Ways of an estimation of efficiency of final decisions at target invention by means of software Solving Mill and technologies OTSM-TRIZ

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Abstract. For support of process of the solution of not trivial technical problems from the analysis of a problem situation before check of efficiency of the received decisions it is developed algorithm of improvement of problem situations (AIPS-2015), on the basis of which software Solving Mill is created [1]. New technologies at factories often cause negative effects and difficultly predicted in advance consecutive lacks. In what ways to reduce quantity of these probable lacks at a stage of generation of ideas?

N. Khomenko noticed that widespread the stereotype of the decision of a creative problem which consists that the correct or suitable system of decisions can be chosen only after generating as it is possible greater quantities of various decisions. On the other hand, the research spent by G. Altshuller and I. Vertkin, shows, that the more innovative the decision is, the greater resistance is met by it from experts and community as a whole.

Algorithm AIPS-2015 and software Solving Mill generates preparation of the formula of the invention which is automatically formed on the basis of the fixed data. However convincing arguments for a choice of ways of an estimation of efficiency of these decisions, including maintenances of the formula of the prospective invention thus are required.

1 Introduction

Some problems require break-through thinking, but not all people are capable of such thinking. Algorithm AIPS-2015 helps them reach their full potential of a solver.

Purpose of an algorithm of improvement of problem situations (AIPS-2015) - to help with problem situation improvement with one undesirable effect. The offered algorithm AIPS-2015 which purpose is the innovative tasks solution and problem situations correction will organize the TRIZ basic tools in uniform set.

In the algorithm a solver is offered a step-by-step process of work on a problem, tools for performing each step and sets of questions for a deeper insight into the problem situation and for problem solving. The algorithm and the tools are universal for problems from any field of industry and can be used in other fields of activity where such non-trivial problems may occur.

Solving Mill is designed for the support of non-trivial technical problem solving starting from the problem situation analysis to checking the efficiency of the obtained solution.

The problems may relate to product development, production, storage, transportation and sale processes as well as to organizational management of an enterprise, advertising, etc. Non-trivial problems defy solution by traditional methods, so there is a need for a solution lying beyond the solver's experience and professional competence (so-called inventive problems).

Who is the algorithm AIPS-2015 and the Solving Mill designed for?

The algorithm is developed on the basis of long-term experience of consulting in the Korean companies SAMSUNG and POSCO, repeatedly checked at the real tasks solution in the companies. It is designed for manufacturing engineers, design engineers, project managers, specialists of innovation units of companies, etc. For all those who face the challenge of solving non-trivial problems. It may be used for training technical students.

Solving Mill is created on the base of algorithm AIPS-2015. The software generates preparation of the formula of the invention which is automatically formed on the basis of the fixed data. But how correctly we can select ways of an estimation of efficiency of final decisions at target invention by means of software Solving Mill? It’s a big problem. We try analyses these ways.

2 Methods

Theoretical foundation of algorithm AIPS-2015 is the theory of inventive problem solving (TRIZ) and related disciplines [2]. The main idea of an algorithm is in uniting theoretical provisions of classical TRIZ and approaches of the general theory of powerful thinking (OTSM) which was developed by N.N. Khomenko.

To improve ability of TRIZ to solve complex cross-disciplinary problem, Altshuller proposed to transform Classical TRIZ into a general approach of problem solving; he proposed to name it “General Theory of Powerful Thinking”, the Russian acronym of which is OTSM (Khomenko and Kucharavy, 2002).

These limitations gave rise to research in the field of inventive problem solving and in the mid-1980s; some research directions were initiated under the acronym OTSM [2]. Today, OTSM is still under development, but some tools to address previous stated limitations, which consist in four main technologies, were developed:

- typical solution technology
- contradiction technology
- new problem technology
- problem flow technology.

These technologies are to be harmonized into a meta-method named “Problem Flow Networks (PFN) Approach”, the function of which is similar to ARIZ in classical TRIZ. Process of the task solution by technologies is presented in "Pyramid of Khomenko" (fig.1).

