From TRIZ to Asit in 4 Steps

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ASIT (Advanced Systematic Inventive Thinking) is a creative thinking method derived from TRIZ. This article describes the four main steps that transformed TRIZ into ASIT.

The motivation to develop ASIT arose while I was learning TRIZ and started using it and teaching the method myself. Though I recognized very early the effectiveness of TRIZ, I also noticed some flaws that I thought could be adjusted.

My acquaintance with TRIZ started in 1988 when I saw an advertisement in an Engineering magazine: “40 hour Inventive Thinking course”. I was intrigued. “If someone can fill 40 hours teaching me how to invent, then there must be something in it”. I signed up without a moment’s hesitation.

After the second lesson I already knew that I had found what I wanted to spend my life doing. The instructor was Ginadi Filkovsky who had studied with Genrich Altschuller, the originator of the method. From the very first moment, I felt that Ginadi expressed with clarity and accuracy ideas that had been bouncing about in my own head for some time, but that I was unable to trap and transform into communicable knowledge.

Despite my enthusiasm for the method, I remained disturbed by a particular phenomenon related to it and to the way it was being taught. Before I elaborate, let me tell you about one of my experiences in the course. In one of the lessons, we were given the following problem to take home (a TRIZ classic): metal balls are moving rapidly through a pipe with a bend in it. At the point where the pipe bends, the balls hit the “walls” of the pipe, scraping against them and causing damage. The problem we had to solve was how to prevent this from happening. At home I immediately began trying to approach the problem according to the method we had been learning.

“It works!” I exclaimed when I arrived at the following solution: Pour oil into the pipe and cool the pipe at the point where it bends. A thin layer of the oil will freeze at the bend, thus protecting the pipe. I volunteered to present my solution on the board at the next lesson, and waited in anticipation for Ginadi’s response.

“Very nice,” he said, “but now let me show you a more elegant solution”. I could hardly believe my ears – a more elegant solution?

Ginadi presented a solution in which the metal balls themselves, rather than the oil, could protect the pipe. Creating a niche at the point where the pipe bends can do this. What happens is that the balls accumulate in the niche and thus shield the inner wall of the pipe. In fact, what holds the metal balls inside the niche are actually the metal balls themselves. As they move through the pipe, they hit the bend and keep the other balls in the niche.

I had to agree that this was truly an elegant solution, but as was the case many times before, I was left with a problem: I believed in the method, but failed to understand why we all too often failed to come up with the “text book solution”.

Step one: From ‘Ideal Final Result’ to the ‘Closed World’ condition

This continued to puzzle me for many years until I finally thought of an idea, which, as is typical of such cases, turned out to be amazingly simple. One day I decided to review my collection of inventive solutions (which had greatly expanded since Ginadi’s teaching), seeking new insight. It was then that I noticed something that almost all the solutions had in common (and most definitely the most elegant ones!): not one single solution involved the addition of a new type of component into the problem world.

I continue to examine this new finding, and I did not come across an exception to this rule. This principle was added to the method, and came to be known as the “Closed World condition <http://www.sitsite.com/method/inpages/frame_solving_articles.html>”. Had I been aware of this condition while working on the pipe problem, I would probably have arrived, along with many others, at Ginadi’s solution. (The Closed World condition would simply not allow me to add oil, as it is a new type of object).

TRIZ also favors using existing resources for solving a problem. But in contrast to ASIT, this principle is scattered around the method. It can be found in the principle of Ideal Final Result (“the best system is when there is no system” – Altshuller), and in some of the forty principles (e.g. Principle 25 – *Self-service* calls for using an existing object to work on itself instead of bringing in a new one).

The difference between TRIZ and ASIT in this respect is that in ASIT the Closed World condition is THE most important principle. In fact, the first step in using ASIT is to define the problem world. Once defined, the problem solver knows that all the building blocks for the solution are right there in front of him and that the solution simply requires the reorganization of the existing objects. This adds great focus and power to the method. It also turns every real problem into an amusing puzzle.

Step two: From ‘Resolving Contradictions’ to ‘achieving Qualitative Change’

The Closed World condition deals with the resemblance between the problem world and the solution world. It is thus obvious that we need another principle, one that will establish the difference between the two worlds. The idea of resolving contradictions was a good starting point.

