Dietmar Zobel, Wittenberg

Contributions to the further development of TRIZ

Preliminary remarks by the publisher

In developing TRIZ as an inventive methodology, G.S. Altshuller made the explicit claim to develop „Creativity as an exact science“ (the title of one of his books). The scientific core of the theory comprises a number of basic methodological approaches and principles, but is closely related to practical experience, coming initially from a detailed analysis of a large patent fund and today (also) from the experience collected during practical applications by a growing TRIZ community. Different versions of ARIZ as algorithmic versions of TRIZ create the link between theory and practice – a processual methodology that transforms the theory into an algorithm when you consider the term *algorithm* not too narrow at this point.

Such an approach *theoria cum praxi* in the tradition of G.W. Leibniz[1] is in the basics of an institute like LIFIS – the Leibniz Institute for Interdisciplinary Studies. We particularly want to bring the legacy of the GDR Inventor Schools of the 1980th to the attention of the TRIZ community[2]. The extensive work of *Dietmar Zobel*[3] as an practitioner until these days is an inherent part of that heritage and goes beyond that. His contributions to the development of TRIZ are described in detail in his methodological books (Zobel 2007), (Zobel 2009), (Zobel/Hartmann 2016), (Zobel 2018a) and (Zobel 2018b).

These books systematise the author's great wealth of practical experience from decades of own inventiveness, especially in the chemical industry, and sharing those experiences in training and teaching with colleagues. This experience has given cause for the author’s critical contribution to the TRIZ foundations, where c*ritique* is to be understood as scientifically based criticism – an essential element of a lively development of any theory.

In this small note, the author presents a summary of his interpretations, suggestions, extensions and modifications to Altshuller’s methodology in a condensed form.

Hans-Gert Gräbe, January 10, 2020

Contributions by the author to the further development of TRIZ

The author's main contributions to the further development of TRIZ are presented here in twelve items in a condensed form. For more detailed information on the individual points the reader is referred to the books (Zobel 2007), (Zobel 2009), (Zobel/Hartmann 2016), (Zobel 2018a) and (Zobel 2018b).

1: *A hierarchy of the principles for solving technical contradictions is proposed. The proposal is to distinguish I: universal principles; II: Less universal principles; III: Solutions useful for certain special domains*.

Altshuller’s contradiction matrix can – not only based on my personal experience, but also after the investigations by (Möhrle 2003) – hardly called accurate. This applies also to the new versions developed in 2003 and after (Mann 2004). But since the Principles for solving technical contradictions *as such* are applicable and helpful, I think a hierarchy as given above is the methodologically better solution: First the universal principles (I) should be considered, then the less universal principles (II),

1 See, for example, Eberhard Knobloch. Theoria cum praxi. Leibniz und die Folgen für Wissenschaft und Technik. (Theoria cum praxi. Leibniz and the consequences for science and technology). Studia Leibnitiana, Vol. 19, H. 2 (1987), pp. 129-147.

2 See the essays *Hegel, Altschuller, TRIZ. Zehn Anmerkungen* (Hegel, Altshuller, TRIZ. Ten notes), LIFIS-Online 25.09.2016, and *Erfinderschulen – Problemlöse-Workshops. Projekt und Praxis*. (Schools of invention – problem-solving workshops. Project and practice), LIFIS-Online 03.07.2016, by Rainer Thiel.

3 http://www.dietmar-zobel.de

and only if nothing has been found then that of category (III). Usually there are enough universal principles (I), and those of categories II and III are, closely considered, almost all subordinate to Category I.

2: *A new view on the reversal and analogy effects is proposed. Even top scientists and famous explorers have methodological deficits in that direction*.

The physical effects are among the most important tools of the inventor in the requirements analysis and the system-creating phase. They describe the (non-protectable) *Cause-Effect Relationships* and provide high-quality suggestions on how to use them for (protectable) *Means-Purpose Relationships*. Two special categories of effects are of great importance: the *reverse effects* and the *analogy effects*. It can be shown on impressive examples that apparently also top scientists – here: *famous inventors* – not "automatically" check whether there is or could be a *reverse* or *analogy* effect to their newly discovered effect gives or could give a reverse effect or an analogy effect. That's way the strange fact is to be observed that the reverse effects are almost regularly discovered by other physicists than the discoverer of the "original effect", and also only years or decades later. For the analogy effects the situation is complete similar, but this can (in contrast to the situation with the reverse effects) be explained: The best analogies are usually found far beyond the area of the discoverer's speciality that has a "hypnotic" influence on his thinking.

