

## **AUTHOR'S ABSTRACT**

of Dissertation to TRIZ Master Certification

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### **IMPROVEMENT OF USABILITY OF SYSTEM OF PATTERNS OF EVOLUTION OF TECHNOLOGICAL SYSTEMS VIA SYSTEMIC CATEGORIZATION OF UNDESIRABLE EFFECTS**

#### **1. Actuality of Researched Topic and Goal of Research**

Patterns of Evolution of Technological Systems were first formulated in form of system of patterns by Henry Altshuller in early 1970's. Later, multiple researchers suggested several improvements to suggested system of Patterns of Evolution, because initial variant of patterns, according to its author, was not a perfect fit to the purpose of inventive problem solving, it was "too general and too cumbersome." The following main directions of improvement to the system of Patterns of Evolution were explored:

- a) logical structuring of Patterns of Evolution for purposes of forecasting;
- b) forecasting of future conceptual solutions via step-by-step application of statistically proven "Lines of Evolution" to existing technology
- c) forecasting the evolution of Technological System (TS) via combination of directions "a" and "b" applied to some fundamental model, e.g. "Evolution along the S-curve," "Direct and inverse trend 'point – line – surface – volume,'" "Running wave of idealization of TS," "Theory of resource capturing," or "Universal evolutionary system."

Without diminishing the advantages of those researches, one can notice that all these methods have very complicated and cumbersome logic of use. Some methods consist of more than 60 steps; thus, the projects aimed at improvement of real-world technological systems are very labor- and time-consuming.

Hence, the importance and actuality of development of relatively simple method utilizing the system of Patterns of Evolution for purposes of elimination of discovered drawbacks and disadvantages of technological systems.

The goal of author's research is to improve efficiency of using the system of Patterns of Evolution for purposes of both forecasting the future concepts and improvement of current technological systems. In the other words, the goal of this research is to improve usability of Patterns of Evolution.

#### **2. Suggested Method**

This goal was achieved through development of usable matrix of Patterns of Evolution, similar to Altshuller's TRIZ Contradiction Matrix.

The suggested method is based on the simple notion that “people improve a technological system by elimination of its drawbacks and disadvantages, and use for this purpose the resources most available at the time of improvement.” This notion does not need any explanations and proofs.

Author developed and used in suggested method the new categorization of main resources used for improvement of technological systems: substance, field, space, time, and information, e.g. need, cost, etc. The Undesirable Effect (UE) of Technological System is used as an input to the suggested method; this UE is determined as subjective-and-objective fundamental reason to invent, i.e. to modify the technological system.

Several hundreds of technological systems with known UE were analyzed. As a result, 36 generalized typical UE's were discovered. These typical UE's are presented in form of 6\*6 matrix. This matrix recommends the most appropriate Patterns of Evolution to eliminate the selected generalized UE. To generate the useful analogies while searching for the ways to eliminate the selected UE's, author used the following additional tools:

- Method of direct analogy: use of specialized knowledgebase of examples “UE → method of its elimination in different industries.” This knowledgebase contains results of analysis of real-world systems. This knowledgebase is organized in the way similar to one used for Function-Oriented Search (FOS): if functions are similar, the solutions might be copied and transferred from one industry to another. According to the Method of direct analogy, if UE is similar, the similar solution might be used to eliminate it.
- Method of forming the solutions, based on results of analysis of statistic frequency of combined actions of a Pattern and some of 40 Innovative Principles. The data is represented in form of empiric table called Matrix of relations between Patterns and Principles.

### 3. **Scientific Novelty of Research**

1. Author pioneered both the new categorization of UE of drawbacks of technological systems and new method of elimination of these drawbacks via direct use of exact recommendations based on Patterns of Evolution.
2. Author suggested use of three different formats presenting the recommendations on elimination of revealed drawbacks:

Format 1. Matrix “Typical UE → most probable Patterns to eliminate it.” In order to make the recommendations more clear, this format is accompanied with knowledgebase of real examples of using every Pattern of Evolution.

Format 2. Direct analogy “UE → example of elimination of this UE in different industries.” Knowledgebase of examples of elimination of each UE links every typical UE with Patterns of Evolution used for its elimination.

Format 3. Method of relationships between Patterns and Principles “Pattern → most frequently used for its realization Principles.” This Matrix matches Patterns of Evolution with Principles sorted by frequency of their use in realization of each Pattern.

Please, notice that formats 2 and 3 are used as support to realization of main format 1.

#### **4. Conclusion**

1. Methods developed in course of author’s research expand the usability of Patterns of Evolution in both forecasting projects and projects aimed at improvement of current technological systems. Since 2005, method had been tested in 7 real-world projects and improved based on feedback.
2. Suggested method is based on direct use of system of Patterns of Evolution via notion of Undesirable Effect. As a result, the analysis is more straightforward, less complicated, and less time- and labor-consuming in real-world projects.
3. The research involved additional usable methods based on direct analogies and empiric relationships between Patterns of Evolution and Innovative Principles.