Altshuller’s greatest contribution to the science of invention was, in my opinion, the idea that inventive solutions overcome contradictions (whereas routine solutions rely on compromise). Going back to the example of the pipe and metal balls, we can analyze the contradiction as follows: Increasing the velocity of the balls improves the system’s throughput but also increases the wear and tear of the system.

From the way TRIZ defines a contradiction it is easy to identify one, but TRIZ does not clarify what *“resolving a contradiction”* means. I have, indeed, seen many TRIZ examples in which the contradiction was very well defined, but the solution did not really seem to overcome it. For example, suppose we use a pipe made of a much harder material, does it overcome the contradiction? A clear indication of what it means to resolve a contradiction is important, because otherwise, instead of using TRIZ to find *new* ideas, people will use it to justify their *old*ideas (I’m sure that many TRIZ instructors know exactly what I mean here…)

In my search for a clear criterion, I once again carefully explored a large collection of inventive solutions and discovered something interesting: In real inventive solutions there is a change in the system’s response to the main problem factor (the main problem factor is a variable determining the intensity of the problem; for example, the *velocity of the balls* is the *main problem factor* in the pipe problem). Before the problem is solved, the main problem factor is directly related to the intensity of the undesired effects. After the solution has been found, the main factor either has no influence or its influence is reversed (so that this factor actually improves the situation). The outcome is a robust design insensitive to the value of the main problem factor.

For example, as regards the case study of the metal balls, in the problem the damage to the pipe increases with the velocity of the balls. In the solution (since there is no direct contact between that balls and pipe) the damage to the pipe ceases to be related to the balls’ velocity at all. (See figure 1).

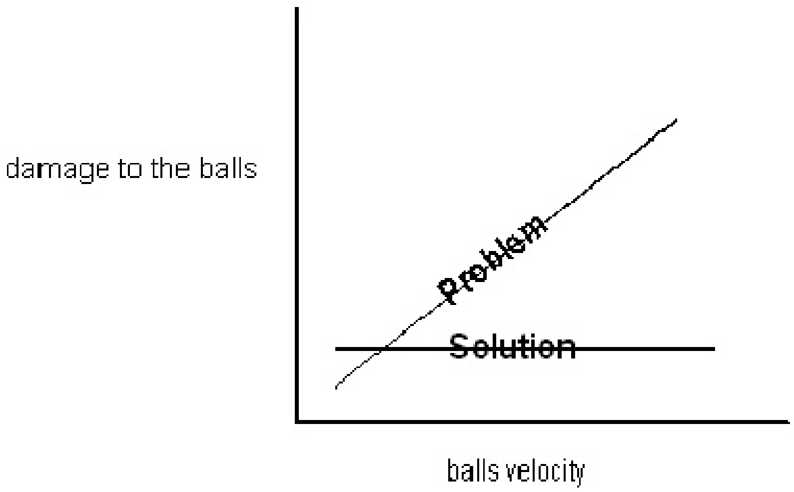

Figure 1: How the system's response to the velocity of the balls changed.

This finding was generalized to become ASIT's Qualitative Change principle, which is defined as follows: Look for solutions in which the influence of the main problem factor is either totally eliminated or even reversed.

This is a good criterion since it is very easy to test whether a specific solution satisfies it or not.

Step three: From the 40 principles to ASIT's five idea-provoking tools

Up until this point we've seen ASIT's two rules, the Closed World rule and the Qualitative Change rule. These rules are very effective in weeding out old ideas but we still need a mechanism to create new ones. More specifically, we need tools to help us identify hidden opportunities within the closed world. The place to look for these tools is, of course, in TRIZ's 40 principles. These 40 principles are TRIZ's main operational tools for developing ideas. There are, however, some obvious drawbacks to this approach:

1. **The principles do not operate on a uniform abstract level**: Some of the principles are very general (e.g. Principle 17 – Another Dimension) and others are very problem-specific (e.g. Principle 18 – Mechanical Vibration, and Principle 29 – Pneumatics and Hydraulics).
2. **The frequency of use is not uniform**: Some of the principles are used very often (e.g. Principle 17 – Another Dimension) and some are rarely used (e.g. Principle 7 – the Nested Doll).
3. **There are too many principles**: Since 40 principles are difficult for the problem solver to follow (because there are simply too many of them) TRIZ organizes the 40 principles in a 'contradiction matrix'. Each type of contradiction, identified by the physical variables involved, is matched with a small set of principles. The problem with this (sometimes very powerful) approach is that:

1. It is time consuming to identify the variables (leading to frustration when a solution is not attained)
2. The variables are very much tied up with engineering problems (while TRIZ is powerful enough to be a universal problem solving method)
3. Training requires repetitive exercises (e.g. solving 10 problems for each principle) which cannot be practically accomplished with 40 principles.