3: *The original sample collection from mechanical engineering was extended by examples from other areas, especially chemical technology.*

The printed publications on the subject not only by Altshuller, but also by current authors are still dominated by mechanical and purely physical examples. The important area of *chemical engineering* at the border of physics, chemistry and mechanical engineering is clearly underrepresented. Based on own inventive experience, many methodically convincing examples from that area are provided.

4: *TRIZ elements can also be found as elements in more general applications of thinking: in literature, in cartoons, in advertising and other non-technical fields.*

In the latest TRIZ literature, too little attention has been paid to the fact that TRIZ is basically rooted in *Hegelian Dialectics* (*thesis – antithesis – synthesis*). It follows that in principle in *all* areas, including the clearly non-technical ones, "TRIZ thinking" should play a significant role. I have shown with examples that this is the case – not necessarily being aware especially to the artists. Creative solutions, however, regardless of the area under consideration, are always especially convincing or stimulating if an *inner contradiction* and its *surprising solution* are presented. I know publications on TRIZ applications in advertising, personnel management and other non-technical areas, but the basic reference to the above-mentioned Hegelian Dialectics is missing. If this had been taken into account, one could well have dispensed with the often almost convulsive "translation" of Altshuller's principles (formulated for applications in the area of technology) in the respective non-technical terminology.

5: *A new law of development of technical systems is proposed: "The functional reliability of a system is not primarily determined by design considerations, but rather by the necessities resulting from the Procedural and Functional Principle.*

When designers are given a task, they often immediately sit down at the computer and begin to work without first thoroughly analysing the problem to be solved according to the rules of TRIZ. They start with the second step before the first. The construction that was started once practically exercises a magical effect, and work will only continue in *this* direction, even if this too hasty selected type of construction is not optimally suited to solve the challenge. It is basically required to address the problem first in terms of the *function* to be guaranteed, and only then to construct it. That may sound banal, but practice things are even worse: if the management and marketing people in an enterprise have more powers than the designers, which is often the case, then there is even less attention paid to the so important functionalities (*Tucholsky: "No quality, only facilities"*).

6: *The concept of fields of thought and chains of ideas is proposed as systematic multiple application of one and the same physical effect for analogue solutions in quite different areas. The common ground is the use of the By Itself Principle.*

Using a specific physical effect, very different (better: *supposedly* different) tasks can be solved. That is undisputed and consensus under TRIZ-niks, although *expressis verbis* not formulated in this way. What is missing are convincing examples in the sense of a "chain of ideas", something like this: I have solved an inventive problem with the help of a certain physical effect and ask which *further* problems (which I am not currently dealing with) could be solved using the *same* effect. Convincing "chains of ideas" of this kind I have not yet found in the literature. I use the "*sucking effect of a hanging or slowly flowing down liquid column*" for the demonstration how this effect can multiply used for automatic *filtration*, automatic *distillation* and automatic *degassing*. All three solutions have proved to be protectable and were patented. At the same time, they convey convincingly what I consider to be especially important (even universal) in Altshuller's Principle No. 25 "By itself".

7: *The principle "by itself" is the fine art of systematic invention.*

Many systems are highly complex and must be so, otherwise we would have probably never reached the current level of technology. However, no system is required *per se* to be highly complicated in *all* of its parts. There are always system parts that could work with very simple means (or even according to the principle by itself) if appropriately designed. In addition, there are still systems that work *in all their parts* by the principle by itself, if instead of highly complicated technical means, *natural forces* such as gravitation, magnetism, buoyancy, cohesion, adhesion etc. are used. In the broadest sense systematic applications of such natural forces fall under the particularly important universal principle No. 25 "By Itself". That's why in my view it is justified to treat and methodically emphasize this principle separately – as well with detailed, convincing examples. In chapter 6.9 of (Zobel 2018a) details about this under the above heading are explained.

