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IMPROVEMENTS TO THE METHODOLOGY OF FUNCTION  
ANALYSIS FOR ENGINEERING SYSTEMS

Author's Abstract of thesis for the Master's Degree in TRIZ (TRIZ Master)

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Saint Petersburg  
2010

## INTRODUCTION

Function approach to analysis and problem solving has found extremely wide application in the implementation of innovation projects. At present detailed procedures for function analysis of Engineering System (ES) are used, and ES can be analyzed either as a product or as a technological process. The present work formulates recommendations for upgrading the practical value of function analysis results due to introduction of additional parameters - "time of function performance" and "place of function performance". In point of fact the author propose to consider a new type of functional disadvantages related to mismatch of actual place and/or time of function performance with required one (ones), which would extend the possibilities of using function analysis for describing ES and formulating non-trivial problems that couldn't be revealed using classical TRIZ-based function approach. In contrast to generally accepted parametric analysis, the author proposes an approach, in which not only a mismatch between function object parameters and requirements is described, but also the place and time where and when such mismatch takes place. The said description allows to identify contradictions requiring resolving in space and contradictions requiring resolving in time.

In addition, the author also formulated recommendations for performing function analysis of engineering systems at the stage of their operation. He also proposed to analyze ES as an operation process thoroughly taking supersystem interactions into account.

### **Utmost significance of subject matter of the thesis**

Construction of exact logical chain from identification of important problems to effective solution for these problems represents one of the most significant directions for TRIZ development at the present stage.

Classical TRIZ possesses powerful tools for problem solving - namely, standards, inventive principles, methods for contradiction resolving and other tools. Problem solving tools are quite developed, reliable and time-proved. They represent the basis or serve as an essential part of all modern versions of TRIZ - GEN3:Innovation Discipline (G3:ID), IdeationTRIZ (ITRIZ), eXtended TRIZ (xTRIZ) and others. All tools of classical TRIZ were successively included in ARIZ, which is currently being improved by many developers in the field of TRIZ.

Methods for analyzing initial situation and formulating "correct" problems include cause-effect analysis, flow analysis and function analysis (the latter is a primary tool among these methods).

Necessity for working out a reliable method enabling to analyze ES, identify and formulate key problems<sup>1</sup> and ways for solving them determine the utmost significance of the present research.

The research for this thesis was conducted according to traditions of Saint Petersburg (Leningrad) TRIZ school. These include emphasis on practical application of research results, extensive application of function approach and precise formulation of methodological recommendations.

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<sup>1</sup> Key problems are the problems, solving of which would enable to accomplish the project goals.

## Goals of research

Development of **Advanced Function Approach** is the main goal of the present research. This approach allows to identify "correct" key problems, formulate them in the form of contradictions, and to use classical TRIZ tools for resolving the formulated contradictions.

Additional goal of this research consists in enhancing the effectiveness of known TRIZ-based function approaches due to employment of spatial and time-related characteristics for function description.

## Object of research

A widely used method of Function Analysis of ES was chosen as an object of research. The author has analyzed the main stages of evolution of this tool - starting from developments of Lawrence D.Miles and ending with TRIZ-based methodology developed by researchers belonging to Leningrad TRIZ School.

The functional TRIZ-based approach, which is the most formalized, developed in detail and widely applied, was taken by the author as the base approach for his research.

Scientific research conducted by V.M.Gerasimov, S.A.Ikovenko, G.I.Ivanov, S.S.Litvin, A.L.Lyubomirskiy, V.M.Petrov, A.M.Pinyayev, M.S.Rubin, Yu.I.Fedosov and N.B.Feyngenson served as methodological basis for the present thesis.

## Major issues to be defended by the author:

- Methodological recommendations for conducting function analysis of engineering systems taking the additional parameters for function description - namely, "time of function performance" and "place of function performance" - into account.
- Methodological recommendations for using **Advanced Function Approach** for analyzing the initial problem and formulating non-trivial problems.
- Methodological recommendations for using **Advanced Function Approach** for conducting an analysis of available resources.
- Recommendations for conducting function analysis for engineering systems at the stage of their operation.
- Examples of application of **Advanced Function Approach** for solving practical problems.

