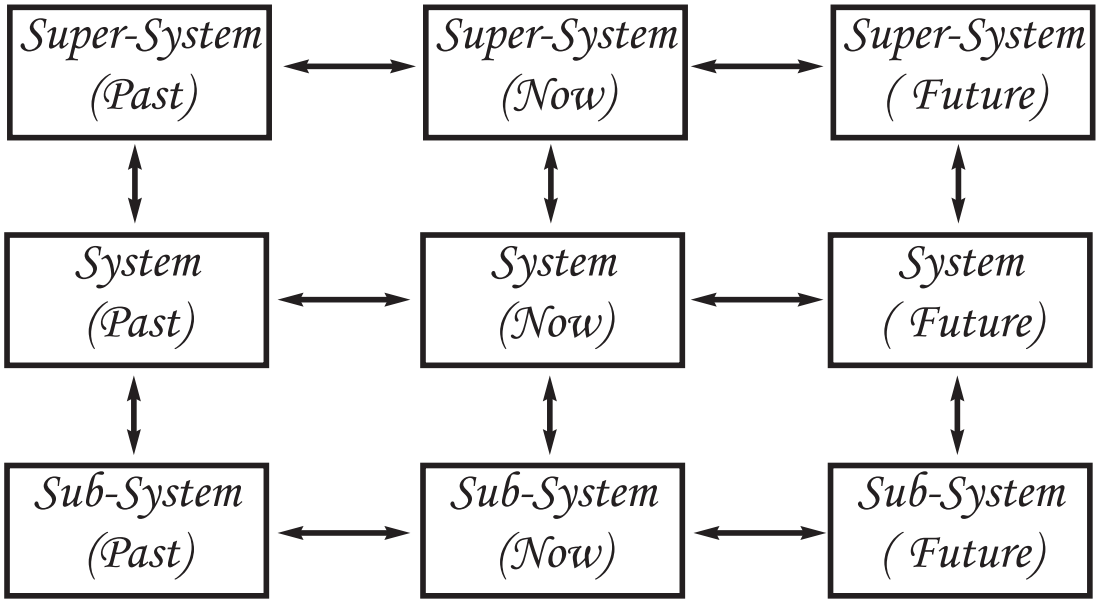
Each system consists of some elements - and each system can be an element of more general structure.



Besides each system is examined now, and also in the past and in the future.

Thus, according to the ***Multiscreen scheme*** each system is examined in a complex: at different hierarchical levels and in different times.

In the minimal case to such scheme corresponds 9 screens.



The similar scheme is built also for anti-system (system with opposite characteristics). It increases the minimal picture up to 18 screens.

Even the most simple analysis under the minimal scheme allows to receive many new interesting results. But for complex systems are not limited to the minimal scheme – construction conduct «upwards» and «downwards» on the many levels of hierarchy, and also in the past and the future on many steps.

Training in drawing up of multiscreen schemes should be carried out constantly, on the most different systems.

Ideal strategy of creative

Serious creative work, as a rule, is carried out at three levels.

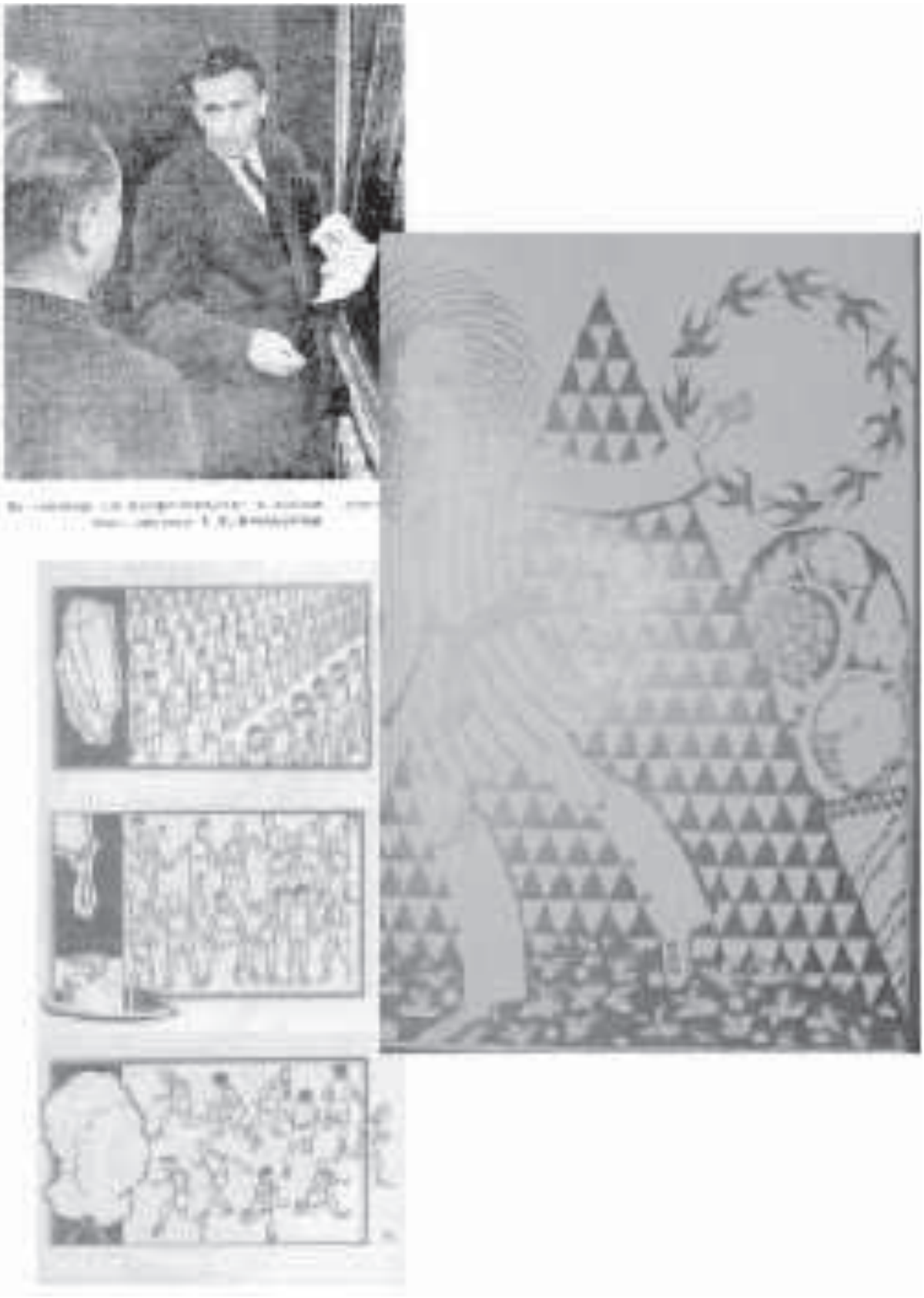
At the very first level are solved concrete technical (including technological) tasks.

When the quantity of the solved of tasks becomes very big (at high quality of solutions) – work passes to the second level. Now it is necessary to formulate and solve tasks general technic and general scientific.

Development of general technic and general scientific tasks results in an output far beyond initial system. Now there are the social, universal problems connected to development of former tasks and solutions of these tasks.

Ideal creative strategy consists in a correct combination of work at all three levels. Carrying out the solution of any specific target, it is necessary to see the nearest and perspective consequences of this solution. If necessary in time it is necessary to be able to pass from one level of work to another even if it looks difficult or in general impracticable process.

The Special rate devoted to ***ideal creative strategy***, was developed simultaneously with ***Strategy of Live for the Creative Person***. This rate is necessary for most productive use TRIZ.



«TRIZ teams»

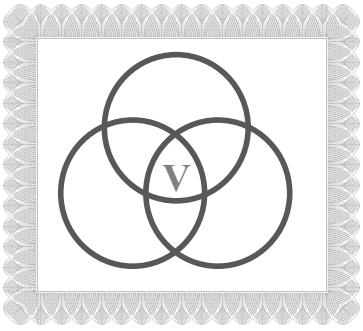
Work with application of TRIZ – is qualitatively new kind of creative activity. And results of such work also unusual.

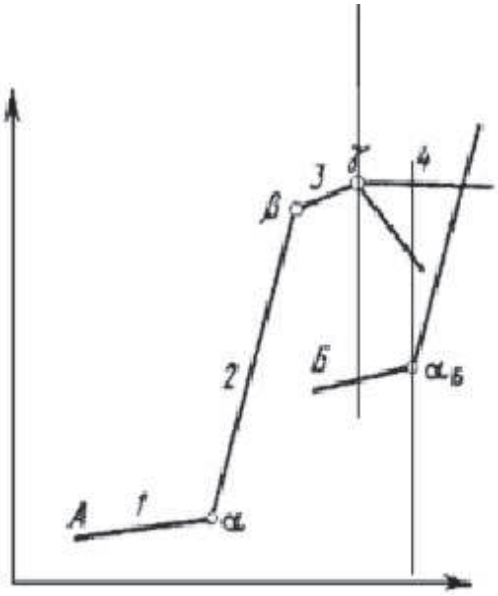
Many researchers mark, that active and exact use TRIZ during long time allows to create the strong, qualified teams. Such teams cope with practical problems much fastly and more successfully. Participants such «TRIZ-teams» realize ideal creative strategy much more often.

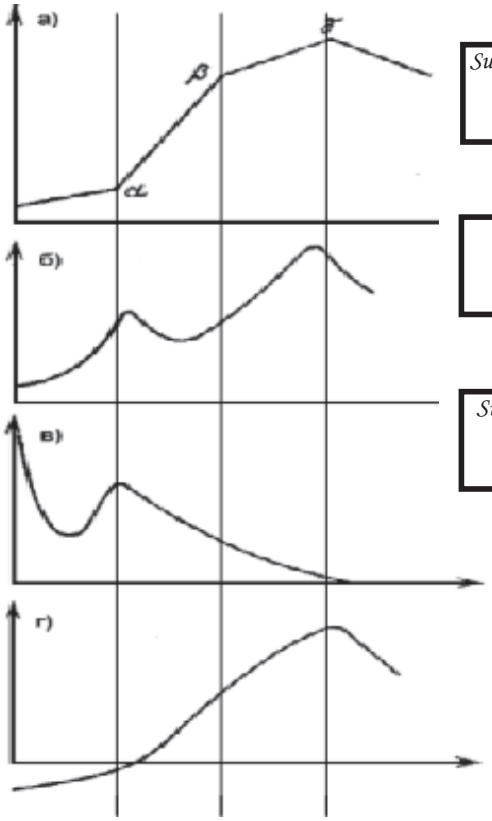
On the other hand – only «TRIZ-teams», and it is even better – interaction of such teams allows to develop a science to receive new results for perfection of TRIZ.

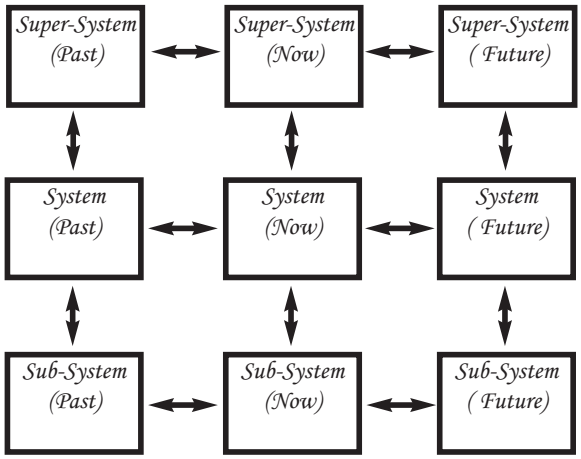
Formation and saving serviceability of «TRIZ-teams», certainly, demands significant efforts from its participants. But there is no other way to receive from TRIZ really serious, significant result.

«TRIZ-teams» – is the major instrument of a science.



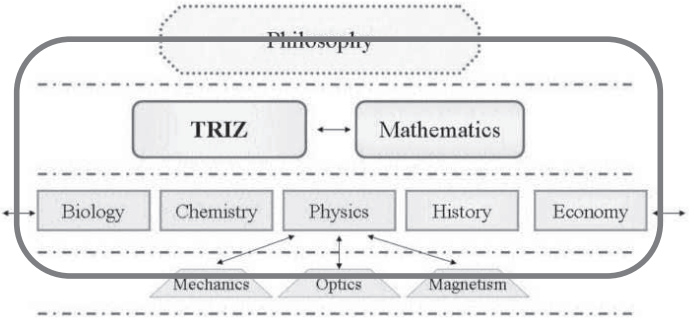

А
1
α
2
Б
αБ
В
3
γ
4


а)
б)
в)
г)

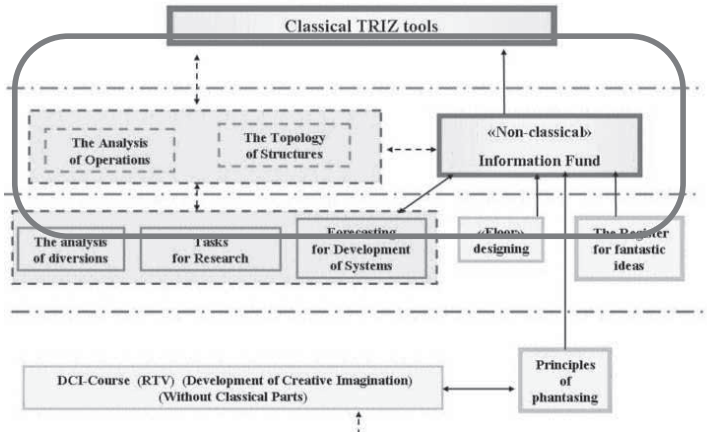

Super-System (Past)
Super-System (Now)
Super-System (Future)
System (Past)
System (Now)
System (Future)
Sub-System (Past)
Sub-System (Now)
Sub-System (Future)

Further development of TRIZ

Development of TRIZ occurs in the usual way for a science. There are two interconnected directions of development. On the one hand any science aspires to cooperate with «environment» – other sciences as much as possible.



