COMPUTER SUPPORT OF INNOVATION´S CREATIVITY

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ABSTRACT
Using of algorithmic methods of the intensification of constructive process logically results in an idea for the creation of computer programs capable of raising efficiency of invention and design activity. In a basis of most effective methods of engineering creativity lays TRIZ - the theory of the solving of the invention tasks. On the basis of this theory a number of software packages are being created, for use by a variety of users who are not familiar with TRIZ at all and only having the basic skills of work with the personal computer. In this report the features of some of these programs are discussed, their advantages and shortcomings are compared, the examples of their use in invention practice are resulted.

KEYWORDS
Innovation, Creativity, Computer programs, IM, TRIZ (TIPS), ARIZ

INTRODUCTION

Invention is the most ancient man's activity. Actually the history of humanity begins with the invention of the first tools for the work, instruments which have allowed man to occupy gradually almost whole the Earth. The ability to create is a most bright attribute differentiating man from other animate nature.

For thousand of years of history man has created set of technologies of designed objects. Only the "trial and error method" has not changed. The price of this method – has been enormous over expenditure of intellectual, power and material resources at manufacture of machinery, frequently low efficiency of scientific research, gross blunders in decisions making. And, if up to the certain period this method could satisfy the conditions of our civilisation development, already in conditions of scientific and technical revolution of XX century, mankind is not capable to resign itself to its monopoly. And though in a history there are separate examples of searching for the ways, which could help to organize the process of thinking, exactly since 20 years of XXth century in technically advanced countries the various methods of activation of "different variants sorting" began to occur. The most effective of the developed approach is the "brain storm", sinectics, the method of morphological analysis. However, it was apparent that these methods are good only at the solving of comparatively simple tasks. If the task is difficult, the effect from application of these methods is insignificant, because their use does not change the essence of "different variants sorting" technology, and only expands the area of such sorting. In order to control a difficult problem it is necessary to use more effective technology for the solving of invention tasks. And

such technology has arisen. In 1946 in the former Soviet Union the work above creation of scientific technology of invention began. Later this theory was titled as the „Theory of Inventive Problem Solving" – TIPS (Russian abbreviation TRIZ). Its founder was G.S. Altshuller [1].

Already in the first publications on the TRIZ their basic ideas, which distinguish the new theory from a "trial and error method" and from all forms of its updating, were formulated:

- All technical systems arise and develop not "at will", but under the certain objective laws, and first of all - through overcoming of both inner-system and over-system contradictions;
- These laws are cognisable, we can use them for conscious (without set of "empty" tests) decision of invention tasks;
- The development of systems is an increase of the degree of their "idealization" (which is determined by the relation of the sum of useful functions, carried out by the system, to the sum of the negative factors which we must pay for the system performance in all cycle of its functioning from creation up to recycling).

Thus, the appearance of the TRIZ marked the beginning of the transformation of new machinery creation process into an exact science, and process of the invention tasks decision began to be under construction on system of logic operations.

THEORETICAL FUNDAMENTALS

Theoretical basis of the TRIZ are the laws of development of technical systems. These are the laws of dialectic but showing itself at the sphere of engineering and technology (a great number of evidences of these laws correctness was revealed by the analysis of the historical tendencies of machinery development). The basis of such analysis was the large massive of existing patent information. It was found out, in particular, that many of these laws have general-system characteristics. The knowledge of these laws allows not only to solve the tasks, which rise before the engineer at his practice work, but also to predict the occurrence of new technical problems at future.

The basic working mechanisms of new technical systems perfection and synthesis in the TRIZ are the heuristic algorithm of inventive problem solving (ARIZ), manners of overcoming the so-called "technical contradictions" and fund of physical, chemical and geometrical effects and phenomena. The ARIZ represents a sequence of the logically coordinated steps purposeful at the analysis of technical system, the formulation of the technical contradiction, revealing of an operative zone of the conflict, resources for the transformation of this zone and receptions this transformation in order to produce the necessary effect. The search for effective ways of system transformation of the specially developed language of modelling its structure and functioning is applied.

By efforts of the G.S. Altshuller followers over 70-80 years the TRIZ became the basis of a creative stage of the functional - cost analysis (VEA). Intensive development of the TRIZ over 70 - 80 years have resulted in the serious contradiction:

1. Rapid increase of volume of a theoretical material, which is necessary for its effective use by the designers, began to complicate the practical application of TRIZ methods.

