Standard VDI 4521 Part 1 in Blueprint

Опубликование предварительной версии нормы № 4521 Немецкого Инженерного Общества (VDI): «Решение изобретательских задач с помощью ТРИЗ»

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Abstract

VDI Guideline 4521 Part 1: “Inventive problem solving with TRIZ: Part 1 – Fundamentals and definitions” has been published in blueprint on 2015-04-01. We are giving reasons for undertaking this project and report on the standardization work procedure. The contents of the standard are summarized and some ideas about future tasks on TRIZ development and on the relation between TRIZ and other methodologies are presented.

Предварительная версия нормы № 4521 Немецкого Инженерного Общества (VDI) была опубликована 01.04.2015. В ней мы представили причины необходимости данного проекта по стандартизации ТРИЗ и докладыаем о ходе его реализации. Обобщенно описано содержание норм, а также опубликованы некоторые мысли о будущих заданиях в развитии ТРИЗ и отношении между ТРИЗ и другими методиками.

Introduction

After the end of the separation between Warsaw-Pact and so-called Western countries, the methodology of TRIZ spread out world-wide and grew up with new ideas and refinements. New thoughts, influence of other theories such as value analysis, as well as translations between various languages, have had the effect that both the inventory of tools and methods has grown and the terminology has been enlarged. By the year 2010, different terms were being used for the same subject and different subjects were called by the same term. This situation is productive on one hand but has disadvantages as well:

- Students of TRIZ cannot well compare different sources of literature to deepen their understanding.

- Beginners confine themselves to single parts of TRIZ and may misunderstand the whole theory.
- Wrong conceptions of TRIZ will come up and will get passed on and multiplied.
- If the theory is not well understood, methods of TRIZ will get mixed up with other theories and their original conception may get lost.
- Users and researchers need exchange and discussion. For this purpose, they need a common language and understanding.
- In order to present TRIZ as a state-of-the-art methodology which ought to be part of technical education, TRIZ should have a generally accepted body or core, i.e. a standard.

The idea of collecting generally accepted knowledge of TRIZ has already been seized before 2010 and a Body of Knowledge has been compiled by Litvin, Petrov, and Rubin [1]. This valuable work is now leading to a set of standard documents with a – hopefully – broad impact. After various discussions within the TRIZ community at MATRIZ and ETRIA conferences 2013 and 2014 [2] and on www.linkedin.com as well as in cooperation with the association of engineers, VDI, we have edited a first part of this document. It has been published in blueprint as VDI 4521 Part 1 (www.vdi.eu/4521) on April 1st, 2015. Objections can be filed until Sep 30th, 2015. The process of this work is being continuously presented and discussed with the international TRIZ community. In the year 2020, the standard will be revised. This does not exclude the possibility of discussing its contents in the meantime.

Standardizing TRIZ

VDI was founded in 1856 and represents 150,000 members world-wide [3]. VDI sees its mission in acting for engineers and engineering in society. Besides this, VDI is a major organization setting technical standards. There are some 2000 valid VDI Guidelines (i.e. standards) at this moment [4]. Characteristics of these standards are:

- VDI guidelines are made by engineers for engineers in non-paid work.

- VDI guidelines describe the state of the art – that is, only approved knowledge can be standardized.
- VDI guidelines are generally approved technical rules.
- The majority of the guidelines are multilingual.
- After 5 years, every standard is re-evaluated. If the state of the art has changed, the standard is removed or updated.
- In contrast to ISO, CEN or DIN standards, VDI guidelines are not set by companies but by individual experts who decide with one consent.
- Cost of standardization work is covered by selling the standards via Beuth Editions, Berlin.

The main reasons why VDI was chosen for cooperation were the international reputation of TRIZ standards and the way of working in a group of individual experts without economic interests of any party. A certain drawback may lie in the fact that VDI claims the copyright for the product so that it may not be freely circulated among users. In terms of TRIZ, this constitutes the contradiction "The standard *shall be* a VDI standard *in order to* enjoy VDI quality *but it shall not be* a VDI standard *in order to* be freely available".