The Second direction – perfection of internal mechanisms, development of old tools and creation new.



The necessary condition of such perfection is presence and the minimal serviceability «***TRIZ-teams***».


Тайное творчества

History of TRIZ development

The beginning of researches in TRIZ concerns to 40-th years of 20-th century. About this time first information fund TRIZ is formed.

1956 – the first publication about TRIZ in magazine, the first publications on a fantasy, a formulation of concepts of ideality of systems, contradictions in development of systems, the first ARIZ.

1957 – the first educational and practical TRIZ seminars.

1961 – the first book about TRIZ, formation of «G.S.Altshullera's school».

1969 – the beginning of work on special funds (physical effects).

1971 – creation of the Azerbaijan institute of inventions creativity (Baku).

1973 – the beginning of works by vepol models.

1975 – a formulation of system of laws of development of technical systems, the beginning of work by standards, the beginning of formation of system of schools («TRIZ movement»).

1979 – the book «Creativity as the exact science», the beginning of work of Public laboratory of the theory of invention, the beginning of a plenty of regular seminars and publications by TRIZ.

1981 – the beginning of work by SLCP.

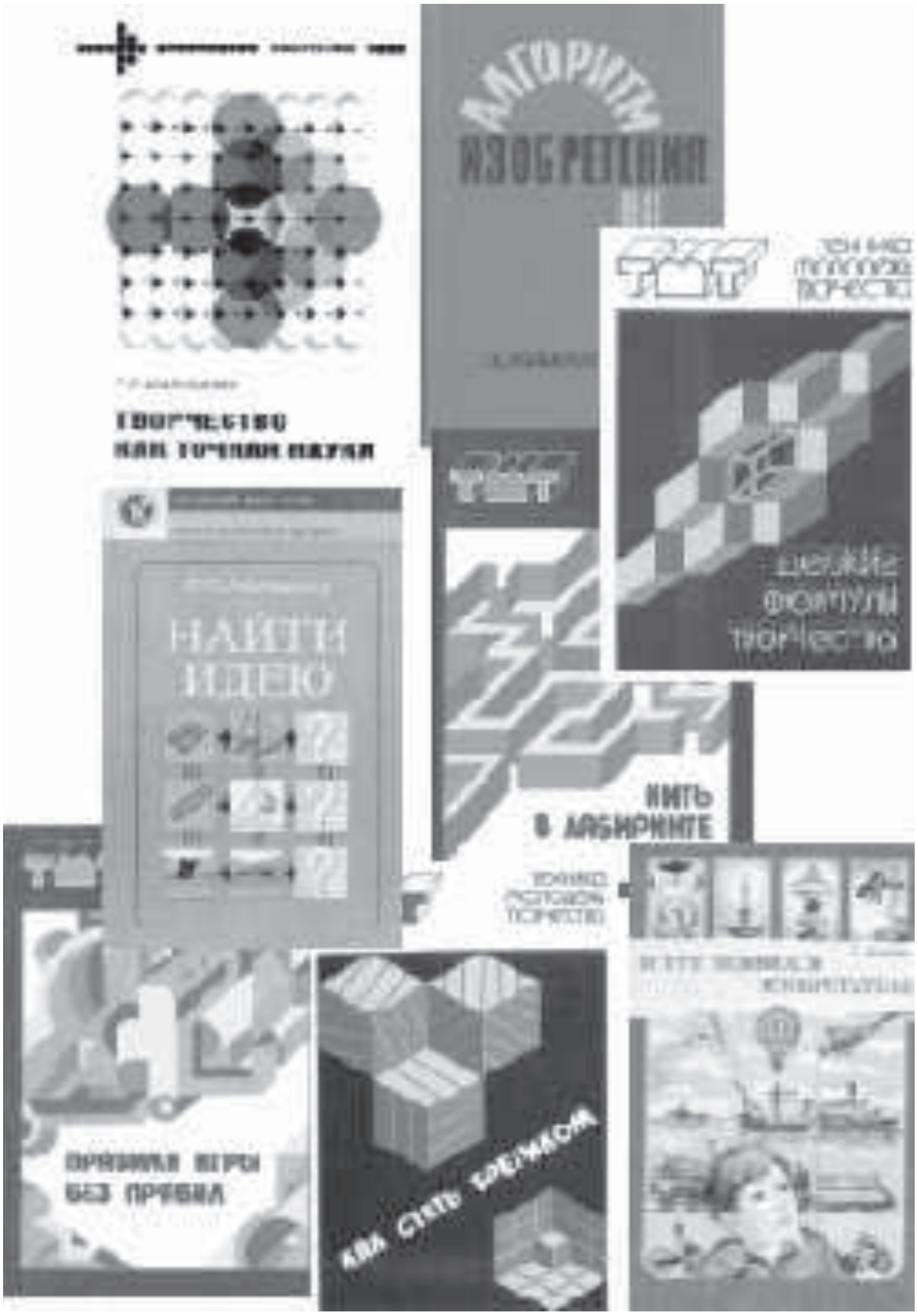
1985 – are prepared ARIZ-85V and System of standards-77.

1990 – sharp reductions of regular seminars and quantities of working schools (the reason not dependent from TRIZ, «external» – economic and social), braking of development of «TRIZ movements».

1996 – occurrence TRIZ in the Internet.

1998 – G.S.Altshullera's last circular.

2003 – the beginning of formation of new TRIZ schools in the different countries.


АЛГОРИТМ
ИЗОБРЕТЕНИЯ
НАЙТИ
ИДЕЮ
НИТЬ
В ЛАБИРИНТЕ
ПРИЗЫВ ВЕРН
БЕЗ ПРЫЖКА

The Literature

For qualitative studying and application of TRIZ it is necessary to use the full original text of basic instruments of TRIZ. Analyses of tasks and comments in this textbook were carried out only on the basis of such texts.

Full texts of basic tools TRIZ in the original look in such editions (other sources are not recommended):

ALGORITHM for SOLUTION of INVENTIONS TASKS
ARIZ-85V. G.S.Altshuller. **Rules of game without rules / ARIZ – the victory means.** – Petrozavodsk: Karelia, 1989. with. 9-50.

STANDARD SOLUTIONS for INVENTIONS TASKS
(76 standards). G.S.Altshuller. **A string in a labyrinth / the Small immense worlds**. – Petrozavodsk: Karelia, 1988. with. 168-230.

STRATEGY for LIVE for the CREATIVE PERSON
(SLCP). G.S.Altshuller, I.M.Vjortkin. **How to become the heretic / How to become the heretic**. – Petrozavodsk: Karelia, 1991. with. 9-184.

Theoretical questions of TRIZ are shown in such books:

G.S.Altshuller. **Creativity as the exact science**. – Moscow: the Soviet radio, 1979.

G.S.Altshuller. **To find idea**. – Novosibirsk: the Science, the Siberian branch, 1991.

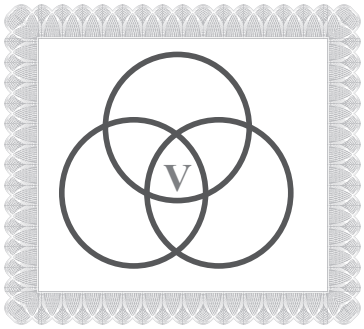
G.S.Altshuller. **Algorithm of the invention**. The edition 2 corrected and added – Moscow: the Moscow worker, 1973.

For initial acquaintance with ÒÐÈÇ the book is recommended:

G.Altov. **And here the inventor has appeared**. – Moscow: the Children's literature, 1984.

It is necessary to take into account, that at the moment of preparation of this book there is no satisfactory translation of books of G.S.Altshullera from Russian. All seen translations contained the important, basic mistakes.

In the Internet also there are no full and exact texts of books of G.S.Altshullera and descriptions of separate instruments of TRIZ.



Education Plan

Criteria of quality educational preparations are formulated by G.S.Altshuller (for example, in the book «To find idea», p. 176):

1 level. General time of occupations – till 40. Written works are not present. The purpose of training – acquaintance with principles of the theory, attraction to the further study. For occupations it is necessary 60-70 pages of teaching materials on each student.

2 level. General time of occupations – 60-80 (half-year at occupations once a week or a fortnight seminar with a separation from work). Written works – domestic tasks. The purpose of training – profound acquaintance with principles; partial development of working instruments of TRIZ. Materials – 120 pages.

3 level. General time of occupations – 120-140 (year at occupations once a week or a monthly seminar with a separation from work). Written works – domestic tasks, examination. The purpose of training – development of basic working instruments of TRIZ and the solution with their help of one industrial task (with the subsequent registration of the patent application); development of some skills of creative thinking. Materials – up to 200 pages.

4 level. General time of occupations – 220-280 (two years of occupations once a week or two monthly seminars with a separation from work). Written works – domestic tasks, control and course works, final work upon termination of a rate, degree work upon termination of the second rate. The purpose of training – development modern TRIZ and the solution of several industrial tasks (with registration of applications for patents); development of skills of creative thinking; preparation of teachers and developers of TRIZ. Materials – 400 and more pages.

Quality of practical application of TRIZ is easily checked on control to questions of ARIZ (the step 7.2).

Criteria of quality of research work in the TRIZ are formulated by G.S.Altshuller. These are six control questions:

1. Whether the methodology offered in is based the book on any information fund? If there is no information fund to speak there is nothing.

2. If on patent fund, whether that levels of the solution are revealed?

3. Whether «instrumented» given recommendations? What for all this? How it to use?

4. Whether recommendations practically are checked up? Whether such check is possible? Such recommendations are sometimes given to check up which efficiency is impossible. Such recommendations are senseless.

5. Whether there correspond conclusions and the recommendations given in the book to what has already settled?

We admit, that the person on good patent fund proves, that there is no law of increase of ideality, and there is any other law. There should be a conformity with already known. Infringements are extremely interesting. It or the indication on existence of something new, or the indication on hack-work.

6. Typical attributes of the bad publication: quasi-science, «outmind», abundance of a unnecessary terminology, super-mathemating (any formule are resulted, it is not known for what in which not integrate, will not receive) for demonstration of learning of the author. Superfluous citing «classics», at the slightest pretext (in one clever book are not quoted in succession classics). Bulky proofs of positions not requiring for the proof.

Education Tasks

As any exact science, TRIZ is difficult enough. For master the main thing – classics of TRIZ, it is necessary a minimum two years of regular jobs under the direction of the skilled teacher. It is necessary to read many books, articles, other additional materials. But the most important – needs to be solved, carefully to disassemble many educational tasks.

The minimal norm – one task by ARIZ-85V per one week (not including two-three weekly tasks and exercises on application of other instruments of TRIZ). Each this analysis should be checked up by the teacher, mistakes are eliminated, remarks are taken into discounted – in new record of the text of analysis of a task. Thus, for two years the base from hundred independently disassembled educational tasks should collect.

The structure of domestic tasks also necessarily includes copies of cards from constantly filled up personal card file (not less than three cards into one week), an estimation on a scale «Phantasy» of science-fiction products (a minimum of one per one week) and the table of the constant account of personal time.

Presence and the constant control, check of such tasks by the teacher – the certificate of quality for educational process. Accordingly, their absence speaks about opposite...

But it's – educational processonly only. The complete set of work in the TRIZ consists of three elements:

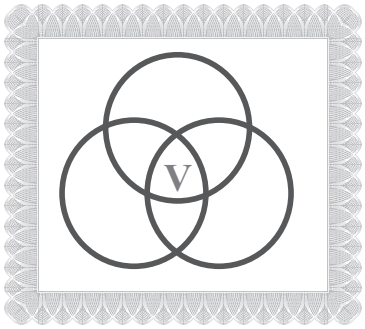
Training and studying of TRIZ;
Applications, uses of TRIZ;
Researches in the TRIZ.

Such complex is characteristic for serious work in any science, but in the TRIZ insufficiency any of elements has especially clearly an effect for decrease of the general results.

Certainly, not for all tasks it is necessary TRIZ, there are many specialized problems which are solved other means. In such cases it is necessary to use these means and to not create at all visibility of application TRIZ. Especially – it is inadmissible «to mask as TRIZ» inventions solutions , but received without TRIZ, other means.

By the way, presence of such solutions – quite normal phenomenon for the creative worker in any area. Eventually, Thomas Edison has received more than thousand patents for excellent solutions – and in one of them did not use TRIZ. Was not in its time of such science...

Unfortunately, even by qualitative educational preparation the good form in TRIZ can be lost for one year – one and a half if not to carry out the most necessary «creative traning». Elements such traning the same, as at qualitative study: regular updating of a personal card file; reading (and an estimation) science fiction; the constant account of personal time. But the most important – careful analysis educational, and then and practical tasks in steps ARIZ-85V.



Terms which are used in TRIZ

In it is **additional**[*)] – section the general-system terms used in TRIZ are shown. Special TRIZ terms are shown in a full training course.

Attention: **not all terms shown in section, are classical for TRIZ**. They are shown to give representation about possible ***system of TRIZ terms***.

The explanatory of each term is given in such sense in what this term is used in TRIZ in general and in ARIZ in particular. In some cases the same term is used in TRIZ in various senses – these a situation each time are explained separately. Use of different terms for identical concepts also is separately explained.

All explanatories of terms – whenever possible short, help. Detailed, full explanations together with necessary examples are shown in a full training course. Latin conformity are shown for simplification of translation.

Object (objectum).

Any part of space, and also change of a part of space in time (process) can be object. Generally coordinates of space and time can have any nature (***natura***).

[*)] *This section is not obligatory for elementary education, but acquaintance to it facilitates understanding of TRIZ.*

Property (proprietas).