2. A further important factor causing necessity of creation of computer technologies for supporting an invention activity is the inner specificity of such activity. The modern inventor represent themselves as the intellectual interpreter, which translates theoretical knowledge saved by fundamental sciences (by physics, chemistry, mathematics etc.) in technical knowledge, suitable for realisation of technical functions of created object. It means that every inventor must acquire all modern knowledge (that is impossible physically), or at least can have a simple access to them.

To solve this problem effectively is possible only by using of computers. It should be noticed that the idea of a similar step logically follows from the structure of the TRIZ: as was mentioned earlier, the basic difference of this theory from previously used methods is the principle about an opportunity of algorithmization of the new technical solving search process. As a basis for creation of appropriate programs the various updating of the ARIZ (from the first ARIZ-56 up to the ARIZ-85B) could be used.

The first attempts of computer intellectual systems creation on the base of the TRIZ concerned to the middle of 70's (USSR): it was the system "Pulsar" (the programming language was FORTRAN). The practice of use of this program demonstrated that it is possible to create such software even without powerful computers and specialised programming languages. Of course the opportunities of this software were rather limited. Nevertheless, with the help of the created system it was possible to solve a number of theoretical tasks in the field of mathematical statistics.

The new opportunities in similar programs creation have opened only after appearance of personal computers in the 80's and logic programming language PROLOGUE created for the decision problems of artificial intellect creation. From this moment the following stage of computer invention systems creation (project the "Invention machine" – IM) began [2]. The developers formulated the main purpose of works on this stage as "democratisation" of creation. It means, that the created software should be intended and spread for a wide range of the users, the degree of which acquaintance with TRIZ can be rather different.

The first variants of IM-system provided the dialogue with the user in Russian. The first versions IM in English were produced from a beginning of the 90's, approximately at the same time for a creation of such versions began to be used the programming language C.

Already from the first versions the IM-system includes some subsystems. The main subjects of them are:

- The system "IM-manner" intended for solving of technical contradictions at the invention tasks decision, (this system was included more than 80 typical invention manners);
- The system "IM-standards" for inventive problem solving with the help of the TRIZ standards (complex manners);
- The system "IM-effects" – allows to search the inventive problem solving with the help of natural sciences (physics, chemistry, mathematics, biology) knowledge funds.
- The algorithm of the inventive problem solving (on the base of the ARIZ-85B);

- The system by “IM-VEA” (carries out the support of the inventor at a stage of the functional - cost analysis).

The program by IM includes, however, not only a set of the listed systems, but also rules of their search, based on the scheme “if – that”. Thus program organizes the purposeful analysis and solution of invention tasks, not allowing the user to be forced down inefficient ways of search for the idea of the solution.

Now the last version of the “Inventing machine”- system is IM-3.5. The advantages of this version are the essentially extended information fund of examples, more convenient interface, opportunity of reception of “help”-information at any stage of the solution etc.

Besides the project “IM”-system also other approaches to construction of the programs for the support of invention activity and engineering design were developed. From a beginning the 90’s there is the improved system “Kassandra” [3], which was created by Kishinyev’s followers of G.S. Altshuller. The “Kassandra” focuses on support of the work not only for the engineer, but also for the manager. The main idea of the approach which is realised by “Kassandra” consists in deep analysis of improvement technical system: the construction of the model of this system, the consideration of system development line, the prospects of its development (including the formation of technical politics of the enterprise - manufacturer), “diversion” analysis etc. At work of system “Kassandra” it is widely applied the technology of hypertexts; the connected reference blocks are professionally - guided orientated (they contain materials which are interesting for mechanical engineers, specialists in electronics, etc.).

Considering the perspectives of development of program systems for supporting of invention activity, it is impossible to bypass by attention the latest successes in the field of works on artificial intellect creation. The construction of semantic processes allows to charge to the computer not only the search, but also to produce the preliminary analyses of the information that could be interesting for man. In connection with it we must mention one of latest developments in this area – the programming system "Knowledgist". This system allows the client find a series of tasks - analogues from existing information funds (library in this case is the network of databanks, the dialogue with which occurs under the Internet). One also allocates from a general Internet data array only those, which contains quite concrete, interesting for the user information.

SUMMARY

Thus, it is possible to make a conclusion that up to the present time on a basis of the TRIZ at once some approaches to the decision of a task of invention and design activity support were developed. On the base of these approaches there were produced programming systems for personal computers, such systems are planed for clients with different levels of knowledge of the TRIZ. The latest ten years' history gives concrete confirmations of the effective employment of such systems in practice (the evidence of this conclusion is commercial success of programmes from IM-series).

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