## Scientific novelty of research

- New methodological recommendations for conducting function analysis of ES was developed. A distinctive feature of this methodology consists in the fact that when specific function is considered, not only a mismatch between object and function carrier parameters and requirements is described, but also the specific place and time where and when such mismatch takes place.
- A new type of functional disadvantages related to mismatch between the actual place and/or time of function performance with the required one (ones). Recommendations

were developed for identifying such disadvantages when conducting function analysis for ES.

- A methodological approach is proposed that enables to objectively formulate contradictions requiring resolving in space and contradictions requiring resolving in time. Contradictions are identified after conducting function analysis in proposed format.
- A methodology for conducting resource analysis was developed. This methodology is based on **Advanced Function Approach**. In contrast to existing methods, the proposed approach enables to avoid labor-and time consuming enumeration all available resources of system and supersystem potentially suitable for solving specific problem. Instead, a functional request for required resource is formulated, after which it could be found without any difficulties.
- It is proposed to analyze ES at the stage of its operation as an operational process taking into account all supersystem interactions. Practical recommendations on conducting such functional analysis were formulated.

### **Practical significance of research**

An enhanced version of function analysis was developed - namely, **Advanced Function Approach**, which is ready for use in innovation projects. Due to deep level of development, the proposed approach could be included in training materials for teaching TRIZ for engineers.

**Advanced Function Approach** makes the process of ES analysis more specific and focused on formulation of adequate problems, solving of which guarantees the accomplishment of project goals. Problems should be formulated in the form of contradictions requiring resolving in time or space, which facilitates application of problem-solving TRIZ tools.

In addition, such tools of modern TRIZ as Flow Analysis, Feature Transfer, Function-Oriented Search and ARIZ could be further improved based on developed **Advanced Function Approach**.

### **Personal contribution of degree-seeking candidate**

Statement of research task and goal, survey of approaches to ES analysis, development of methodological recommendations for conducting function analysis taking the introduction of "place and time of function performance" parameters into account, and development of resource analysis based on **Advanced Function Approach**, represent personal approach of degree-seeking candidate.

### **Testing of research results**

Fundamental issues of the thesis were reported by the author and co-authors of his publications at international conferences organized by European TRIZ Association TRIZFuture 2007 and TRIZFuture 2008, at international conferences organized by MATRIZ TRIZFest-2007 in Moscow and TRIZFest-2009 in Saint Petersburg.

The proposed approach representing a basis for **Advanced Function Approach** was used by the author in consulting projects performed by Algorithm, Ltd./GEN3 Partners. Inc. and when solving practical tasks at G3:ID training seminars at General Electric and Wrigley.

### **Structure and volume of thesis**

The thesis consists of introduction, five chapters, conclusion and list of references. The total volume of thesis is 45 pages including 16 Figures and 5 Tables.

### **List of published works related to the subject matter of thesis**

1. O.Feygenson, M.Urusova. Function Approach for Resource Analysis. Proceedings of European Conference TRIZ-Future 2008 "Synthesis of Innovation". Enschede, The Netherlands. November 5-7, 2008.
2. O.Feygenson. Function oriented resource analysis. Collected papers of International Conference TRIZ – Fest 2009, Saint Petersburg, 2009.
3. R.G.Khorenyan, O.N.Feygenson. Practical Techniques for Identifying Main Functional Parameters of Product Value. Collected papers of International Conference TRIZ – Fest 2007, Moscow, 2007. Presented at web site <http://www.metodolog.ru/01151/01151.html> (last download 20.05.2010, 16:54:00).
4. M.Ksenofontova, O.Feygenson. Innovative improvement of consumer products. Proceedings of European Conference TRIZ-Future 2007. Frankfurt, Germany. November 6-8, 2007.
5. M.M.Ksenofontova, O.N.Feygenson. Selection of Engineering Parameters for the Synthesis of New Consumer Goods. Collected papers of International Conference TRIZ – Fest 2007, Moscow, 2007. Presented at web site <http://www.metodolog.ru/01152/01152.html> (last download 20.05.2010, 16:57:00).
6. O.N.Feygenson. Analysis of Training Problem on ARIZ-85-C. Evaporation of High-Melting Ceramic Glazing Molding in Laser Beam. Presented at web site <http://www.metodolog.ru/01509/01509.html> 10.10.2008 (last download 20.05.2010, 16:50:00)
7. Advanced Function Approach. S.Litvin, N.Feygenson, O.Feygenson. European Conference TRIZ-Future 2010 (in print)