Some action made by object and causing changes in other objects or in the given object refers to as Property.

Interaction (interactio).

Process of change of properties of objects as a result of action of objects against each other refers to as interaction. Various interactions between the same objects are possible.

The Combination (combinatio).

The Certain accommodation of objects in space not resulting (bringing) to interaction refers to as a combination. Various combinations of the same objects are possible.

System (systema).

Some objects refer to as system in that case when their interaction or a combination has some property which is not to properties of one of these objects. The objects forming system, refer to as elements of this system.

Complex system (compositus systema).

The System refers to complex if it has (shows) some various properties which are not reduced to one of properties of this system. In turn properties of one or several systems can be elements of new system (can form new system).

The Environment (externa).

Objects and the interactions which are not included in the given system, refer to as an environment concerning the given system. Elements of an environment can form some other systems. In some cases elements of an environment can be placed inside system or inside its separate elements without interaction. Elements of an environment also can cooperate with elements of the given system or with all system (thus it is formed one or several new systems).

Process of reception the information on system.

Any action allowing the external observer to define property of system, its elements, and also properties of these elements, refers to as process of reception of the information on this system. For reception of one «standard unit» of change of the information action which twice reduces uncertainty of a condition of system for the external observer is accepted.

The External observer (externus observator).

The Object (a part of an environment), having an opportunity to influence system for reception of the information on this system, refers to as the active external observer. The object (a part of an environment) not having an opportunity to influence system for reception of the information on this system, but receiving such information, refers to as the passive external observer. The external observer can be any object of an environment having necessary properties.

Operation (operatio).

Any change in the system, caused by the active external observer, refers to as operation.

Properties of system.

For the external observer of property of system can be obvious and unevident. In the second case elements of system can look like vaguely long time group of objects independent from each other (can be an environment the friend for the friend). However properties of system are objective, i.e. these properties exist irrespective of the external observer. At the same time, process of active supervision can make changes to system (in its elements and properties). Character and size of these changes depend on objective properties of the system and process of supervision.

Elements of system (elementum …).

Each element of system in turn can be system. On the other hand - each system can be an element of other system. Elements of system can change under influence of internal and external influences change the

interaction and a combination. Such changes can result in change of properties of system.

Model of system (schema …).

Each system it is possible to describe as model in which elements are conditional «substances», and influences – conditional «fields». Such models refer vepol. Thus conditional «substances» can be any objects (including real fields or processes), and conditional «fields» – any processes. Models of simple systems can coincide with systems practically. For construction of model of complex system, as a rule, are limited to its one property and those elements which provide this property.

Levels of systems (gradus …).

Each system a priori is considered system of a base level (a level «zero»). In this case its(her) elements have a under – system level (a level «a minus unit»), and systems into which it enters as an element, have an above – system level (a level «plus unit»). Each system can have unlimited quantity(amount) of positive and negative levels. Changes at one level of system can result in changes at other levels (positive and negative). Character and size of these changes depend on objective properties of various levels of system, and also from objective properties of interaction of these levels.

Layers (floors) of a level of system (stratum …).

At one level of system its(her) elements can be divided and be united, forming new groups, but not creating thus of qualitatively new property – there is only a quantitative change of property existing. Such groups refer to as layers (floors) of the given level of system. At each level of system there can be some layers (floors).

Development of systems (evolutio …).

Under action of external and internal influences of system vary. Changes of systems (their elements and properties at different levels) occur naturally. Each observably(notice) law of change of systems represents model of some process which is carried out under certain conditions. These laws operate simultaneously, influence against each other and in turn form system.

Objectivity of laws of development of systems.

Laws of development of systems depend on objective properties of systems and do not depend on the external observer. For the external observer these laws can be obvious and unevident. Process of supervision and controlled change of properties and elements of system can not change laws of development of systems. Therefore the result of development of system due to controlled change depends first of all on objective natural development of this system. Constantly it is necessary for active external observer to collect the information on systems to reveal laws of development (to do their obvious) for systematic purposeful development of systems.

Ideal system (perfectus …).

If properties of system are obvious to the external observer, and elements of this system for it are unevident (are not-observably), such system refers to ideal. Ideality can depend on properties of the external observer (subjective ideality), but also can be real, objective feature of the system. In the second case property (properties) of system at a base level is realized by elements of sublevels (negative levels) that allows to reduce quantity of elements of system of a base level. The size of ideality of system is directly proportional to quantity of properties of system and in inverse proportion to quantity(amount) of elements of a base level.

Interaction of systems.

Systems of one level can have the general(common) elements. In that case ideality of each of these systems can raise. At the same time additional interactions between elements of systems can cause additional conflicts. In other cases (if the general(common) elements are not present) systems are the friend for the friend an environment.

Conflicts and contradictions (conflictus, controversia).

Interaction of elements of system creates various properties of this system. Thus active change of one of properties is accompanied by passive changes of other properties. Such phenomenon refers to as the conflict. Conflicts are objective (are independent of the external observer) and are defined(determined) by properties of elements and the interactions causing this conflict. In development of system both parties of the conflict can change quantitatively (without occurrence of new property) and is qualitative (with occurrence of new property). At qualitative changes conflicting elements or their interactions always have opposite properties. Such phenomenon refers to as the contradiction.

Development of systems - process of elimination of contradictions.

Development of system is qualitative change of this system (its properties and elements). Such change occurs by elimination (removal) of the objective contradictions arising in this system.

Natural, social and technical systems (natura, civilis, technicus).

All systems, arising and consisting of natural (natural) elements a priori refer to as natural way natural (natural). Natural systems for the development use ready external objects. Systems which for the development will transform external objects (systems), refer to as ï ðî òî -social systems. These systems can have biological (albuminous) or not biological (not albuminous) structure. As a rule, such systems are capable to reproduction (creation self-like systems). The systems creating new (distinct from) the systems intended for transformation of external objects, refer to as social systems. Social systems contain social or proto-social elements. The systems created by social systems for transformation of external objects, refer to as technical systems.

The Subjective factor (subjectum factor).

The Overactive external observer can influence elements of various systems for the directed change of properties of these systems (in view of the general information on systems as laws and models, and also the concrete information on the given system). Such overactive observer refers to «the subjective factor». For realization of the directed influences the subjective factor uses technical systems. The subjective factor is social system.

The Solution of a task, approximation (approximare).

Complex process of subjective influence on objective development of systems of a different nature and a various level refers to as Approximation. The basic result of such process is objective reception (creation) of system with subjectively given properties. As a rule, reception of such system occurs by gradual approach – approximation to some ideal system having only given property (properties). At transition from initial system to ideal a lot of objective contradictions comes to light and eliminated. Process of approximation is complex system of operations. Usually, this process in TRIZ refers to as the decision of a task.

Quality of result and process of approximation (qualitas).

Quality of result of approximation is defined by size of ideality of the received system, and also in direct ratio to a maximum level of the changed above - system (concerning a base level). Quality of process of approximation also depends on a maximum level of the changed subsystem and in direct ratio to the module of this level.

Tools of approximation (instrumentum …).

Elements (subsystems) of process of approximation refer to as tools of approximation. Technological the tools focused mainly on systems which is exposed to change refer to. Organizational the tools focused mainly on the subjective factor refer to. Process of reception of the information is the separate tool group having both technological, and organizational properties. All tools are divided(shared) also on «classical» and «non-classical». Classical tools which at correct application practically always give a sufficient degree of quality refer to. The numerical size of a sufficient degree of quality can be various for different systems, and also

for one system in different time. Generally separate tools can pass from one group in another.

Resources (supellex).

All conditional «substances» and «fields» which can be used for creation of system with the given property, refer to as resources. As a rule, the degree of availability of resources is inversely proportional to the module of a level of resources concerning a base level of created system. There can be other special conditions also influencing a degree of availability of resources.

Conditions of a problem(task) (conditio).

The List of necessary and existing elements of process refers to as conditions of a problem(task). In most cases initial conditions are not sufficient for reception of the decision (existing elements insufficiently, necessary all are known not). Conditions of a problem(task) form system which will transform to minimally necessary model.

Types of models of problems(tasks) (typus …).

There Are three basic such as models of the problems(tasks) decided(solved) during approximation:

1. Construction of the system having given property, at presence of the certain resources (in an ideal - reception of the given property without construction of new system).

2. Definition of the resources necessary for construction of system with given property (in an ideal – reception of the given property without use of resources).

3. Definition of properties of systems which can be constructed from existing resources (in an ideal – a maximum quantity of new properties for the given quantity(amount) of resources).

Kinds of problems(tasks) (species …).

The Trivial problem(task) – concrete conditions, concrete operations for the given conditions and concrete result earlier were known. For the decision it is necessary to execute concrete operations precisely.

The Standard problem(task) – the model of the conditions, typical operations for the given models of conditions and model of result earlier

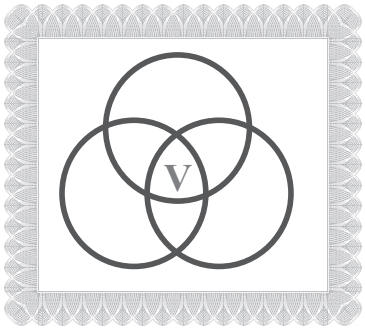
were known. For the decision it is necessary to transform typical operations in concrete (for the given concrete conditions) with the help of known tools.

All other problems(tasks) - non-standard. For the decision it is necessary to create new operations with the help of known or new tools.

Standarding and a non-standarding of tasks can be objective and subjective.

System of tasks.

For development of complex(difficult) system it is necessary to solve many problems which also can form system. At this system there can be various kinds and types of problems(tasks).



Classical TRIZ
Project's Manual

Altshuller

At him was two variants of " usual day ". As at the accumulator: charging and discharging.

The First variant - the day up to the top filled with the information. Books on a history of engineering, the patent literature, a fantasy. And still - philosophy, psychology, cybernetics... Letters... On the average it(he) spent For them till four per day. Some thousand letters monthly!

The Second variant - day, " when something you write ". Here the superfluous information only in harm. It is important to sustain the style to not get off from idea, to write so that at once it was possible to learn(find out) the author. In one of such dayshave appeared "Legends about star captains", "Port of stone storms... And in the same days - "Algorithm of the invention", "Creativity as the exact science"... Thos books is different, unlike one on one. But the author at them one – Gengikh Saulovich Altshuller.

" Among inventors the greatest impression on me has made Ãåí ðèõ Altos " is a fragment from Arcady Strugatskogo's interview, the known writer - visionary. A little bit further, speaking about features of this person, he will note: "... Bright talent, irrepressible bent for to creativity. And still - precise realization of plans... ". G.Al'tov - G.S.Al'tshuller's pseudonym. The inventor. And can, the visionary? Not you see his stories are placed in the Anthology of a fantasy. So the visionary or the inventor?

That G.S.Al'tshuller writes:

- I do not think myself neither the inventor, nor the writer. My speciality, - the theory of development of technical systems. Something similar to the general(common) biology, only sphere of application - engineering, instead of alive organisms. As if to invention and a fantasy... To invent I start then when it is necessary to test a new method, reception. And in a fantasy I am engaged, when I want to consider a problem for which scientific decision else there are no conditions., say, a problem of universality of knowledge. Strong solutions for inventive problems (tasks) are always hidden far from that area for which the problem (task) is formulated. The inventor should not be afraid to leave for limits of the narrow speciality, but if necessary is not afraid to go deep into "another's" areas, is able to borrow therefrom interesting ideas, methods.

We shall Bring attention to the question question more widely: and whether it is impossible to refuse specialization in general? Or it is possible to prepare universales which all would be able? Here we at once enter area of a fantasy. One life is given to the person. And somewhere on a slope of years there is an idea: and there were other, not less interesting ways!.. But already never it will be possible to live other life. The trade demands full feedback - differently will not become the Master. And all other opportunities remain non-realized. The problem is obvious, but meanwhile she(it) can be investigated only means of art, a fantasy...

Many years Genrikh Altov wrote the story have appeared "The Third millenium". Action is developed(unwrapped) in XXII century. It is epoch of superspecialization, but there are daredevils who put the first

experiments with preparation universales... The Theme for the author not casual. Even it is more - the third millenium really began in G.S.Al't-shuller's already mentioned book " Creativity as the exact science ". The book has a subtitle " the Theory of the solutions of inventive problems (tasks) ". But it is interesting not only to inventors.

And again - G.S.Al'tshulleru's word:

- the theory of the solutions of inventive problems (tasks) is a theory of thinking during the decision of creative problems(tasks) in engineering. But creative problems (tasks) exist in all spheres of activity of the person. Work on creation of the first algorithms of the decision of scientific problems (tasks) already is now conducted... Further inevitably there will be a General Theory of Creative Thinking. The next century the person necessarily will learn to operate process of thinking.

Such idea can seem too optimistic. But we shall recollect: more recently improbable other idea - about an opportunity to do(make) the invention with the help of " any algorithm " seem. The first publications on TRIZ it is far from being all were met with enthusiasm and understanding.

- what the theory of invention can give? - sceptics asked. - What effect from it?

G.S.Al'tshuller's Opinion:

- it is difficult to result exact figures of economy, quantity(amount) of concrete inventions. You see the main source of the information about TRIZ - books. There come many letters from those who, having read the book, starts to use TRIZ in the work. But you see write it is far from being all.

In 1974 in the USSR passed scientific - practical conference "Heuristics". In recommendations of this conference it is told: during 1971-1974 years graduates of schools TRIZ have made hundreds inventions. I shall note: then there were only six schools. Now them more than

hundred.. More perfect updating ARIZ - algorithm of the solution of inventive problems (tasks) Is used. And to train TRIZ we became much better. So figure 1000 of inventions " under the theory " annually - is minimal. Already there are experts who have made more than on hundred inventions everyone with use of the theory. It is difficult to list everyone, at whom quantity(amount) of inventions more than ten.