There have been several objections about setting a standard on TRIZ which were discussed in [2]. The main fears expressed concerned a possibility of restricting the free use and further development of TRIZ. A VDI standard, however, only describes one – generally approved – way of designing objects or performing work. It does not hinder anyone from doing his work in other ways. On the contrary, any TRIZ user may refer to VDI 4521 and point out in what way his result differs from or is better than the standard.

Work Schedule

The first meeting of the guideline committee took place on Oct. 10th, 2013 on which Kai Hiltmann was elected chairman of the board. The preparative work was described in [2]. Valeri Souchkov was preparing a collection of TRIZ terms in English [5] with short explanations, based upon the Body of Knowledge [1] among other sources. The committee, Table 1, first decided upon the structure of the standard:

Part 1 – Basics of TRIZ and definitions of fundamental terms

Part 2 – Modelling the Problem

Part 3 – Solving the Problem

Parts 2 and 3 will concisely describe the tools used for the respective goals. Along with this, the terminology related to the tools mentioned will be defined.

A subcommittee consisting of Robert Adunka, Karl Koltze, Pavel Livotov, Oliver Mayer, and Christian Thurnes worked through V. Souchkov's list and prepared a proposal on which terms should be regarded as fundamental and which as related to specific tools. Double terms were merged into one, their definitions were edited so that they would each fit into a single sentence, and German translations were sought in accordance with the most established terms in existing literature [6–14]. The procedure has also been described in [2]. K. Hiltmann contributed general information on TRIZ.

Table 1 VDI 4521 Part 1: Members of Committee. "VDI": VDI member

Robert Adunka, Erlangen (vice chairman)	Oliver Mayer VDI, Munich
Alexander Czinki, Aschaffenburg	Jürgen Meier VDI, Hanau
Barbara Gronauer VDI, Hünfeld	Bert Miecznik, Igersheim
Kurt Götz VDI, Würzburg	Hermann Mohnkopf VDI, Rangsdorf
Michael Hartschen VDI, Wangen (CH)	Wolfgang Müller VDI, Düsseldorf
Claudia Hentschel VDI, Berlin	Horst Nähler VDI, Hünfeld
Kai Hiltmann VDI, Coburg (chairman)	Bruno Scherb, Herzogenaurach
Norbert Huber VDI, Weidenbach	Leonid Shub, Peissenberg
Karl Koltze VDI, Krefeld	Valeri Souchkov, Enschede (NL)
Pavel Livotov VDI, Offenburg	Christian Thurnes VDI, Zweibrücken (vice chairman)
Rainer Lohe VDI, Siegen	Tobias Wigger, Siegen

The whole committee would then discuss the results on several meetings which resulted in changes of various parts of the work. The whole process took

approximately one year, seven meetings of the whole committee at different locations in Germany, and many nights of work of the subcommittee.

After passing the blueprint version of part 1, work packages were distributed for parts 2 and 3, Table 2, some of which are still uncovered. Not yet decided to date is the question of what further languages the standard shall be translated to. The committee strongly favours a Russian edition; its realization will depend on the editor's market expectations. Other languages such as French, Korean, Malaysian and Farsi (Iranian) would be desirable as well.

A solution to the contradiction given above will be mentioned at the conference.

Contents of Part 1

The standard is structured into three main sections:

1 Scope: describes the intention of VDI 4521 in accordance with the disadvantages of the current situation as named above.

2 Terms and definitions: lists the fundamental terms of TRIZ together with a short (one sentence) definition of each term.

3 Basic principles: short description of the fundamentals of TRIZ with subsections

3.1 Solution structure and contradiction approach: TRIZ in relation to general problem solving, the contradiction approach, and system orientation.

3.2 Use of TRIZ: Concrete problem → model building / TRIZ generalization → general solution → concrete solution

3.3 Generic problem solving process with TRIZ: Example of applying TRIZ in the process of product development with steps to be taken, intermediate results, and suitable TRIZ tools.

3.4 Basic assumptions of TRIZ: Short explanation of ideality and ideal final result as well as principles of the evolution of technical systems.

