How to Find and Formulate Contradictions out of the Initial Problem Situation

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Abstract

The main power of TRIZ originates from the systematic way to eliminate the contradictions involved in our problems. However, TRIZ looks a very poor methodology from the viewpoint of how to find and formulate contradictions covered by the initial problem situation. As TRIZ is getting more familiar to engineers, the need to find and formulate contradictions from their problems is on the increase. In this paper, we show the approaches to the method for derivation of contradictions at the beginning of problem solving. Based on understanding of OTSM-TRIZ, the main idea of 'Full Scheme' is required to vary the initial problem description. For better formulation of contradictions, different problem descriptions have to be offered according to various viewpoints such as 'Level of Purpose', 'Level of Abstraction', 'Cause-Effect', 'Level of Ideality', 'Size', etc. After deployment of various initial problem descriptions, ENV model and TOP analysis have to be adopted to formulate contradictions.

1. INTRODUCTION

TRIZ has been introduced as a powerful methodology to eliminate contradictions derived from problems. To overcome contradictions, TRIZ provides the solver with several thinking tools such as 40 principles, separation rules, substance-field model, etc. According to TRIZ, creativity depends on how to use them proficiently. The starting point of creativity must be with contradictions formulated from the problem. However, no tools of classical TRIZ show the way to find and formulate contradictions from the initial problem situation. ARIZ starts with only technical contradictions without any process for making them out of the initial situation. The difficulty on this point have the engineers too embarrassed to follow the problem solving procedure with TRIZ even though they are familiar to TRIZ. In order to be a more applicable methodology, TRIZ must evolve to the system that has not only contradiction solving tools but also the ways for drawing out contradictions from the initial situation.

In this paper, we tried to show how to reveal and formulate contradictions as a process. First of all, we are going to proceed to how to transform the initial problem to various problem descriptions. G. Altshuller gave us some clue in Part 3 of ARIZ. He converted a physical contradiction in ‘Macro-level’ into in ‘Micro-level’. We thought something happens during the transformation of a contradiction into others. Just before a new expression of contradiction appears, a problem description must be transformed along a certain viewpoint. In case of Part 3 of ARIZ, the problem description is transformed along ‘Size’ axis. Therefore, we posed ‘problem transformation’ in the front of contradiction formulation. As shown in Figure 1, we propose a sub-process composed of steps of problem description and the contradiction formulations following that. The sub-process is named ‘Deployment of Problem Descriptions’. From our experience of solving real problems, the problem transformation helps us a lot to get more creative solutions.

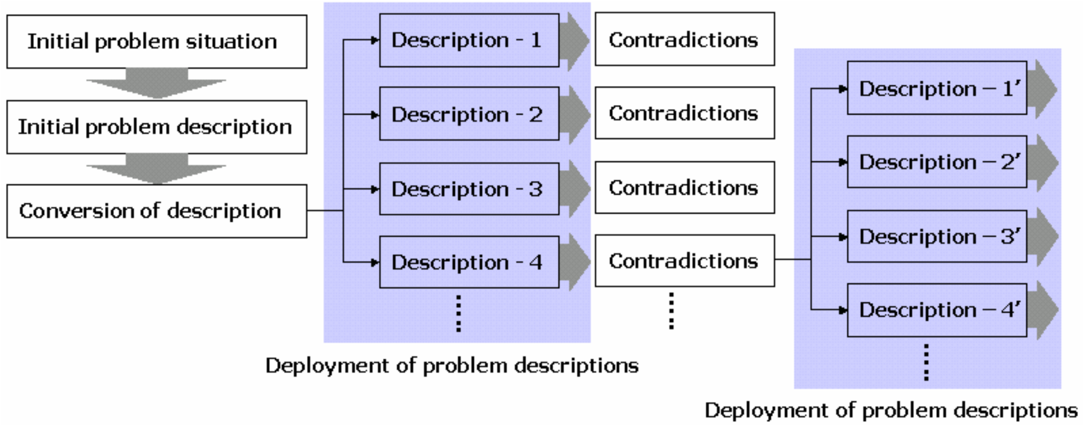

Figure 1: A schematic view from the initial problem situation to contradiction formulation