In the Theory of invention actively are interested in many countries. Books on TRIZ are transferred(translated) in Germany, USA, Poland, Bulgaria, Japan. The book " Creativity as the exact science " has left simultaneously to the USSR, GDR, Hungary and Czechoslovakia...

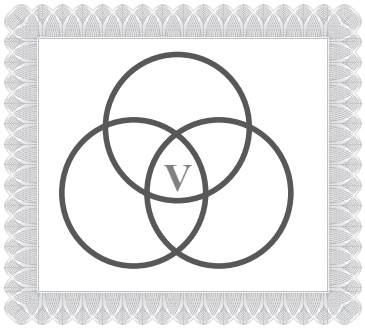
It not seems to you, what we give too many time not to the person, and his(business? Probably, for someone the hobby which prevents work " would be expedient to search for another secret "points", any ". You see played Einshtein on a violin simply so, for itself. At Genrikh Saulovich- has the hobby and work many years supplemented each other. The theory of the solutions for inventive problems (tasks) - his speciality and hobby. TRIZ frequently name " technique of Altshuller ". It not so. The theory of invention for a long time became the exact science.

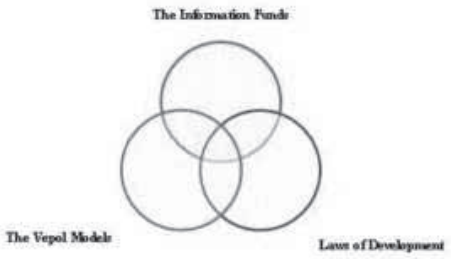
Certainly, to one person work on development of the whole science would be not under force. Many years were engaged in development TRIZ Public laboratory of the theory of invention. In it(her) scientists, engineers, inventors worked. Results of this work î ï ðî áû âàþ ò thousand inventors of the country. A feedback between them and laboratory - a pledge of further perfection TRIZ, bail of increase of its(her) efficiency. Supervised over work of laboratory of G.S.Al'tshuller. The person keen. The person borrowed(occupied) with the business.

Genrich Saulovich Altshuller

The basic dates of life.

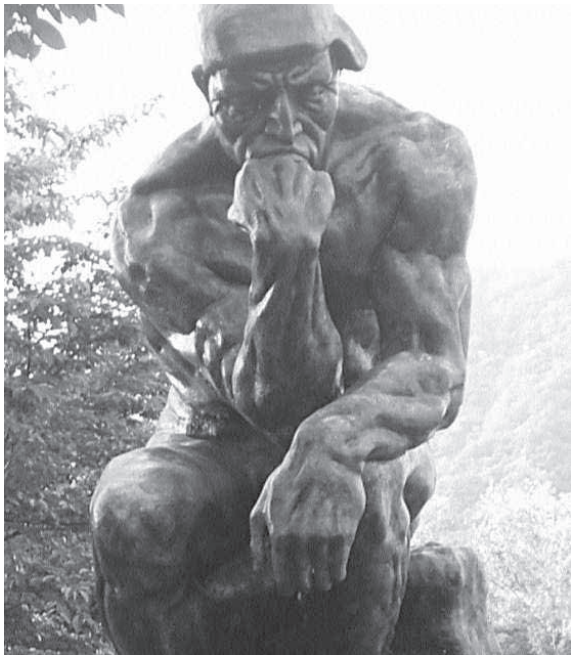
15.10.1926 – the first day of his life, Tashkent (Uzbekistan).
1931 – together with parents comes to Baku (Azerbaijan).
1943 – after the ending of professional school it is called up for military service, serves in inspection on invention of the Caspian flotilla.
1943 – creates the first invention (with co-authors).
1945 – after the ending of the Second world war continues service in a military flotilla, occurrence of the first ideas about creation TRIZ.
1950 – becomes the younger officer of a military flotilla, it is arrested and condemned on false accusation.
1954 – the prisoner is released as unduly. Comes back in Baku.
1956 – the first publication by TRIZ in magazine, the first publications on a fantasy.
1957 – the first educational and practical seminars on TRIZ, G.S.Altshuller's marriage with V.N.Zhuravlyova.
1961 – the first book about TRIZ.
1971 – creation of the Azerbaijan institute of inventions creativity (Baku).
1979 – creation of Public laboratory of the theory of invention, the beginning of regular seminars and publications by TRIZ.
1990 – the moving to Petrozavodsk (Russia) in connection with war in Azerbaijan.
24.09.1998 – Petrozavodsk (Russia), last day his lifes.





TRIZ is exact science.
G.S.Altshuller.

ARIZ is the tool for thinking,
but not instead of thinking.
G.S.Altshuller.



ARIZ - education text (short)

ATTENTION!

ARIZ is a complicated tool. Do not apply it to solve new practical problems without at least for 80 academic hours of preliminary study.

ARIZ is a tool for thinking, but not instead of thinking. Do not hurry! Consider each step carefully. Besides, note obligatory all considerations (at margins), appearing in process of the problem's solving.

ARIZ is a tool for solving non-typical problems. Let's check: may your problem be solved using the System of Standard Solutions for Inventive Problems (Inventive Standards)?

PART 1. ANALYZING THE PROBLEM

The main purpose of Part 1 is the transition from an indefinite initial problem situation to the clearly formulated and extremely simplified description (model) – Problem Model.

1.1. formulate the mini-problem

Formulate the "mini-problem" conditions (without special terms) accordingly to the following pattern:

A technical system for <state the purpose of the system> includes <list the main parts of the system>.

Technical contradiction 1 (TC-1): (identify).

Technical contradiction 2 (TC-2): (identify).

It is necessary with minimum changes to the system, to <state the required result>.

Example:

The technical system <for receiving of radio waves> includes <radio telescope's antenna, radio waves, lightning, and lightning rods>.

TC-1: if there are many lightning rods, then they reliably protect the antenna from lightning, but absorb radio waves.

TC-2: if there are few lightning rods, then there is no remarkable absorption of radio waves, but the antenna is not protected from lightning.

It is necessary with minimum changes to the system, to <protect the antenna from lightning without radio waves' absorption>.

(For this definition it should be replaced the special term "lightning rod" to "conducting rod", "conducting column" or simply "conductor").

Comments:

1. The mini-problem is obtained from the initial problem situation by introducing the restrictions: "Everything in the system remains unchanged or becomes simpler, while the required action (or property) appears or a harmful action (or property) disappears. The transition from the problem situation to the mini-problem does not mean intention to solve small problem. Quite the contrary, introduction of additional requirements (result has to be achieved "without nothing") directs to intensify conflict, and cuts the paths to compromise solutions.

2. While formulating step 1.1, it should be indicated not only the technical parts of the system but also the natural ones that interact with the system. In the problem of protection the telescope antenna the natural parts are lightning and received radio waves (if they are emitted by natural cosmic objects).

3. The Technical contradictions (TC) denote the interaction in the technical system when the useful actions create the harmful ones. In other words, introduction (or improvement) a useful action or elimination (or reducing) a harmful action cause degradation (in particular, complication) either all or part of the system as result.

Technical contradictions are formulated by identifying (write down) one state of a system element with explanation of both the good and bad results of this state. Then the opposite state of the system element is identified, along with its associated explanation.

Sometimes for problem situation is given only the product. There is no a technical system (a tool) and therefore there is no clear technical contradiction (TC). In this case the TC can be identified by considering two states of the product, even if one of the states is impossible to achieve.

For example a problem is given: "How to watch the micro-particles in a sample of an optically clean liquid with the naked eye; the particles are so small, that the light flows around them?"

TC-1: if the particles are small, then the liquid is optically clean, but it is impossible to watch the particles by the naked eye.

TC-2: if the particles are big, then they are well watched, but the liquid is not optically clean, this is unacceptable consequence.

It seems that the problem definition excludes considering TC-2: it is prohibited to change product! In fact we will consider only TC-1 for this problem, but TC-2 will give us an additional requirements for product: small particles have to be small and have to be also become large.

4. To reduce mental inertia, special terms associated with the tool and environment should be replaced with easy words, because special terms:

* impose old concepts about working principles of the tool: for example, "the icebreaker breaks ice", when it possible to move through ice without breaking its;

* can hide certain properties of the elements described in the problem situation: "mould" (to form concrete) this is not plain "wall", but "iron wall";

* narrow the range of possible states of a substance: the term "paint" impose to imaging liquid or solid paint, although paint may be gaseous.

1.2. define the conflicting elements

Identify and write down the conflicting pair: a product and a tool.

Rule 1.

If the tool according problem situation conditions can be in two states, it is necessary to indicate the both of these states.

Rule 2.

If the problem situation include several similar pairs of interacting elements, it is enough to consider only one pair.

Example:

Product: lightning and radio waves.

Tool: conducting rods (many rods or a few rods).

Comments:

5. The product is the element that needs to be processed (manufactured, moved, changed, improved, protected from a harmful influence, revealed measured etc.) according the problem conditions. For problems about detection and measurement some element considered as tool (according its base function), can be considered as product (e.g., grinding wheel).

6. The tool is the element that directly interacts with the product (e.g., mill rather than a milling machine; fire rather than a burner). In particular, a part of the environment can be considered as a tool. The standard parts from which the product is assembled can be considered as a tool too (e.g., meccano this is tool to create of various "product").

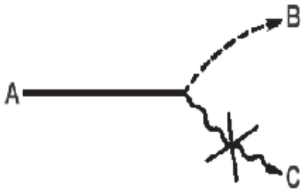
7. One of the elements in the conflicting pair can be doubled. For instance, two different tools are given, and they have to act on the product simultaneously, where one tool interferes with the other. Or two products are given, and they have to be processed with the same tool, where one product interferes with another.

1.3. describe graphic models for technical contradictions

Build graphic models for conflicts for TC-1 and TC-2 using Table 1. Typical Graphic Models of Technical Contradictions.

Example:
TC-1: Many conducting rods

TC-2: A few conducting rods

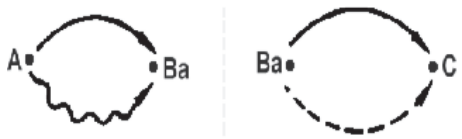


Comments:

8. The Table 1 contains graphic models of typical conflicts. It is acceptable to use original (atypical) graphic models if they describe the meaning of conflict clearly.

9. Some problems can be described by multi-linked graphic models, for example:

Such models can be converted as two one-linked graphic models:



If B is considered as a modified product or the basic property (or state) of A is transferred on B.

10. The conflict can be considered in time as well as in space.

11. Steps 1.2 and 1.3 specify the general problem situation description. Therefore it is necessary to return to the step 1.1 after step 1.3 and to check if there is any discordance in the sequence 1.1 - 1.2 - 1.3. If a discordance exists, it is necessary to remove its and set up the sequence.

1.4. select a graphic model for further analysis

From the two graphic models of conflict it is necessary to choose the one, which provides the best performance for the Main Manufacturing Process (i.e., the main function of technical system as indicated in the problem description). Indicate what the Main Manufacturing Process (MMP) is.

Example:
In the problem of protection the radio telescope antenna the Main Manufacturing Process is receiving of radio waves. Therefore it should choose the TC-2: in this case the conducting rods do not absorb the radio waves.

Comments:

12. When choosing one of the two graphic conflict model, it is chosen one state of the tool from its two opposite states. Further problem solving efforts should be related to this state. It is prohibited to replace few conductors by some optimal number of conductors.
ARIZ requires intensifying the conflict rather than smoothing it over.

Holding one state of the tool, it is necessary in future to achieve the required positive property for the tool in this state (needed property inherent in another state of the tool).
There are few conductors and we will not increase their number,

but as a result of solving problem the lightning has to be eliminated in the same manner as if there were many conductors.

13. From time to time, it is difficult to define MMP for measurement problems. Ultimately, measurements are almost always performed for modification purpose, i.e. to process a product, to produce something, etc. Therefore the MMP for measurement problems is the MMP of the whole system, not just its measuring part.

For instance, it is necessary to measure gas pressure inside electric bulbs. MMP - to produce electric bulbs rather than to measure gas pressure.

However, some problems of measurement for scientific purposes can be considered as exception.

1.5. intensify the conflict

Intensify the conflict by indicating the extreme state (action) of the elements.

Rule 3.

Most problems contain the following types of conflicts: "many elements" versus "few elements" ("strong element" versus "weak element" etc.). The conflict about "few elements", should be converted into form "no elements" ("absent element") only.

Example:

Let's consider that instead of "few conductors" there is "absent conductor" in TC-2.

1.6. describe the problem model

Formulate the Problem Model to indicates the following:

1) the conflicting pair;

2) the intensified definition of conflict;

3) what has to do the X-element introduced to solve problem (what the X-element should keep, eliminate, improve, provide, etc.).

Example:

It is given an absent conductor and a lightning. The absent conduc-

tor does not produce interference (when antenna receives the radio waves) and does not provide protection from lightning.

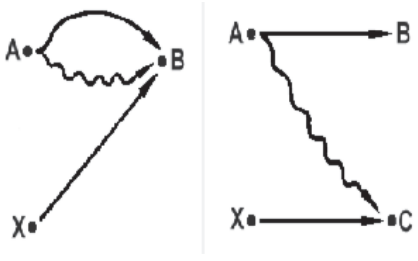
It is required to find an X-element that will keep ability of the absent conductor does not produce interference (for antenna) and will provide protection from lightning.

Comments:

14. The Problem Model is a type of abstraction with artificially selected only some of the elements of the technical system. Other elements are implied only.

For instance, in the Problem Model of antenna protection it was selected only two of the four elements (the antenna, radio waves, the conductor and a lightning). The another two elements are just implied - they could be ignored at all.