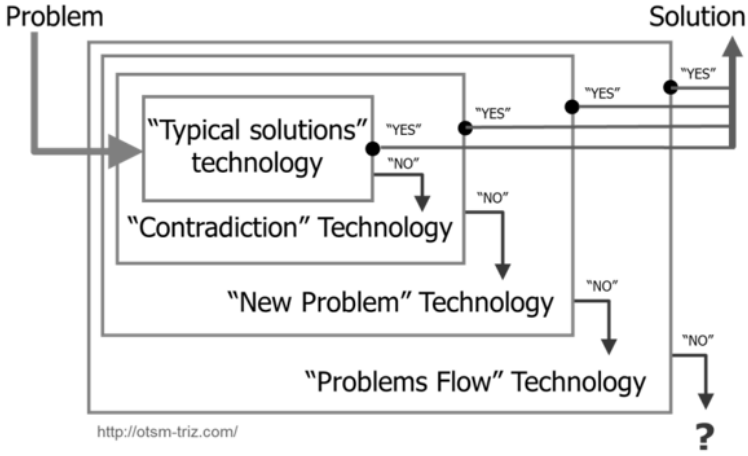

Figure 1. Pyramid of Khomenko

Methodical basis of an algorithm of improvement of problem situations (AIPS) is G.S. Altshuller's algorithm ARIZ-85 complemented with OTSM technologies and a number of practical methods of a problem situation analysis and the task solution developed by authors. The successful combination of the models and tools used in TRIZ, to the general course of the task solution, well worked in OTSM technologies turns out.

The algorithm continues tradition the TRIZ-algorithms developed by G.S. Altshuller, therefore in it are widely used analytical and the tools applied in TRIZ. The important role in algorithm is played also by key positions of the general theory of strong thinking (OTSM), developed by N.N. Khomenko. Besides, at creation of algorithm we have tried to consider as much as possible long-term practical experience of the decision of the problems, turned out on the different companies, first of all on Samsung. The algorithm shows, that it is necessary to make at a certain stage of the decision of a problem, and what result thus needs to be received. Working over algorithm, we wanted, that it was algorithm-interlocutor, original "guide" who conducts at the problem decision, explains, that it is necessary to make on any step and what result to receive.

Methods with which use the result turns out, undoubtedly, are important, however they have auxiliary character. Important feature AIPS-2015 is the aiming at the most widespread type of problems. Innovative problems happen the most different both on complexity degree, and on width of coverage of a situation. It can be both rather simple situational problems, and difficult big projects. The most widespread type of problems, a headache of the production worker, the manager is more or less simple problem situations containing one or several undesirable effects. Often they dare at once, and sometimes it is necessary to spend considerable time for their decision. According to our

estimations, such problems make 70-80 percent from all innovative projects which are carried out by the companies (fig. 2).

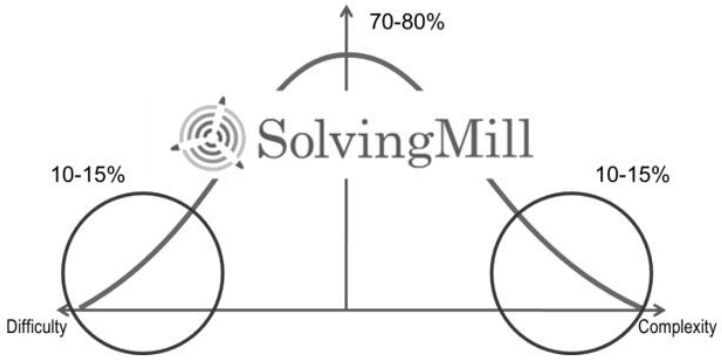

Figure 2. Distribution of innovative projects in the company

The absolute must to have the mechanism aimed at the decision rather simple innovative problems, correction of problem situations, has been considered by working out of our algorithm. The matter is that for any company the most important, irreplaceable resource is time. Innovative problems solved without any TRIZ, instinctively, using engineering intuition and experience. But now, when generations of cars and technologies are replaced all faster and faster, on long searches and meditations simply there is no time. The problem consists not in solving a problem, and in making it quickly, effectively, with small expenses of forces. Only that company, which will outstrip competitors, will be successful in the market.

Certainly, there is also other type innovative projects are big complex projects, and also challenges: working out of new materials and technologies, decrease in the cost price of production, optimization of a control system by the company, production improvement of quality. Such projects are carried out collectively, at interaction of several intellectual divisions, with attraction, first of all, experts of TRIZ. To understand difficult problem situations, use powerful analytical tools. As a result of the analysis the project inevitably decompose, is divided into a number of "elementary bricks», the simplest problem situations. For the decision of these allocated problems, elimination of undesirable effects defined at the analysis, AIPS-2015 can be applied rather effectively.