TRIZ suggests us to consider everything as a process. The way from the problem situation to contradiction formulations must be a process, too. ‘Systematic Vision’ of TRIZ is given the way to deal with something as a process. As G. Altshuller says in his great book, the systematic vision along time, system scale and anti-system could be located in the center of creativity(1). After TRIZ was propagated in U.S.A., the systematic vision has been called as 'System Approach' or 'Multi-screen Method'. OTSM-TRIZ developed by Nikolai Khomenko offers 'Full Scheme', which is an advanced version of 'Systematic Vision'(2). We have owed a lot to 'Full Scheme' in development of a process for deployment of initial problem descriptions.

For description of a process of contradiction formulation, we borrowed main concepts from two sources, 'ENV model' of OTSM-TRIZ by Nikolai Khomenko(2) and 'TOP Analysis' by Zinovy Royzen(3).

2. PROBLEM DEPLOYMENT FOR CONTRADICTION VARIATION

Let us start with explanation of how to vary problems. Main ideas of this suggestion came from our comprehension of 'Full Scheme' as a part of OTSM-TRIZ. The purpose of problem conversion is to get contradiction variation. The contradictions obtained from these varied problem descriptions show different from each other in solving methods.

As you know well, TRIZ offers typical problem models in different abstraction level. Based on the same idea, different problem descriptions could be acquired according to different points of view. The various viewpoints selected are as follows;

- Level of Purpose
- Level of Abstraction
- Cause-Effect
- Level of Ideality
- Size (Macro→ Micro)

It is necessary to transform problems along a certain viewpoint because transformation of problems gives us benefits as follows;

(1) More radical contradictions would be formulated.
(2) More reflections for one problem would be provided with.
(3) More solution areas would be found.

Let us show an example for conversion of one problem along 'Level of Purpose' and 'Level of Abstraction'. As explained in Figure 2, a kind of chemical liquid composed of chemical material 'A' and water, flows into a reservoir to be heated by surroundings. As a result of heating, unnecessary material 'B' appears. Material 'B' is a little heavier than material 'A'. From the bottom of the reservoir, the liquid is bypassed to filter the material 'B'. The chemical material 'A' returns to the reservoir after filtering. The bypassing rate must be increased for better purification. However, the bypassing system causes energy loss because material 'A' already heated undergoes cooling during the return process. The customer asks to improve the bypass system not the whole system including the heating part. He/She wants a system that bypasses only material 'B' without material 'A'.

Let's formulate this initial problem like the following;

"How do they bypass only B except A without no more cost and no change in the system?"

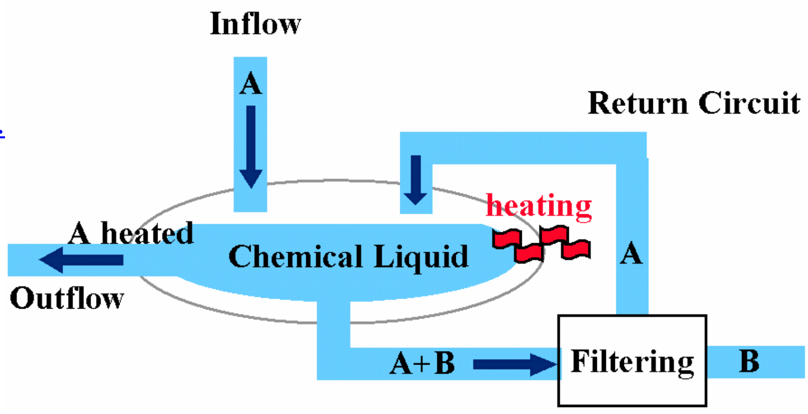

Figure 2: Chemical Liquid Treatment System

You could proceed to start TRIZ process with this problem description. However, we could get more problem descriptions resulted from transformation according to 'Level of Purpose' and 'Level of Abstraction'. Figure 3 shows some examples.