15. After step 1.6 it is required to return on step 1.1 and check the creation logic of the Problem Model. Generally, it is possible to define more exactly the chosen graphic model of conflict by indicating the action of the X-element, for instance:



16. The X-element is not necessarily the new material part of the system. The X-element this is some modification in system, something basically unknown - X. For instance, it may be temperature changes or phase state changes for some part of system or the environment.

1.7. apply the inventive standards

Check possibility to apply the System of Standard Solutions for Inventive Problems for solving the Problem Model. If the problem has not

been solved, go to Part 2 of ARIZ (i.e., steps 2.1 - 2.3). If the problem has been solved, go to Part 7 of ARIZ. Although in this case, it is recommended to continue the analysis through Part 2 too.

Comment:

17. The analysis performed in Part 1 of ARIZ and developing of the Problem Model makes problem clear and in many cases allows identifying standard (typical) properties for non-typical problems. It gives a possibility to use the Inventive Standards more effectively than for initial problem situation description.

PART 2. ANALYZING THE PROBLEM MODEL

The main purpose of Part 2 is to identify available resources (space, time, substances, and fields) that may be useful for problem solving.

2.1. define the operational zone (oz)
Analyze and describe the Operational Zone (OZ).

Comment:

18. In the simplest case the Operational Zone this is the space where the conflict indicated in Problem Model appears.

Example:
In the problem about protection of antenna the OZ is the space previously occupied by the lightning conductor, i.e., mentally defined as the "empty" rod, or "empty" column.

2.2. define the operational time (ot)
Analyze and describe the Operational Time (OT).

Comment:

19. The operational time there are available resources of time: the time when conflict occurs - T1 and the time before the conflict - T2.

A conflict (especially high-velocity, short-term) can usually be eliminated (prevented) during T2.

Example:

In the problem about protection of antenna the Operational Time consists of the time T1' (during lightning discharge) and the time T1" (before next lightning discharge). The T2 is not considered here..

2.3. define the substance-field resources (sfr)

Define the Substances and Fields Resources (SFR) of the analyzing system, the environment, and the product. Compose a list of SFR.

Comments:

20. Substance and Field Resources (SFR) there are substances and fields that already exist or may be easily obtained according to the problem conditions. There are three types of SFR:

1. System (internal) resources:
a) SFR of the tool;
b) SFR of the product.

2. Available (external) resources:
a) SFR of the environment that are particular for the problem conditions, for instance, in the problem about small particles in an optically clean liquid, water is SFR;
b) SFR common for any environment, including "background" fields, for instance gravity and magnetic field of the Earth.

3. SFR of super-system:
a) waste materials of some outside system (if available according problem conditions);
b) very cheap outside resource, which cost may be ignored.

During solving a Mini-Problem it is necessary to achieve needed result with minimum expenditure of SFR. Therefore, the utilization of internal (system) SFR should first be considered. However, when it is nec-

essary to develop solution concepts and/or solve problem about forecasting (i.e., Maxi-Problems), the maximum of various SFR should be considered.

21. It is known that the product is the unchangeable element - so what kinds of resources can be it has? Indeed the product can not be changed, i.e. it is unsuitable to change product while solving the Mini-Problem. However, sometimes the product can:

a) change itself;

b) allow consumption (i.e. modification) of part, when the product amount is unlimited (for instance, wind etc.);

c) allow transition to the super-system (for instance, brick has not changed, but house has changed);

d) allow application of micro-level structures;

e) allow being combined with "nothing", i.e. with void;

f) allow temporary modification.

Therefore, the product can be considered as SFR only in rare cases if product can be easily modified "without modification".

22. The SFR are available resources and thus they should be utilized first. If there are not enough available resources other substances and fields can be considered. The analysis of SFR in step 2.3 is preliminary.

Example:

In the problem about protection of antenna the "absent lightning conductor" is considered. Therefore the SFR contain only substances and fields of environment. In this case SFR this is the air.

PART 3. DEFINING IDEAL FINAL RESULT (IFR) AND PHYSICAL CONTRADICTION (PhC)

As result of applying Part 3 should be formulated the image of Ideal Final Result (IFR). The Physical Contradiction (PhC) that prevents from achievement of IFR should be identified too. The ideal solution is not always achievable, but the IFR indicates the direction to the most powerful solution.

3.1. formulate ifr-1

Formulate and describe the IFR-1 using the following pattern:

The X-element, without complication of a system and without harmful side effects, eliminates
<to indicate the harmful action>
during the <Operational Time>
inside the <Operational Zone>,
and keeping the tool's ability to provide
<to indicate the useful action>.

Example:
The X-element without complication of a system and without harmful side effects, eliminates
<"non-attraction" of lightning by the absent conducting rod>
during the <Operational Time>
inside the <Operational Zone>,
and keeping the tool's ability to provide
<not hinder the antenna's reception>.

Comment:

23. There are other conflicts besides the conflict "a harmful action is associated with a useful one", for instance "introducing a new useful action results in complicating the system" or "one useful action is incompatible with another one". Therefore the formulation of IFR, identified in step 3.1 this is just a pattern to write down the IFR.

Basic meaning for any definition of the IFR is the following: a useful feature's obtaining (or a harmful feature's eliminating) should be achieved without other features' deterioration (or a harmful feature's appearing).

3.2. intensify definition of ifr-1

Intensify the formulation of IFR-1 by introducing additional requirement:

the introduction of new substances and fields into system is prohibited, it is necessary to use the SFR only.

Example:

There is no tool in the Problem Model about the antenna protection ("absent lightning conductor"). According to Comment 24 it should be introduced the environment into definition of IFR-1, i.e. it is necessary to replace an X-element by the word "air" (or, more exactly: "the air column where the absent lightning conductor was").

Comment:

24. According to Comments 20 and 21, SFR should be considered in the following order during problem solving process:

* SFR of the tool (system/internal resources);
* SFR of the environment (available/external) resources);
* SFR of super-system;
* SFR of product (if it is not prohibited by Comment 21).

The above types of resources (SFR) determine four directions of further analysis.

In practice, the problem conditions cut off some directions. When solving the Mini-Problem, it is enough to develop analysis up to the point where a solution concept is obtained; for instance, if a concept was obtained on the "tool line" (first line, above), then the other directions need not be considered. When solving the Maxi-Problem, it is necessary to consider all available directions. Thus, if you have found a concept on the "tool line", it should be considered the directions for environment SFR, for super-system SFR, and for product SFR.

When mastering ARIZ, a sequential, linear analysis is gradually being replaced by parallel analysis: ability to transfer the solution concept from one "line" to another. This kind of ability called a "multi-screen thinking": possibility to analyze changes for super-system, system, and subsystems simultaneously.

ATTENTION!

The problem solving is accompanied by breaking down of old conceptions. New concepts appear, which often can not be adequately described in words. For instance, how to describe a property of paint to dissolve, without dissolving (to paint, without painting)?..

Applying ARIZ, it is necessary to describe analysis using simple, non-technical, even "childish" words, avoiding special terms (they increase the mental inertia).

3.3. identify the physical contradiction for the macro-level

Identify and describe the Physical Contradiction at macro-level using the following pattern:

the <Operational zone>,
during the <Operational time>,
has to… <indicate physical macro-state, for example "hot">
in order to perform <indicate one of the conflicting actions> and
has to… <indicate the opposite physical macro-state, for example "cold">
to perform <to indicate another conflicting action or requirement>.

Comments:

25. The Physical contradiction this is opposite requirements to physical state of Operational Zone.

26. If it is difficult to describe a complete definition for the Physical Contradiction, it is allowed to compose the brief PhC according to the following pattern:

The element (or a part of it in the operational zone)
Has to be <feature> to perform <indicate> and
Does not have to be <feature> to perform <indicate>.

Example:

the <air column>, during the Operational Time
has to be <conducting> to <remove the lightning> and
does not have to be <conducting> to <prevent absorption of the radio waves>.

This definition suggests the answer: the air column has to be electrically conductive when a lightning discharge and does not have to be conductive when all the rest of the time. Lightning discharge occurs relatively seldom and it acts quickly. The Law of coordination the rhythm of systems parts: periodicity of the lightning conductor appearance has to be same as the periodicity of lightning strike.

Obviously, this is not a complete solution concept. For instance: How can the air column be transformed into conductor when lightning discharges? How can the conductor be made to disappear immediately after the lightening has discharged?

ATTENTION!

When solving problem using ARIZ, the solution concept develops slowly (gradually).

It is risky to interrupt the problem solving process when an idea first appears or you may later find yourself fixing a half-developed idea. Carry the solving process through to the end of ARIZ!

3.4. identify the physical contradiction for the micro-level

Identify and describe the Physical Contradiction at micro-level using the following pattern:

there should be particles of a substance <indicate their physical state or action> in the Operational Zone

in order to provide <indicate the macro-state according to step 3.3>

and there should not be the particles (or particles should have the opposite state or action)

in order to provide <indicate another macro-state according to step 3.3>

Example:

There should be <free charges> in the Air Column (when a lightning strikes)

to provide <electrical conductivity to "remove" the lightning>

and there should not be <free charges> (when the rest time)

to provide <prevent absorption of the radio waves>.

Comments:

27. It is not necessary in step 3.4 to precisely define the term "particles". For instance, the domains, molecules, ions etc. can all be considered as particles.

28. The particles may be:
a) particles of a substances;
b) combination of particles and field, or
c) "particles of a field" (seldom).

29. If the problem has solution only on the Macro-Level, there may be difficulties to formulate step 3.4 because definition PhC on micro-level provides additional information: the problem is solved for on macro-level. In other words, attempting to formulate the Physical Contradiction for the micro-level can prove beneficial, if only because it provides us with the additional information that the problem has to be solved at the macro-level.

ATTENTION!
The first three parts of ARIZ essentially change the initial problem. The step 3.5 summarized this change. By formulating the Ideal Final Result IFR-2, we obtain an entirely new problem, a physical one. From this point we have to focus on this new problem!

3.5. formulate ifr-2

Identify and describe the Ideal Final Result (IFR-2) using the following pattern:

The Operational Zone <indicate>
has to provide <indicate the opposite macro- or micro-states>
itself during the Operational Time <to indicate it>.

Example:
The <neutral molecules in the air column> has to <transform themselves into free charges> during <the lightning strikes>, and <the free

charges> has to <transform itself into the neutral molecules> <after the lightning strikes>.

The meaning of this new problem is as follows: for the duration of the lightning discharge the free charges should appear on their own inside the air column; in this case the column of ionized air acts as the lightning-conductor and "attracts" the lightning. Immediately after discharge the free charges in the air column should, on their own, become neutral molecules again. To solve this problem a knowledge of middle-school physics is need.

3.6. apply the inventive standards to resolve physical contradiction

Check possibility to apply the Inventive Standards to solve the new Physical Problem that formulated as the IFR-2. If after doing this, the problem is still unsolved, go to Part 4. If problem is solved using Inventive Standards it is possible to go at Part 7, however it is recommended to continue analysis through Part 4 anyway.

PART 4. MOBILIZING AND UTILIZING OF SUBSTANCE-FIELD RESOURCES (SFR)

At the step 2.3, the available resources, which can be used "free of charge", were identified. Part 4 of ARIZ includes systematic procedures to increase availability of resources. It is considered the derivative SFR that can be obtained almost free of charge through slight modification of the already available resources. Steps 3.3-3.5 began the transition from the problem to the solution based on applying of physics; Part 4 continues this direction.

Rule 4.

Particles of any kind that are in one state have to perform one function only. In other words, rather than using "A" particles to perform functions 1 and 2, they have to perform function 1, and "B" particles have to be introduced for the purpose of performing function 2.

Rule 5.

Introduced "B" particles may be divided into two groups: B-1 and

B-2. This provide possibility to perform a new function 3 as "free of charge" by arranging an interaction between two "B" groups.

Rule 6.

If the system has to include only "A" particles, these can be divided into two groups as well: one group of particles remains in the previous state; the main parameter of the other particles are changed according to the problem.

Rule 7.

Groups of particles that are divided or introduced have to become identical to each other or to previously existing particles after they realize their functions.

Comment:

30. Rules 4 through 7 apply to all Part 4 of ARIZ.

4.1. simulation with little creatures

Method of Simulation with Little Creatures

a) describe graphic model of conflict using the Simulation with Little Creatures (SLC);

b) modify this graphic model so that "Little Creatures" act without conflict.

Comments:

31. Simulation with Little Creatures includes of imaging the conflicting requirements as drawing that describe how the Little Creatures operate (in group, several groups, a crowd, etc.). Model can includes one or sequence of figures. The Little Creatures have to represent changeable elements of the Problem Model (the tool and/or the X-element).

"The conflicting requirements" describe the conflict in the Problem Model or the opposite physical states indicated in step 3.5. The latter is perhaps the best, but there are no exactly rules for transition from the

physical problem (step 3.5) to the Little Creatures model. To describe Problem Model conflict is usually easier.

Sometimes it is preferable to modify the graphic model (step 4.1b) of the conflict by combining two figures in one drawing: the "bad action" and the "good action". If the events evolve in time, making several consequent drawing is appropriate.

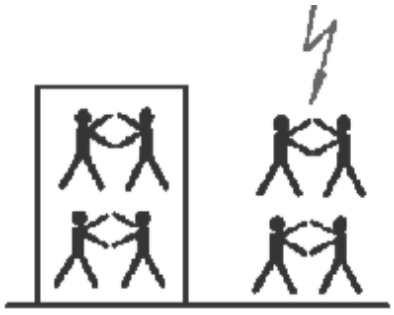
ATTENTION!

The most common mistake in this step is to draw careless. Good figures meet the following properties: a) they are expressive and understandable without words; b) they provide additional information about Physical Contradiction and indicate general ways that it can be resolved.