The methodical foundation is the Algorithm of Improving Problem Situations (AIPS).

Graphically the algorithm AIPS-2015 is presented by the curtailed scheme which is often called by "Christmas Tree diagram", it is shown on fig.3. The detailed description of algorithm is presented to monographies [3].

Work with algorithm begins with the description of an initial *problem situation***.** An algorithm exit - *the improved situation*, that is a problem situation without undesirable effect. Our purpose - to correct some problem situation in which the undesirable effect contains, the phenomenon which is not arranging the customer.

At first there is an **analytical stage** – we understand a situation, we try to understand why there is an undesirable effect, and under what conditions it wouldn't be. This stage completely coincides with technology of OTSM "New Problem" which describes process of the analysis of an initial situation.

The analysis begins with specification of a problem situation, allocation of undesirable effect.

Then transition to the level of the technical tool, machine which operation is related to a problem situation follows. This part of work is directed to narrowing of the field of search and allocation of conflict interaction of components of system. Further it is necessary to understand what reasons cause the conflict and to make working hypotheses how it is possible to remove these causes. Final action of an analytical stage – task formulation.

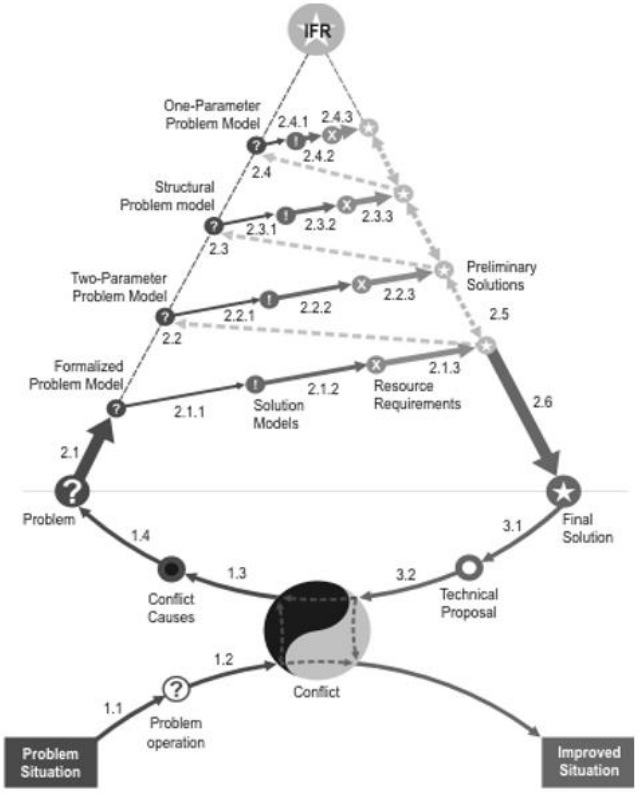

Figure 3. Type model the closed structure, such scheme often name «the Christmas Tree diagram».

At the **second stage** we solve a problem, i.e. we find how to create conditions under which the undesirable effect won't appear. For the solution of the allocated task technologies of OTSM "Typical solution" and "Contradiction" are used. That is, it is necessary to construct its model on the basis of a statement of the problem, to transform it to decision model, to define the necessary resources and to find the idea of the decision. The solution stage of an algorithm has that feature that the used tools make uniform system that increases efficiency of their application.

And, at last, at the **third stage** it is necessary to analyze a situation again – whether our efforts whether it was succeeded to get rid of a shortcoming were crowned with success. The third stage is necessary, first of all, at the solution of real production tasks. It has test character and allows to tie the solution of a task to conditions of concrete production better.

As a matter of fact, the algorithm AIPS-2015 unites all OTSM technologies: "Typical solution ", "Contradiction", "New problem" and "Flow of problems". However in an algorithm the order of use of these technologies is changed. At first we analyze a problem situation ("new problem" technology), then we solve the allocated problems ("standard decision" and "contradiction" technologies). If after checking it turns out that the received solution of a task eliminates undesirable effect, the course of the decision repeats, i.e. the "Flow or network of problems" technology works.

Among the methods introduced into Solving Mill, there are: process analysis, root-cause analysis, harmful system method, multi-screen scheme, inventive principles, Su-Field modeling, system of standard solutions, technical system evolution patterns, smart little people modeling, size-time-cost operator, etc.