3.5 Tools of TRIZ: Table of tools which will be explained in parts 2 and 3

Table 2 Parts 2 and 3 with distribution of work packages (R: responsibility, C: cooperation)

Part 2 Description of Objective , Problem Definition, and Priorization of Solution			**Part 3 Solution**		
Ideality	R ✓	C ✓	Contradiction		
TRIZ Forecast	R ✓	C ✓	Inventive principles		
Function analysis, function model	R ✓	C ✓	Anticipatory failure identification		
Innovation Situation Questionnaire	R ✓	C ✓	Catalogue of effects		
Problem formulation	R ✓	C ✓	Feature transfer		
Root-conflict-analysis	R ✓	C ✓	Laws of engineering systems evolution		
Cause-effect chains analysis	R ✓	C ✓	Function-oriented search		
Patent circumvention	R ✓	C ✓	Size-time-cost operator		
			Resource analysis		
			Principles of separating Contradictory demands		
			Substance-field analysis		
			Inventive standards		
			System operator		
			Trimming		
			Contradiction matrix		
			"Smart little people" model	R ✓	C ✓
			ARIZ		

Further Work

TRIZ work – the work of composing the standard comprised defining terms. The committee has generally used definitions which are widespread in the TRIZ community. There were however some terms which caused considerable discussion. Among these are the terms

"function": "Influence from a system or a system component upon one or more others which changes, eliminates, or maintains a parameter of the other component or system." – Since the influence from one system component acting upon another is an influence inside the system, it is a function of the system upon itself. Moreover, in practice the correct formulation of functions appears to be a task nearly impossible to the average user. Evidently, the theory does not explain well what a function is. We therefore see some need for elaboration of function theory in TRIZ.

"field": "Effect onto an object which influences, i.e. changes or maintains, properties of the object." – Ikovenko [15] and Feygenson [16] define a field as "an object without rest mass that transfers an interaction between substances" which seems to be logically consistent with Functional Analysis and may be better suited but is very hard to imagine. Anyway, the relation between function and field is not clear.

"technical system": "Man-made assembly of several interacting elements which meets a purpose." – Do not all man-made objects meet a purpose – at least to please their creator – and does not an anthill or a woodpecker's nesting hole meet a purpose as well? As it seems, technical systems are not necessarily man-made.

Further topics which seem worthwhile for future examination may include resource analysis on which Lyubomirskiy [17] presented a very valuable work, and clarification of the relation between Su-Field and Functional Analysis with their terms "substance" vs. "component".

TRIZ and other methodologies – the committee debated over the question to what degree the guideline on TRIZ should be regarded as separate from or related to other methodic systems such as *VDI 2221: Systematic approach to the development and design of technical systems and products* and *Value Analysis* (*VDI 2800 et sqq.*). It was decided to keep it separate in general, only

mentioning other guidelines. This is in contrast, though, to the aim of VDI to cover all areas of technology and to relate and harmonize guidelines with each other. Moreover, TRIZ has profited earlier from outside stimuli like Synectics which led to the “Smart Little People” model and Value Analysis (VA) which influenced Functional Analysis as well as the Laws of Engineering Systems Evolution. One very promising concept is seen in the FAST functional diagram [18,19] which may potentially contribute to further develop TRIZ system theory. TRIZ and the user might finally benefit from harmonization of terms used in different contexts. One of the authors has therefore joined the committees of VDI 2221 and VDI 2803: *Functional Analysis* (notably for VA). Even though it may not be necessary to adapt terminology – which, in case of VA happens to be rather cumbersome –, it will be worthwhile to rethink the models made by other methodologies in terms of TRIZ.

Conclusions

VDI Guideline 4521 Part 1: “*Inventive problem solving with TRIZ: Fundamentals and definitions*“ has been published in blueprint on 2015-04-01. The standard will provide a basis for common understanding of terminology and concepts without hindering further development and intentional deviation from this basis. Discussion on the standard among TRIZ users should be encouraged for deeper understanding and further development of the theoretical background of TRIZ. Any shortcomings which may be observed during the application period will be corrected in the following edition.

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