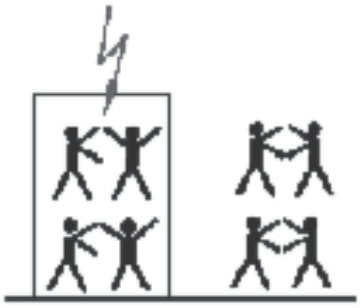
32. Step 4.1 is an auxiliary step. Its function is to visualize before SFR mobilizing the needed actions of the particles in the Operational Zone and around the OZ. Simulation with Little Creatures perform to clarify the ideal action ("what should be done") without the physics ("how it should be done"). It also decreases mental inertia and improves the imagination. Thus, the SLC this is a psychological method. However, simulation with the help of "Little Creatures " is realized according to the Laws of Evolution of Technical Systems. Therefore the SLC often leads to solution concept. It is not recommended to stop solving process here, the mobilization of the SFR has to be performed.

Example:

A. The Little Creatures inside the mentally selected air column are the same as the air Little Creatures outside the column. Both groups are neutral (by convention, the Little Creatures hold each other hand-in-hand; their hands are busy, and thus they can not "catch" the lightning).



B. According to the rule 6, it is necessary to divide the Little Creatures into two groups: the Little Creatures outside the column remain unchanged (neutral); Creatures inside the column remain in pairs (i.e. remaining neutral), but each Little Creature release one hand, suggesting its desire to catch the lightning.



(Other graphic models are possible as well. In any case however, it is clearly necessary to divide the Little Creatures into two groups and change the state of group inside the column air).

C. The neutral state of the molecules inside the column should be favorable to ionization, to decomposition. The simplest way to achieve this is to reduce the air pressure inside the column.

ATTENTION!

The purpose of resources mobilization for Mini-Problem solving process is not to apply all resources. The purpose is contrary it is necessary to achieve solution concept with a minimum expenditure of resources.

4.2. to take a "step back" from ifr

If it is known what the desired system has to be (from description of problem conditions) and the problem is to find way to achieve this system, it might be helpful to "step back" from the Ideal Final Result. The desired system is described, after which some minimum disassembling change is applied.

For instance, if according to IFR two elements have to contact each other, the "step back from IFR" would propose a gap between them. A new micro-problem then appears: How to eliminate this defect?

This problem is usually easy to solve, and the problem solution concept provides hint for solving the main problem.

4.3. using combination of substance resources

Consider possibility to use a mixture of the substance resources.

Comments:

33. If it was possible to solve problem using available substance resources, the problem would never have appeared or would have been solved "automatically". Usually it is necessary to introduce the new substances, but introducing new substances results in a more complicated system, the rising of harmful side effects etc. The subject of SFR analysis in Part 4 is to resolve this contradiction - to introduce substance without introducing them.

34. The step 4.3 recommends (in the simplest case) a transition from two mono-substances to a heterogeneous (not uniform) bi-substance.

The question then arises: is it possible to transit from mono-substance to heterogeneous bi-substance or poly-substance? System transition analogous to homogeneous bi- and poly-systems are widely used and described in Inventive Standards 3.1.1. However this Standard consider with combination of systems rather than substances, which are called for step 4.3. The result of integration of two systems is a new system. The result of integration of two substances - two "pieces" of system - is one piece and an increased volume of substance.

One of the techniques for creating a new system by integrating similar systems is to keep the borders of the integrated systems in the new system. For instance, the single page of paper this is mono-system, the notebook this is poly-system, but a thick page of paper is not poly-system.

Therefore, keeping of boundaries requires the introduction of a second substance - a "border" substance - even if this substance is empty space

Thus step 4.4 represents the creation of a heterogeneous quasi-poly-system, with empty space as a second border substance. However, the empty space (void) is unusual substance. When a substance and empty space are mixed, the borders are not always clearly recognized - but a new feature appears that is required result.

4.4. using "void"

Consider possibility to solve problem by replacing the existing substance resources with an empty space or a mixture of substance resources and empty space.

Example:

Mixture of air and empty space this is rarefied air. It is well known from physics that reducing of pressure of gas results in a reducing of the voltage required for discharge. Thus, the solution concept for problem about antenna is obtained completely.

It is proposed to make radio-transparent lighting conductor from dielectric hermetically-sealed tube, with the air pressure inside the tube chosen so as to provide the minimum gas-discharge gradient created by the lightning's electrical field [A.c.177497].

During a storm, the rarefied gas inside dielectric rod becomes ionized. The ionized air inside tube will conduct the lightning currents to the ground. After storm the ions recombine, gas becomes to neutral state. From this case the lightning conductor does not distort the radio waves.

Comment:

35. The empty space is an extremely important type of substance resources. It is always available in unlimited quantities, is very cheap, and easily mixed with the available substances to create hollow or porous structures, foam, bubbles, etc.

Empty space is not necessarily a vacuum. If the substance is solid the empty space inside it may be filled with liquid or gas. If the substance is liquid the empty space inside it may be a gas bubble. For substance structures of a particular level, lower-level structures may serve as empty space (see Comment 37). For instance, separated molecules can be considered as empty space for crystal lattice; atoms can be considered as empty space for molecules, etc.

4.5. using derived resources

Consider possibility to solve problem using derived substance resources or by mixture of derived substances with empty space.

Comment:

36. Derived resources of substance can be obtained by changing of phase state for existing substance resources. For instance, if there is liquid as substance resource, the derived resources can be considered ice and vapor. On the other hand, the products of decomposition the substance resources can be considered as derived resources as well. For instance, hydrogen and oxygen are derived resources for water. The components are derived resources for multi-component substances. Substances obtained as a result of the decomposition or combustion of substance resources are derived resources too.

Rule 8.

If it is required to obtain substance particles (e.g., ions) but it is impossible to obtain them directly according to the problem conditions, they should be obtained by decomposition a substance of a higher structural level (e.g., molecules).

Rule 9.

If it is required to obtain substance particles (e.g., molecules) but it is impossible to obtain them directly or by using Rule 8, they should be obtained by building up or integrating the particles of a lower structural level (e.g., ions).

Rule 10.

The easiest way to apply Rule 8 is by decomposition the nearest higher "complete" or "excessive" structural level (e.g., negative ions); the easiest way to apply Rule 9 is by completing the nearest lower "incomplete" structural level.

Comment:

37. The substance can be regarded as multi-layer hierarchical system. With sufficient for practical application accuracy, it is possible to consider the following hierarchy:

* minimally-processed substance (a simple material, for instance, wire);
* "super-molecules", such as crystal lattices, polymers, associations of molecules, etc.;
* complex molecules;
* molecules;
* parts of molecules, groups of atoms;
* atoms;
* parts of atoms;
* fundamental particles;
* fields.

The kernel of rule 8: the new substance can be obtained through bypass (indirect) way by decomposition of large structures of either substance resources or substances that can be introduced into the system.

The kernel of rule 9: it is available also another way by completing smaller structures.

The kernel of rule 10: it is recommend to decompose "complete" particles (such as molecules or atoms), because incomplete particles (e.g., positive ions) are already partially decomposed and thus resist further destruction; conversely, the building up of "incomplete" particles is recommended, because these tend to be more easily restored.

The Rules 8-10 indicate effective direction to obtain derived substance resource from "depths" of existing or easily-implemented substances. These Rules point to the required physical effects for particular conditions.

4.6. using an electrical field

Consider possibility to solve problem using introduction of an electrical field or two interacting electrical fields instead of substance.

Example:

A well-known method of testing the strength of a pipe is to twist it until it breaks. [A.c.182627]. this method requires that the pipe be mechanically clamped, but clamping deforms the pipe.

It is proposed to produce twisting torque by electrodynamic forces inside the pipe. [A.c.342759]

Comment:

38. If conditions of problem situation have restrictions to use available and derived substance resources, the electrons (electrical current) can be applied. Electrons this is "substance" that exists inside any object. Moreover, electrons are associated with a field that is well controllable.

4.7. using a field and field-sensitive substance

Consider possibility to solve problem using pair: "field + substance additive that responsive to this field".

For instance: "magnetic field + ferromagnetic substance", "ultraviolet radiation + phosphor", "heat + shape-memory metal", etc.

Comment:

39. In step 2.3. was explored available SFRs. The steps 4.3-4.5 was considered about derived (for available SFRs) resources. Step 4.6 is a partial deflection from available and derived SFRs: it is introduced "foreign" fields. Step 4.7 is next partial deviation: it is introduced "foreign" substances and fields.

The fewer the resources (SFRs) consumed, the more ideal the solution concept is likely to be. However, it is not always the case that a problem can be solved with small expenditure of resources. Sometimes it is necessary to step back and consider introduction of "foreign" substances

and fields. This should be done only when absolutely necessary, if it is impossible to apply available SFRs.

PART 5. APPLYING THE KNOWLEDGE BASE

In many cases, Part 4 of ARIZ helps to achieve a solution concept, so it is possible to go to Part 7 of ARIZ. If no solution is achieved after step 4.7, Part 5 is recommended.

The purpose of Part 5 of ARIZ is to mobilize all experience accumulated in the TRIZ knowledge base. The problem is significantly clearer at this point so it is very likely that direct utilization of the knowledge base will be successful.

5.1. applying the system of standard solutions for inventive problems

Consider possibility to solve problem (formulated as IFR-2, keeping in mind the SFRs considered in Part 4) by applying Inventive Standards.

Comment:

40. Actually, return to the Inventive Standards takes place in steps 4.6 and 4.7. Before these steps the main idea was to utilize available SFRs, without introduction of new substances and fields wherever possible. If it is impossible to solve problem utilizing available and derived SFRs only, it is necessary to introduce new substances and fields. Most of the Inventive Standards introduce techniques for introducing the additives.

5.2. applying the problems-analogous

Consider possibility to solve problem (formulated as IFR-2, keeping in mind the SFRs considered in Part 4) by applying solution concepts to non-standard problems, that have already been solved using ARIZ.

Comment:

41. Although there is an infinite number of inventive problems, there are comparatively few Physical Contradictions associated with them.

Therefore drawing an analogy from a problem that contains an analogous contradiction can solve many problems. The problems might appear to be different, and therefore the appropriate analogy can be discovered only as the result of analysis on the level of the Physical Contradiction.

5.3. applying Principles for Physical Contradictions Elimination

Consider possibility to resolve Physical contradiction using the typical transformations (see Table 2. Principles for Physical Contradictions)

Rule 11.

Only solution concepts that completely match the IFR or come close to it are acceptable.

5.4. applying the pointer to physical effects and phenomena

Consider possibility to resolve Physical contradiction using the Pointer to Physical effects and phenomena.

Comment:

42. Parts of the Pointer to Physical effects and phenomena was published in journal "Technika i nauka" (1981-1983), books:

* DARING FORMULAS OF CREATIVITY, Karelia, Petrozavodsk/ Selutsky A. B., ed.: 1987;

* A THREAD IN THE LABYRINTH, Karelia, Petrozavodsk/ Selutsky A. B., ed.: 1988.;

* RULES OF A GAME WITHOUT RULES, Karelia, Petrozavodsk/ Selutsky A. B., ed.: 1989.

PART 6. CHANGING OR SUBSTITUTING THE PROBLEM

Simple (typical) problems can be solved through directly elimination of Physical Contradiction, for instance, by separation of conflicting properties in space or in time. Complex (non-typical) problems solving is usually associated with changing the problem statement, that is, with removing the initial restrictions created by mental inertia – those that seem obvious from the beginning.

For instance, to resolve problem about increasing the speed of "ice-breaker" it is necessary to transit to "iceNObreaker".

Infinity "paint" can be obtained by transition to "NOpaint" - electrolysis, gas bubbles were created. The bubbles themselves provide an adequate marker. Mental inertia had dictated that "painting" the model's trial improve the use of actual paint rather than another type of marker.

To correctly understand a problem it has to be solved; inventive problems can not be precisely formulated at the outset. The process of problem solving is the process of correcting (reformulation) the problem statement.

6.1. transition to the technical solution

If the problem is solved, transfer the physical solution concept into a technical one: formulate the principle of action and develop a schematic diagram of device that implements this principle.

6.2. checking the problem formulation for combination of several problems

If the problem is not solved, check to see whether the description in Step 1.1 represents a combination of several problems. In this case, it is necessary to reformulate the step 1.1, by extracting separated problems. Those problems have to be solved one after another (often it is enough to solve just a main problem).

Example:

It is necessary to solder sections of very thin gold chains. One meter of a chain of this type weighs only a gram. A method is needed by which hundreds of meters of a chain can be soldered per day.

This problem can be decomposed into the following sub-problems:

a) How to introduce the micro-doses of solder into the gaps of the links?

b) How to heat the introduced micro-doses of solder without harming the chain?

c) How to remove excessive solder, if any?

The main problem is to introduce the micro-doses of solder into the gaps.

6.3. changing the problem

If the problem is not solved, change the problem by selecting another Technical Contradiction in step 1.4.

Example:

If a problem of measurement and/or detection is solved, to choose another TC often means that it is necessary to discard improvement of the measurement part and try to change the entire system so that the need for measurement disappears (Standard 4.1.1)

For instance, it is necessary to transport different types of oils through same pipeline. If it is used liquid separator, or directly transportation (without separator), the problem is "How to increase precision of measurement for 'joint' section of oil?"

This "measurement" problem was changed into "modification" problem: "How to eliminate mixing of oils and liquid separator?"

Solution: the liquid separator can mix with oils free, but liquid separator has to be transformed into gas and to be eliminated from container itself, when it needs.

Required properties of liquid separator:

* it is not dissolved with oils;
* it is neutral to hydrocarbon substances;
* it has density equal to density of transported oils;
* it is not frozen up to –50oC;
* it is cheap and safe.

The ammonia was found through the reference book.