3 Software realization of AIPS-2015

The algorithm AIPS-2015 is logical, intuitively clear, covers all process of improvement of a problem situation. It gives wide opportunities of mutual understanding between the experts solving a problem. They begin to speak one language, understand what should be made on each step of solution process and how to receive the required result.

High organization degree of an algorithm has given the chance to shift it to computer language, software of Solving Mill has been developed. The purpose of software development – to automate solution process as much as possible, having released the user for creative operations performance.

The main part of Solving Mill is a template, organized in accordance with the algorithm AIPS, using which the user follows step-by-step all the stages of the work on a problem. The user fills the template (the solving map) placing their descriptions, images, schemes, conclusions and other content generated in the course of work on a project. The template allows both viewing the entire problem solving procedure and focusing on individual steps. Simple navigation of the template provides a convenient control of the solving process. The map template is convenient for a simultaneous joint work of several solvers on a problem.

There are operators for performing complicated actions and for work with TRIZ-methods. Each operator has its own special interface. The work result obtained in each operator is placed into the template and the entire auxiliary inforation is stored inside the operator and is accessible to the user at any time.

If difficulties arise, the “how to” instructions are used. If instructions are not enough, the user can look through the examples of performing one or another action. Examples are through case-studies based on solved problems.

If this is also insufficient, the user can take advantage of the training course dedicated to inventive problem solving and containing detailed information on the performance of each step of the algorithm.

There is a built-in training course on solving problems by using the algorithm and TRIZ methods. The training course contains explanations concerning the problem solving process as a whole and the essence of the solver's actions at each step. It is illustrated with a large number of examples so that the user can work on his problem according to the proposed model. Thus, the synergism of training and practical work are provided.

The Solving Mill software has matrix structure (fig.4).

- The main level – template for the task solution.
- Except it there are five levels of information support:
- Hints how to fill cells
- Operators for model creation
- The analyses of the solved tasks executed according to a template
- The instruction how to work with software (helps)
- The training course explaining how the algorithm AIPS-2015 works

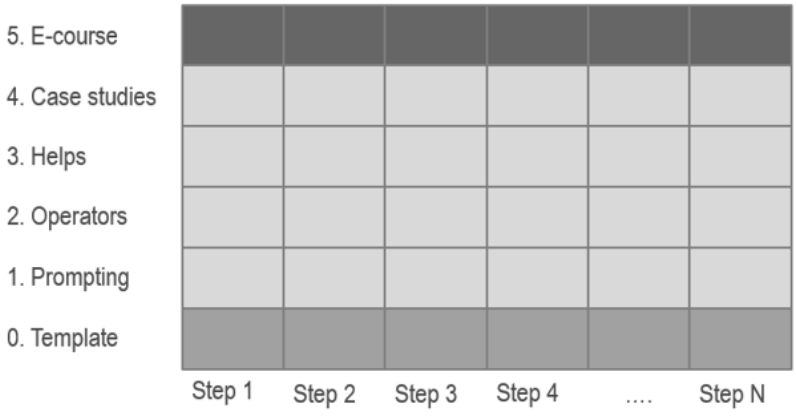

Figure 4. Software Solving Mill looks like a matrix

Solving Mill software product is designed for one quite definite goal: solving of non-trivial problems. The core of the software structure is a template by filling which the user solves a problem. All the accompanying information is structured so as to effectively support the solving process. Though Solving Mill is highly effective, it is relatively simple. And, as a result, it is easy to learn and to deal with.

The software structure is designed to direct users towards a strong solution making them choose the most effective and fast route. The operators used in Solving Mill are convenient and facilitate the work on a problem.

The case studies are based on the inventive projects executed by consulting solvers of inventive problems. The problems described in the case study were solved according to the algorithm used as the basis for the software product. The case studies are presented in such a manner as to precisely match the algorithm steps. While solving a problem, the user can employ each case study as a model. The case studies can illustrate both the entire problem solving cycle and the work on individual steps of the algorithm.

We have mane steps using Solving Mill. A preliminary solution is generated automatically based on your answer to the algorithm questions. The solution text can be edited. You can run the algorithm as many times as you need changing other transformation versions and generating new preliminary solutions.

Important operators " Constructor of solution " and "TI-transformer" which help to build the task solution.