To resolve the issues above, TRIZ's 40 principles were reduced to ASIT's five idea-provoking tools by: eliminating principles that are too problem-specific; eliminating principles that are not used very often; grouping similar principles together.

The result was the identification of the following five idea-provoking tools:

1. **Unification**: Solve a problem by assigning a new use to an existing component (the pipe and metal balls problem is solved by Unification – the balls are put to a news use, i.e. protecting the pipe).
2. **Multiplication**: Solve a problem by introducing a slightly modified copy of an existing object into the current system.
3. **Division**: Solve a problem by dividing an object and reorganizing it parts.
4. **Breaking Symmetry**: Solve a problem by turning a symmetrical situation into an asymmetrical one.
5. **Object Removal**: Solve a problem by removing an object from the system and assigning its action to another existing object.

Here are a few examples of how ASIT techniques were formed from the 40 principles:

- Principle 3 **– Local Quality** (e.g. Change an object's structure from uniform to non-uniform), Principal 4 – **Asymmetry**, and Principle 17 – **Another Dimension**, were grouped together under ASIT's **Breaking Symmetry technique**.
- Principle 15 – **Dynamics** is achieved under ASIT's **Division** and **Breaking Symmetry** techniques.
- Principle 6 **– Universality** (e.g. Make a part or object perform multiple functions; eliminate the need for other parts) is achieved by using ASIT's **Object Removal** and **Unification** applied one after the other.
- Principle 7 - **Nested Doll**, and Principle 8 – **Antiweight**, Principle14 – **Spheroidality**: **Curvature** eliminated due to it being too specific.

One interesting aspect of ASIT's five idea-provoking tools is that each can be related to a specific mental block. For example the Unification technique helps overcome Functional Fixedness while the Division Technique help us deal with Structural Fixedness.

Note: The next article in this series will supply detailed examples for the use of the five tools.

Step four: Eliminating other TRIZ elements

In addition to the contradiction matrix, the 40 principles and the ideal final results were transformed into ASIT's two rules (Closed World and Qualitative Change) and five tools (Unification, Multiplication, Division, Breaking Symmetry and Object Removal). In TRIZ there are many elements that were excluded from ASIT's framework.

Here is a list of some of them and an explanation for why they were excluded:

Standard solutions and physical effects

One of TRIZ's tools is a collection of ready-made, highly domain-specific standard solutions and physical effects. This collection represents invaluable knowledge and can definitely assist an engineer in trying to solve tough problems. Moreover, a collection of knowledge units such as standards and effects lends itself easily to computerization, and in fact some products do already exist (see for example www.cobrain.com). To keep ASIT as a pure thinking (as opposed to knowledge) tool these elements were eliminated.

Evolution of systems

This TRIZ tool is used to make forecasts as to the future development of an existing product. One of the uses for this capability is to invent new products. ASIT can also be used for the same purpose.The third article in this series will report, in detail, on how ASIT can be used to invent new products.

The little man method

The "little man" is a TRIZ tool that is used to model ideas on an abstract level. Although it is certainly a powerful approach it is, once again, a specific approach useful mainly for problems in the physical world in which geometry plays an important role.

Summary

I tried to depict in this article the main steps that transformed TRIZ to ASIT. The move was motivated from the desire to create a method that will be easier to learn and retain (achieved through a smaller number of rules and tools), more universal in application (achieved through elimination of engineering-specific tools) and tighter in keeping the problem solver within a real inventive framework (the closed world principle does the job here).

ASIT should be viewed more as complementing TRIZ than a replacement. Some people would find it easier to start their problem solving experience through ASIT and then move to TRIZ especially if they are more into mechanical type problems. Other people may start with TRIZ then decide ASIT is more suitable for them. Next month I will bring some examples and case studies demonstrating the application of ASIT's five idea provoking techniques.

References

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