[see: G.S.Altshuller: 1973, ALGORITHM OF INVENTION, Moscowskiy Rabochy, Moscow, p.207-209; 270-271]

6.4. reformulation of mini-problem

If the problem is not solved, return to step 1.1 and reformulate the Mini-Problem with respect to the super-system. If necessary, repeat this reformulation process with the next several successive super-systems.

Example:

Typical example for these step this is solution concept about gas-

heat-reflecting suit (rescue suit). [see: G.S.Altshuller: 1973, ALGORITHM OF INVENTION, Moscowskiy Rabochy, Moscow, p.105-110].

Originally, this problem was formulated about development of refrigerating suit. However, to provide required power of refrigeration for fixed weight of suit was impossible, according physical principles.

This problem was resolved using transition to the super-system. It was proposed to make gas-heat-reflecting suit by providing simultaneously functions of cooling system and respiratory system. The rescue suit works using liquefied oxygen. The liquefied oxygen is evaporated at first and works as cooler. After transformation to the gas the oxygen is used in respiratory system. [A.c.111144]

Transition to the super-system provides possibility to enlarge limits of weight at 2-3 times.

PART 7. ANALYZING THE METHOD OF RESOLVING THE PHYSICAL CONTRADICTION

The main purpose of Part 7 of ARIZ is to check quality of obtained solution concept. The Physical Contradiction should be resolved almost ideally, "without nothing". It is better to spend an additional two or three hours to obtain a new, more powerful solution concept than to fight half of lifetime with weak, difficult to implement idea.

7.1. checking the solution concept

Check the solution concept. Consider each introduced substance and field. Is it possible to apply available or derived SFRs instead of introducing the substances/fields? Can self-controlled substances be applied? Correct obtained technical solution accordingly.

Comment:

43. Self-controlling substances are substances that modify their state in a specific way in response to changes in environmental conditions (e.g., loose their magnetic properties when heated above the Curie point). Applying the self-controlling substances allows the system to be changed or its state modified without any additional devices.

7.2. preliminary estimation of the solution concept

Check the solution concept preliminary.

Control questions:

a) Does the solution concept provide the main requirement of IFR-1 (the element without complication of a system…)?

b) Which Physical Contradiction (if any) is resolved by the solution concept?

c) Does the new system contain at least one easily controlled element? Which element? How is it controlled?

d) Does the solution concept found for "single-cycle" Problem Model fit the real conditions, multi-cycle conditions?

If the solution concept does not comply with all of the above, return to step 1.1.

7.3. checking the priority of the solution concept through patent funds

Check the novelty of the solution concept via patent search.

7.4. estimation of sub-problems to implement obtained solution concept

What sub-problems might appear during embodiment design of the new technical system?

Write down those possible sub-problems that might require inven-

tion, design, calculation, the overcoming of organizational challenges, etc.

PART 8. APPLYING THE OBTAINED SOLUTION

The real innovative idea not only solve the particular problem, but also provides a universal "key" to many other analogous problems. The purpose of Part 8 of ARIZ is to maximize utilization of resources unveiled by obtained solution concept.

8.1. estimate of changes for super-system

Define how the super-system that includes the changed system should be changed.

8.2. find new application for obtained solution

Check whether the changed system or super-system can be applied in a new fashion.

8.3. apply solution concept for other problems

Apply the solution concept to solving other problems:

a) Formulate a general Solution Principle.

b) Consider direct application of the Solution Principle to other problem solving.

c) Consider applying the opposite Principle to other problems.

d) Create a morphological matrix (e.g. "parts location" versus "phase states of the product" or "applied fields" versus "phase states of the environment", etc.) that includes all possible modification of the solution concept, and consider every combination produced by the matrix.

e) Consider the modifications to the Solution Principle that would result from changing the dimensions of the system or its main parts, imaging the result if dimensions were to approach zero or stretch toward infinity.

Comment:

44. If the purpose of work is not just solving a particular technical problem, careful following step 8.3 might initiate the development of a general theory based on the Solution Principle.

PART 9. ANALYZING THE PROBLEM SOLVING PROCESS

9.1. compare proposed process and real

Compare the real process of problem solving with the theoretical one (that is, according to ARIZ). Write down all, if any, differences.

9.2. compare obtained solution concept and knowledge from TRIZ

Compare the obtained solution concept to the information in the TRIZ knowledge base (Inventive Principles, Inventive Standards, and Pointer to Physical effects and phenomena).

If the knowledge base does not include a principle that applies to obtained solution concept, document this principle into preliminary knowledge base.

ATTENTION!

ARIZ-85C has been tested on many problems – on nearly every available problem fund – and utilized for studying/teaching. Some users forget this and suggest improvements to ARIZ based on their experience in solving one problem. Even assuming that a given suggestion is good for a particular problem, as a rule, improving the solving of one problem renders the solving of other problems more difficult…

For this reason, any suggestions should first be tested outside ARIZ, as was case, for instance, with the Simulation with Little Creatures. Then, after being included in ARIZ, any change should be tested by solving at least 20-25 reasonable challenging problems.

ARIZ is constantly being developed and therefore needs new ideas. But these ideas should first be carefully tested.

Classical TRIZ
Project's Manual

СССР

ОПИСАНИЕ ИЗОБРЕТЕНИЯ

К АВТОРСКОМУ СВИДЕТЕЛЬСТВУ

Г. А. Альтшуллер и Р. Б. Шапиро

АППАРАТ ДЛЯ ИНДИВИДУАЛЬНОЙ ГАЗОТЕПЛОВОЙ ЗАЩИТЫ

Заявлено 24 июля 1956 г. за № 555265 в Комитет по делам изобретений и открытий при Совете Министров СССР

Изобретение относится к средствам индивидуальной газотепловой защиты, применяемым при ведении горноспасательных работ под землей, при ликвидации подземных пожаров, а также при горячем ремонте различной аппаратуры.

Особенностью предлагаемого газотеплозащитного аппарата является использование в нем для дыхания отработанного в холодильной системе кислорода, благодаря чему устраняется необходимость в специальных респираторах.

На фиг. 1 изображена схема предлагаемого газотеплозащитного аппарата; на фиг. 2— конструкция резервуара жидкого кислорода.

Аппарат состоит из комбинезона *1*, шлема *2*, соединительного кольца *3*, резервуара *4* жидкого кислорода, дыхательного мешка *5* и маски *6*.

Отвод внешнего теплопритока достигается за счет теплопоглощения при газификации жидкого кислорода и при последующем нагревании холодного газообразного кислорода.

Часть испарившегося под небольшим избыточным давлением кислорода из резервуара *4* поступает через дыхательный мешок *5* и гофрированную трубку *7* в маску *6*, а другая часть проходит в инжектор *8*, расположенный по оси сквозного цилиндрического канала *9* резервуара *4*.

Холодный кислород, вытекая из сопла инжектора *8*, засасывает теплый воздух подкостюмного пространства и, смешиваясь с ним, охлаждает его.

Для регулирования интенсивности холодильного действия аппарата служит дроссельная заслонка *11*, управляемая маховичком *12*, с помощью которого можно изменить коэффициент инжекции и тем самым регулировать теплоприток внутрь резервуара.

Для обеспечения нормального газоотвода при любых положениях резервуара, заполняемого кислородом на $^5/_6$ свободного объема, последний имеет четыре газоотводных отверстия *13*, *14*, *15* и *16*, расположенных по его вершинам. Чтобы предохранить костюм от заливания кислородом через все четыре отверстия, каждое из них снабжено газоотводной трубкой *17*, огибающей резер-

Classical TRIZ
Project's Manual

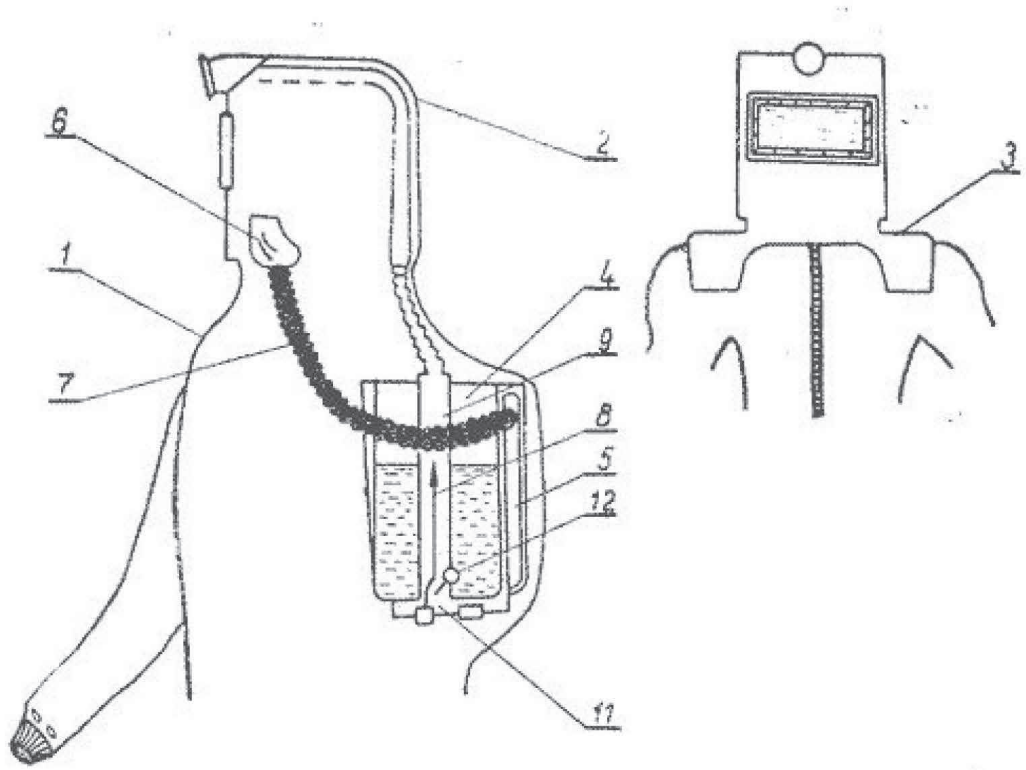
вуар последовательно над всеми отверстиями, благодаря чему жидкость не может пройти по трубке, так как одно из отверстий всегда выше уровня жидкости, а трубка выше отверстия.

Предмет изобретения

1. Аппарат для индивидуальной газотепловой защиты, состоящий из герметизированного комбинезона, шлема, соединительного кольца, дыхательного мешка, маски и размещенного в подкостюмном пространстве резервуара жидкого кислорода, отличающийся тем, что для устранения необходимости в специальных респираторах, отработанный в холодильной системе газ используется для дыхания.

2. Форма выполнения резервуара для хранения и газификации жидкого кислорода по п. 1, отличающаяся тем, что, с целью обеспечения газоотвода при любых положениях резервуара, дренажные отверстия расположены по его вершинам, а дренажные трубки, выходящие из каждого отверстия, огибают резервуар, проходя последовательно над остальными дренажными отверстиями.

3. Форма выполнения устройства для регулировки интенсивности газификации по п. 1, отличающаяся тем, что резервуар имеет сквозной канал с расположенным внутри него инжектором, изменением коэффициента инжекции которого достигается регулировка теплопритока внутрь резервуара.



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 536 670 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.06.2005 Bulletin 2005/22

(51) Int Cl.[7]: **H05B 6/12**, H05B 3/74

(21) Application number: **04253654.0**

(22) Date of filing: **18.06.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **29.11.2003 KR 2003085930**

(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon-si, Gyeonggi-do (KR)

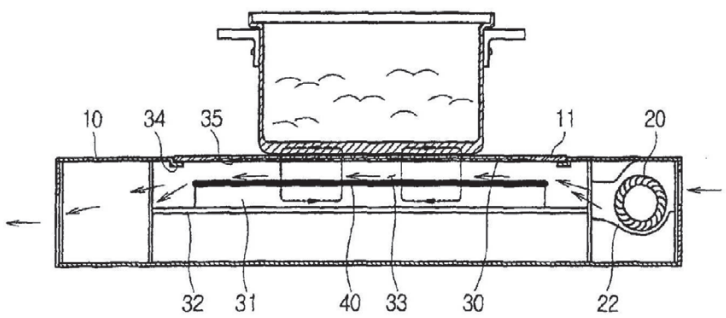
(72) Inventors:
- **Hoh, Jung Eui**
  Suwon-si, Gyeonggi-Do (KR)
- **Lee, Jun Young**
  Yongin-City, Gyeonggi-Do (KR)
- **Shin, Dong Lyoul**
  Suwon-Si, Gyeonggi-Do (KR)
- **Yang, Ha Yeong**
  Suwon-City, Gyeonggi-Do (KR)
- **Kim, Jong Gun**
  Taean-Eub, Hwasung-City, Gyeonggi-Do (KR)
- **Narbut, Alexandr**
  Suwon-Si, Gyeonggi-Do (KR)

(74) Representative: **Waddington, Richard et al**
Appleyard Lees,
15 Clare Road
Halifax HX1 2HY (GB)

(54) Composite cooking Apparatus

(57) A composite cooking apparatus having a body (10), a heating unit (30), and an induction heating unit (40). The heating unit (30) is positioned in the body to generate heat used to heat food. The induction heating (40) unit is positioned adjacent to the heating unit (30) to generate a magnetic field to cook the food by induction heating. The induction heating unit (40) has at least one wire (41), a coating (51) of which is exposed to an electron beam to strengthen a heat resistance thereof.