We can use “Constructor of solution” operator to analyze resources and compose a draft of preliminary solution.

This operator gives the chance to compare the list of requirements to a necessary resource to the list of available resources to choose the most suitable.

The TI-transformer operator represents the course of the solution of a task (fig.5). Depending on task model type the operator asks the user questions which that has to answer. At the end of process, the idea of the solution of a task is automatically generated.

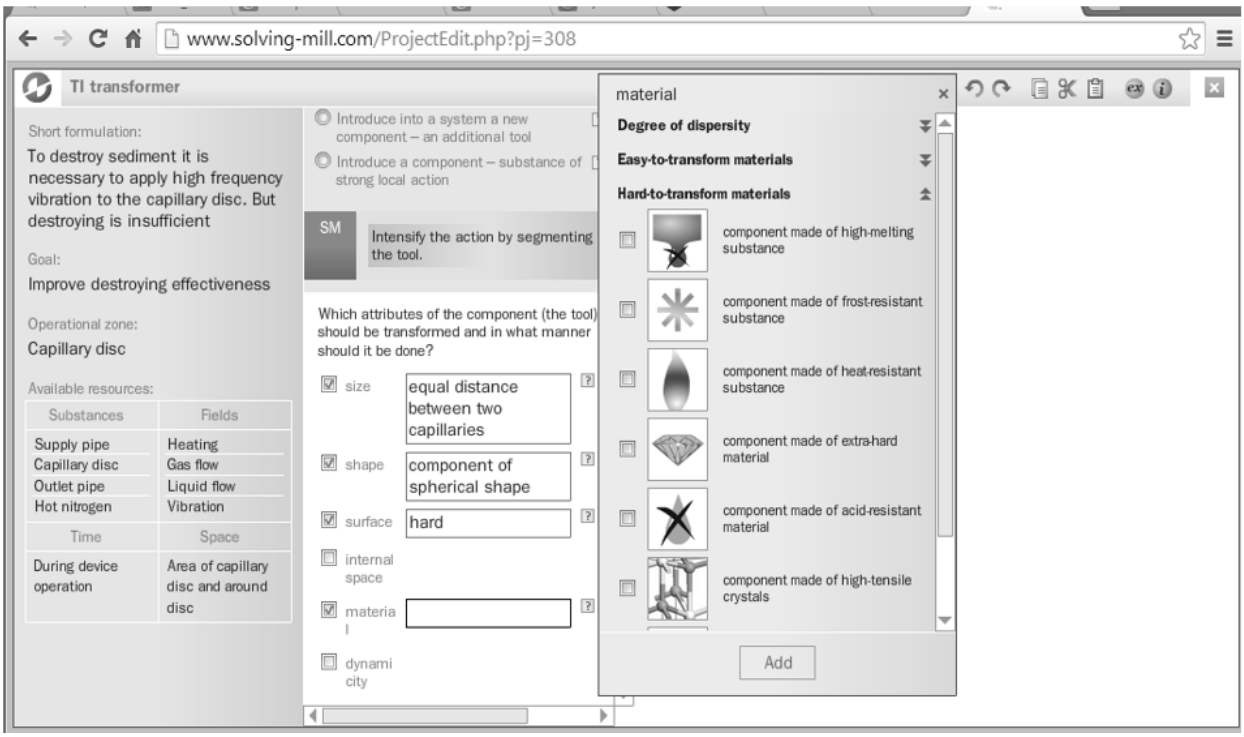

Figure 5. Screen of “TI-transformer” operator

We will also be able to select the best preliminary solution for building a final solution and generate additional solutions using the “Generator of alternatives” operator. We can accept the best of preliminary solutions as the final solution, and we can group the final solution from several intermediate.

After building a final solution, it is necessary to evaluate it. There are three significant evaluation criteria: the main evaluation criterion for a final solution is — whether a method of implementing the problem requirements has been really found; proximity of a described technical device to the ideal system.

Possibility of implementation of a new device version.

Conclusions

1. Algorithm AIPS-2015 is designed for a very definite purpose: the solution of non-trivial problems with one undesirable effect.

2. Thanks to the focus on the single most common type of problems, the algorithm and the software Solving Mill are effective, relatively easy to learn and use.

3. The core of the structure of Solving Mill - is an easy-to-use template, filled by user during solving a problem.

4. All related information is structured in such a way as to effectively support the process of problem solving.

References

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