An earlier version of this paper appeared in the proceedings of the Altshuller Institute's TRIZCON2005, April 2005.

NEW TRIZ-BASED TOOL — FUNCTION-ORIENTED SEARCH (FOS)

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Abstract

One of the major obstacles for a worldwide TRIZ implementation is a contradiction within TRIZ itself. On the one hand, based on Altshuller's five levels of Invention Classification, the best solutions belong to Levels 4–5, which require dramatic changes in the design of a Product or Process, or even the Action Principle. On the other hand, the TRIZ mini-problem approach requires minimal changes in the initial Product or Process, to make implementation of the solution easier. Usually, it takes years to actualize a new Action Principle.

As a part of the TRIZ*plus* methodology, we developed a new paradigm shift — Function-Oriented Search (FOS) — to help solve this contradiction. The main idea of this approach is to find an **existing** Technology (Product or Process) and transfer it to the Initial Problem, as a Solution. Thus, we can offer a new and very effective Action Principle to solve the initial problem; we also do not need to spend a lot of time and effort proving the effectiveness of this new solution and putting it into practice, because the Technology already exists.

Key Words

Function-Oriented Search, TRIZ*plus*, secondary problem, engineering system, action principle

Function-Oriented Search entails finding and effectively using appropriate existing Technologies. Three major issues should be addressed as part of that effort. First, a direct technology search is very ineffective — every subject matter specialist tries to find new developments in his or her scientific or engineering field. The probability of actually finding some new, effective solution via a direct search is very low.

Second, if you are trying to search for the right solution/technology in a remote engineering area, the search field becomes almost infinite.

Third, even if you find a potentially attractive technology in a peripheral area, you simply cannot effectively apply it to your initial engineering system, because you don't have enough knowledge about the new action principle.

FOS allows us to address these three issues.

We began to develop this new piece of TRIZ methodology in mid-1980s, in the former Soviet Union. The first practical implementation of FOS took place in 1988. Since then, we have seen hundreds of successful examples of FOS applied in various engineering areas, worldwide.

FOS further develops Genrich Altshuller's idea that the shortest path to an effective solution is to use an analogy; however, to find a non-trivial solution, that analogy should be not direct. Altshuller even suggested one of the possible bases for such remote analogies: physical contradiction. He recommended using an analogous problem as a problem-solving tool in the latest versions of ARIZ. However, to effectively use this tool, the TRIZ community needed to create a significant database of the analogous based on physical contradictions. This was never done.

FOS represents another kind of analogous — based on the same or similar functions.

The simplified algorithm for FOS will be demonstrated with a practical case study.

Initial situation

The Client was producing plastic hygienic pads that had thousands of tiny holes. The Client produced these holes using multi-punch stamping equipment. There were two major problems with this product:

a) Low open area of holes (< 12%)

b) Uneven edges of holes after stamping

The Client also considered laser technology that could eliminate these problems, but that represented much lower productivity than stamping, and much higher cost.

FOS Algorithm

1. Identify the Key Problem that prevents the Product / Process from solving the Initial Problem. TRIZ*plus* has a fairly well developed methodology for identifying Key Problems.

   Example:

   One of the key problems related to hygienic pads:

   There should be a large number of holes to create a large total open area; however, there should be a very limited number of holes to prevent material strength deterioration.

2. Formulate necessary function(s) for Key Problem solving.

   Example: Function — to punch (perforate) the plastic sheet

3. Formulate required functional parameters.

   Example: Most important required parameters are:

   - Plastic sheet thickness — 0.5 mm
   - Diameter of holes — 5 μm
   - Open area (desired) — > 20%
   - Pad mechanical strength — not less than after stamping
   - Cost — not higher than stamping

4. Formulate a generalized function.

   Example: Generalized Function: create holes in a thin material

5. Identify a leading area(s) of industry where such types of functions are vitally important.

   Example: One of the leading areas found in the function-oriented database was the Space Industry

6. Find the best experts in the identified leading area.

   Example: Using our proprietary Global Knowledge Network, we found the best experts in the area of spaceship hull testing.

7. Using professional databases and experts' knowledge, identify candidate technologies.

   Example: We found a technology of micro-meteorites modeling for spaceship hull testing. The material for modeling was steel foil. Diameter of micro-meteorites was 5 – 10 μm. The technology for testing was based on a Powder Gun that shot thousands of equal-sized particles at the foil, making thousands of even holes in a fraction of a second, resulting in an open area of up to 30% without foil strength deterioration.

8. Select the Technology(ies) closest to required functional parameters.

9. Formulate a Secondary Problem(s) that would potentially prevent the selected technology from being immediately implemented to solve the Initial Problem.

10. Solve that Secondary Problem(s).

    Example: We formulated and solved a couple of problems for powder gun technology transfer / adaptation to the hygienic pad production.

    a) How to assure the largest total open area for a plastic sheet, not foil.

    b) How to set up a continuous process instead of the batch operation of the Powder Gun.

11. Describe a slightly modified existing technology as the solution to the Initial Problem.

12. Submit necessary data to substantiate the effectiveness of the identified technology, and suggest a practical plan for its implementation.

    Example: In the end, we presented to the Client an actual Powder Gun, with samples of perforated plastic sheet (25% open area).

    We also submitted all necessary data about a potential vendor of the equipment, cost calculations, and proof of patentability of the technology.

Key components for effective implementation of FOS methodology are:

- Function-based Technology Database
- Leading Area-based Global Knowledge Network (GEN3 has more than 7000 subject matter experts in almost all areas of science and technology).

Conclusion:

We developed a new TRIZ-based tool for effective inventive problem solving — Function-Oriented Search.

Instead of direct problem solving (even with all powerful TRIZ tools), this method states that almost all solutions necessary to solve problems ***do*** exist in a form of some specific technology implemented in some engineering area.

We should find these best technologies and transfer them to the initial problem. There are two major creative steps in this process — how to:

- Find the best technology, and
- Effectively transfer it to the initial engineering system.