FIG 2



EP 1 536 670 A1

Printed by Jouve, 75001 PARIS (FR)

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2005-166630
(P2005-166630A)
(43)公開日　平成17年6月23日(2005.6.23)

(51)Int.Cl.[7]	F I			テーマコード（参考）
H05B 6/12	H05B	6/12	311	3K051
F24C 11/00	H05B	6/12	302	3K059
H05B 6/36	H05B	6/12	317	
	F24C	11/00	A	
	H05B	6/36	B	

審査請求 有　請求項の数 17　OL　（全 9 頁）

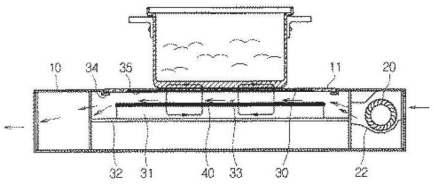
(21)出願番号　特願2004-205173 (P2004-205173)
(22)出願日　平成16年7月12日 (2004.7.12)
(31)優先権主張番号　2003-085930
(32)優先日　平成15年11月29日 (2003.11.29)
(33)優先権主張国　韓国 (KR)

(71)出願人　390019839
三星電子株式会社
大韓民国京畿道水原市靈通区梅灘洞４１６
(74)代理人　100064908
弁理士　志賀　正武
(74)代理人　100089037
弁理士　渡邊　隆
(72)発明者　楊　河榮
大韓民国京畿道水原市靈通區靈通洞（番地なし）　碧山アパート２２１－５０５
(72)発明者　李　▲ジュン▼泳
大韓民国京畿道龍仁市器興邑甫羅里（番地なし）　雙龍アパート１０１－１８０４

最終頁に続く

(54)【発明の名称】複合調理器

(57)【要約】
【課題】　誘導加熱調理装置であるワークコイルを構成する素線の被覆に電子線を照射して耐熱性を強めた複合調理器を提供すること。
【解決手段】　本体と、前記本体内部に設置されて調理物を加熱調理するための熱を発生する発熱装置と、前記発熱装置に隣接設置されて前記調理物を誘導加熱調理するための磁場を生成する誘導加熱装置と、を含むものにおいて、前記誘導加熱装置は、電子線に晒されて被覆の耐熱性が強化されたワイヤを持つことを特徴とする複合調理器を提供する。
【選択図】　図２



US006847798B2

(12) **United States Patent**
Cho et al.

(10) **Patent No.: US 6,847,798 B2**
(45) **Date of Patent: Jan. 25, 2005**

(54) **FUSING DEVICE FOR AN ELECTROPHOTOGRAPHIC IMAGE FORMING APPARATUS**

(75) Inventors: **Durk-hyun Cho**, Gyeonggi-do (KR); **Hwan-guem Kim**, Seoul (KR); **Narbut Aleexandr**, Gyeonggi-do (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/624,899**

(22) Filed: **Jul. 23, 2003**

(65) **Prior Publication Data**

US 2004/0141777 A1 Jul. 22, 2004

(30) **Foreign Application Priority Data**

Oct. 22, 2002 (KR) 10-2002-0064545

(51) **Int. Cl.**[7] **G03G 15/20**
(52) **U.S. Cl.** **399/330**; 219/216; 432/60
(58) **Field of Search** 399/307, 330, 399/334; 219/216, 388, 469; 432/60; 492/46

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,426,495 A * 6/1995 Sawamura et al. 399/331
5,805,766 A * 9/1998 Wang 392/343
5,945,020 A * 8/1999 Kuroda et al. 219/543
5,987,295 A * 11/1999 Matsuo et al. 399/330
6,571,080 B2 * 5/2003 Lee et al. 399/330
6,580,896 B2 * 6/2003 Lee 399/330
6,628,917 B2 * 9/2003 Lee 399/330
6,665,515 B2 * 12/2003 Lee 399/330

FOREIGN PATENT DOCUMENTS

JP 10268686 A * 10/1998 ..... G03G/15/20
JP 11065340 A * 3/1999 ..... G03G/15/20
JP 11184290 A * 7/1999 ..... G03G/15/20

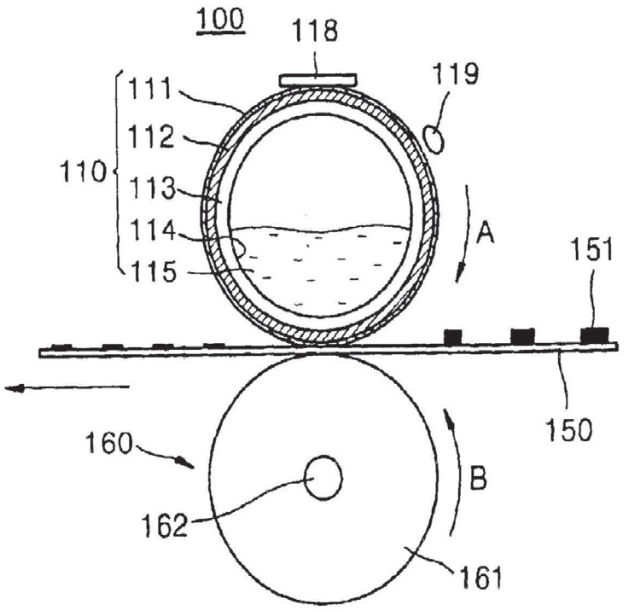
* cited by examiner

Primary Examiner—Robert Beatty
(74) *Attorney, Agent, or Firm*—Staas & Halsey LLP

(57) **ABSTRACT**

A fusing device for an electrophotographic image forming apparatus. The fusing device includes a heat pipe, both ends of which are sealed and in which a predetermined amount of a working fluid is contained, a cylindrical roller which surrounds the heat pipe, and a heating element which is installed between the cylindrical roller and the heat pipe. The working fluid is supercooled at room temperature, and crystallizing and producing heat when acted on by a mechanical force, and at least one mechanical unit applies a mechanical force to the heat pipe and crystallizes the supercooled working fluid.

10 Claims, 5 Drawing Sheets



공개특허 10-2004-0035413

(19)대한민국특허청(KR)
(12) 공개특허공보(A)

(51) 。Int. Cl.7
G03G 15/20

(11) 공개번호 10-2004-0035413
(43) 공개일자 2004년04월29일

(21) 출원번호 10-2002-0064545
(22) 출원일자 2002년10월22일

(71) 출원인 삼성전자주식회사
경기도 수원시 영통구 매탄동 416

(72) 발명자 조덕현
경기도수원시장안구화서2동화서주공4단지아파트401동1904호

김환겸
서울특별시은평구응암4동714경남아파트101동704호

알렉산드르나르부트
경기도수원시팔달구영통동신나무실5단지502동504호

(74) 대리인 이영필
이해영

심사청구 : 있음

(54) 전자사진 화상형성장치의 정착 장치

요약

본 발명은 전자사진 화상형성장치의 정착장치에 관하여 개시한다. 개시된 전자사진 화상형성장치의 정착장치는 양단이 밀폐되어 있고, 그 내부공간에 소정량의 작동유체를 수용한 관상의 히트파이프; 상기 히트파이프를 감싸도록 설치되는 컨트롤러; 및 상기 컨트롤러와 히트파이프의 사이에 설치되어 열을 발생하는 발열부를 구비한다. 상기 작동유체는 아세트산 나트륨 용액이며, 상기 히트파이프에 기계적 충격을 가해서 과냉각된 상기 아세트산 나트륨 용액을 결정화하는 적어도 하나의 기계장치를 구비한다. 이에 따르면, 콜드 스타드시에는 과냉각된 아세트산 나트륨 용액의 응용열을 이용하여 워밍업 시간을 단축하고, 인쇄 모드에서는 히트파이프 내의 열적 매체로 정착롤러의 표면의 온도를 균일하게 유지할 수 있다.

대표도

도 3

명세서

도면의 간단한 설명

도 1은 할로겐 램프가 열원으로 적용된 종래 정착롤러의 개략 횡단면도이다.

도 2는 도 1에 도시된 정착롤러를 포함하는 정착장치의 개략 종단면도이다.

도 3은 본 발명의 바람직한 실시예에 따른 정착장치의 개략 단면도이다.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 536 669 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.06.2005 Bulletin 2005/22

(51) Int Cl.[7]: **H05B 6/12**

(21) Application number: **04253653.2**

(22) Date of filing: **18.06.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **29.11.2003 KR 2003085929**

(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon-si, Gyeonggi-cho (KR)

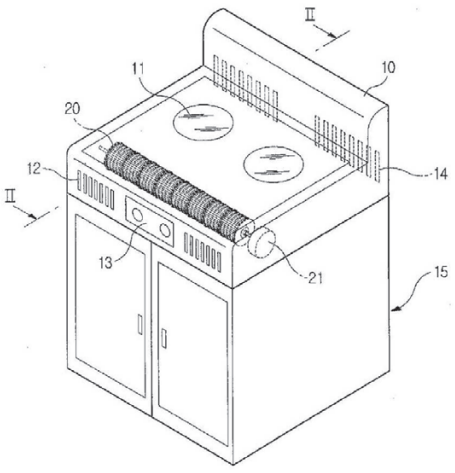
(72) Inventors:
- **Hoh, Jung Eui**
  Suwon-Si Gyeonggi-Do (KR)
- **Lee, Jun Young**
  Yongin-City Gyeonggi-Do (KR)
- **Shin, Dong Lyoul**
  Suwon-Si Gyeonggi-do (KR)
- **Yang, Ha Yeoug**
  Suwon-City Gyeonggi-Do (KR)
- **Kim, Jong Gun**
  Taean-Eub Hwasung-City Gyeonggi-Do (KR)
- **Narbut, Alexandr**
  Suwon-Si Gyeonggi-Do (KR)

(74) Representative: **Waddington, Richard et al**
Appleyard Lees,
15 Clare Road
Halifax HX1 2HY (GB)

(54) Composite cooking apparatus

(57) A composite cooking apparatus having a body (10), a heating unit (30), an induction heating unit (50), and an insulating plate (40). The heating unit (30) is positioned in the body (10) to generate heat used to heat food. The induction heating unit (50) is positioned adjacent to the heating unit (30) to generate a magnetic field to cook the food by induction heating. The insulating plate (40) is positioned between the heating unit (30) and the induction heating unit (50) to prevent heat generated from the heating unit (30) from being transmitted to the induction heating unit (50). Further, the insulating plate (40) is provided with at least one heat reflecting layer (41) to reflect the heat generated from the heating unit (30).

FIG 1



EP 1 536 669 A2

Printed by Jouve, 75001 PARIS (FR)

[19] 中华人民共和国国家知识产权局

[51] Int. Cl[7]
H05B 11/00
H05B 6/36
H05B 3/62

[12] 发明专利申请公开说明书

[21] 申请号 200410059266.X

[43] 公开日 2005 年 6 月 1 日

[11] 公开号 CN 1622697A

[22] 申请日 2004.6.15
[21] 申请号 200410059266.X
[30] 优先权
[32] 2003.11.29 [33] KR [31] 2003 - 0085929
[71] 申请人 三星电子株式会社
地址 韩国京畿道
[72] 发明人 许政义 李埈泳 申东烈 杨河荣
金钟根 纳尔布特·亚历山大

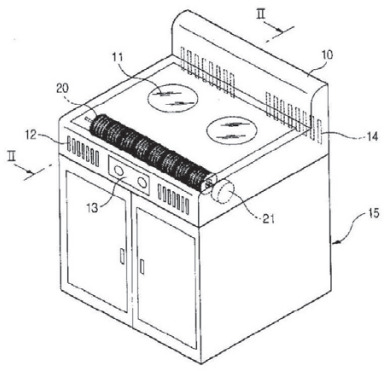
[74] 专利代理机构 中科专利商标代理有限责任公司
代理人 王新华

权利要求书 3 页 说明书 7 页 附图 3 页

[54] 发明名称 复合烹调装置

[57] 摘要

一种复合烹调装置，具有主体、加热单元、感应加热单元和绝热板。该加热单元设置在主体内以产生用于加热食物的热量。该感应加热单元邻接加热单元设置，用于产生磁场，以通过感应加热烹调食物。该绝热板设置在加热单元和感应加热单元之间，用于防止从加热单元产生的热量被传输到感应加热单元。进一步地，该绝热板设有至少一个热反射层，以反射从加热单元产生的热量。

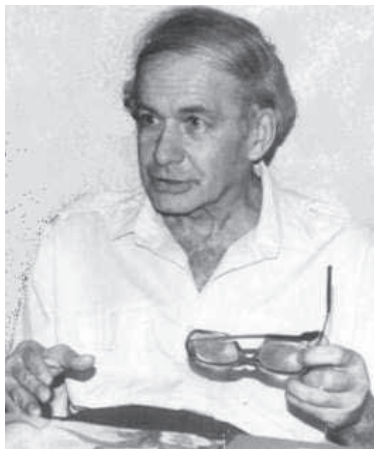


ISSN1008-4274

知识产权出版社出版

For the Memory...

Genrich Saulovich Altshuller,
author of TRIZ
(15.10.1926 - 24.09.1998)



Nataliya N. Narbut,
TRIZ Master by G.S.Altshuller,
first President of COMCON*TRIZ
(13.06.1952 - 03.11.2007)

Nikolai N. Khomenko,
TRIZ Master by G.S.Altshuller,
author of OTSM*TRIZ
(09.12.1954 - 27.03.2011)

ISBN 978-9984-45-994-3

LATVIJAS UNIVERSITATE
ANNO 1919
UNIVERSITY OF LATVIA

About Scientific Editor

Alexander Theodor Narbut
TRIZ Master by G.S.Altshuller, D.Sc., Professor.

Scientific Director & President
of the **COMCON*TRIZ & FRT corporation**

Scientific consultant of the Institute of Atomic Physics (Latvia).

Director General of the National Strategic Service (Ukraine).

Main work practical system projects in the aerospace
and nuclear power industry (Ukraine and former USSR).

Head of projects in the National Institute for Strategic Study
(Department of Homeland Security and Defence of Ukraine).

Some practical projects in the electronic and semiconductors
industry (include Samsung Electronics, South Korea).

Science and education projects in West Europe
(including Germany, Italy, Latvia, Poland, Bulgaria, Hungary)
and East Asia (including South Korea).