8: *The importance of the further developments of ARIZ-77 is overestimated.*

Today ARIZ-85B or ARIZ-85C are usually used, at least inside the modern TRIZ community to achieve a higher level within the certification process. In the *generally accessible* sources, however, there are almost no detailed practical examples, which describe the processing of a concrete topic in a comprehensible way. A positive exception seemed to be the work (Koltze/Souchkov 2017) until I noticed that the lightning conductor example explained there is an old example already given in (Altshuller 1984). Koltze and Souchkov applied ARIZ-85C to the same problem that Altshuller had already been processed convincingly using ARIZ-77. *Concrete evidence on specific business issues* in relation to this older, in my opinion still very useful ARIZ-77 I have not found. Two own examples describe on the one hand the solution of a safety-related problem in the transport, on the other hand the solution of a processing problem in chemical technology. The first example led to a registered design, the second to a patent.

9: *The morphological table is a two-stage applicable universal tool and should be integrated into ARIZ.*

(Zwicky 1959) developed morphology as a comprehensive, independent method. Nowadays, it has become common practice to use only one component of his method, the Morphological Matrix (morphological table), on its own. This just happens not only without connection to the overall morphology, but also without connection to other methods. In my opinion, the connection with ARIZ would be useful, considering the double character of the table. On the one hand, it delivers a comprehensive description of the system worked on by the inventor (morphological analysis: *given* variant combinations). On the other hand, it provides the possibility to recognize *unusua*l combinations of variants and to use them inventively. That's why I proposed to insert the morphological table in ARIZ on two positions: at a suitable point on the system-analytical level on the one hand, and as a *tool* in the system creation level on the other hand. As a detailed example I presented a morphological table with interpretation on the topic “Airship”.

10: *The Dimension-Time-Cost operator according to Altshuller has a systemic double function. This is explained on an exotic “by itself” example.*

Altshuller's operator “dimensions, time, costs” has a double function. On the one hand in the early phase of problem solving, it ensures that extreme cases and parameter scopes do not remain completely unnoticed. So the premature “channeling” of thinking is avoided, which would result in an overly restricted scope of the sphere of activity towards the intended invention (it would lead to a “*selection invention*”). On the other hand, the systematic inclusion of extreme parameter scopes leads in the best case to completely new tasks that can be useful to process. At least our general knowledge level will be improved and the field of vision expanded. Coupled with Altshuller’s principle “*incomplete solution*” I carried out corresponding experiments: Making copies using natural, not specially prepared, factual free materials such as plywood, newspaper edges and tree leaves, see (Zobel 2018a).

11: *For the first time, instructions for drafting patent specifications using the contradiction-oriented terminology were provided.*

Even a highly creative solution does not achieve patent protection if the text of the application is poorly formulated. Using an own example from the area of chemical technology, I have shown how useful a contradiction-oriented terminology can be for a successful patent application. A special role is played by the *presentation of the essence of the invention*. First of all, it must be explained which parameters – and why – interfere with each other and thus stand in the way of solving the problem by *conventional* means. Then, the resulting obstacle on the way to the desired goal must be formulated as an apparently *insoluble* contradiction. The section should be terminated with a standard record, that reads: "The present invention resolves this contradiction".

12: *TRIZ-based questions were used as tools for evaluating current processes and products, for evaluating projects and for evaluating newly developed solutions.*

There are already numerous methods for evaluating processes and products. For example the following methods are applied: scoring models, utility value analysis, value analysis according to DIN 69910, overhead cost value analysis, decision table technology and risk analysis. These methods claim to work scientifically. In practice, however, consciously or unconsciously, always a lot of subjectivity influences the evaluation. The methods are hardly suitable for objectively assessing proposals, plans, solutions and projects. In the chapter “TRIZ-oriented assessment replaces subjective judgement” (Zobel 2009) I therefore proposed specifically TRIZ-oriented, practical assessment questions for the purpose of improving objectivity for the categories:

- Evaluation of existing or given products, processes or systems,
- Assessment of plans, projects or specifications,
- Evaluation of innovative solutions or newly created systems.

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