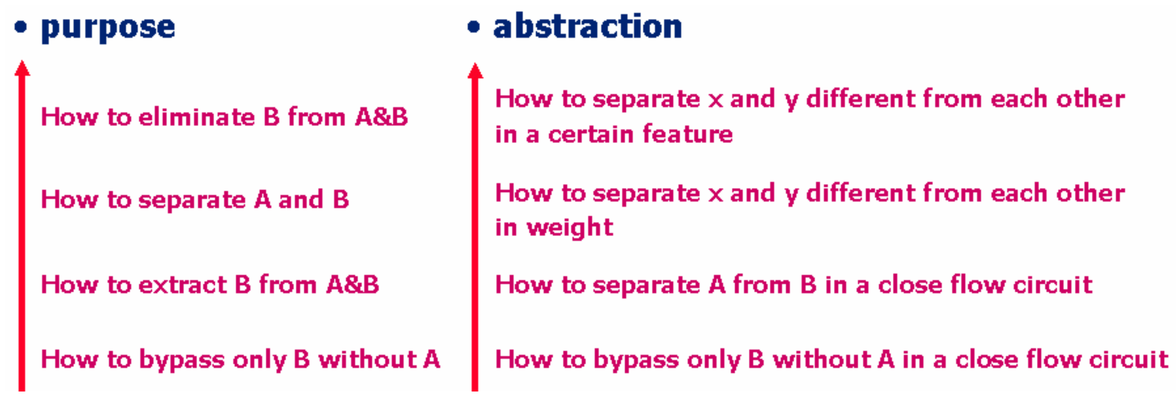

Figure 3: Problem Transformation Along 'Purpose' and 'Abstraction'

Before formulation of contradictions, we have to examine these problem descriptions and determine which description we start with to formulate contradictions. As for us, the higher level of purpose and abstraction the problem description has, the better solution we would get.

3. HOW TO DERIVE CONTRADICTIONS FROM THE PROBLEM DESCRIPTION

After deployment of problem description according to various viewpoints, one problem description must be selected and contradictions should be formulated from that. For each contradiction, we had better transform that like what was explained before if no solution is acquired.

In order to explain our method, we adopted the expression of TOP Analysis. Every stage must result in some descriptions according to ENV model.

Based on OTSM-TRIZ, we start with the following question;

(1) What do we want?

The answer to this question is closely related to the problem description we started with. In real situation, it is not enough to ask the engineers what they get from the system dealt with. Generally,

the system experts answer the name of the product. Required description of what we want must be composed of features of the product different from those of the object.
Therefore, we suggest the following steps;

① What is the difference between 'product' and 'object'?
② As for 'object', what is the feature related to the difference?
③ As for the feature of 'object', what is the initial value of the feature?
④ As for 'product', what is the value of the feature?

Finally, the description of what we want must be as follows;
To change the value of a certain feature of 'object' to the value of the feature of 'product'.
Figure 4 shows the schematic explanation of this stage.

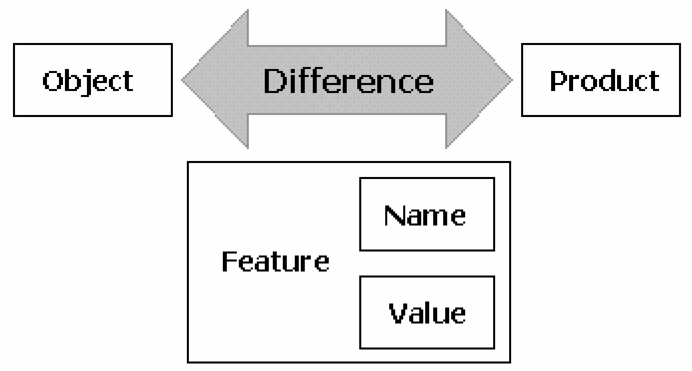

Figure 4: How to define what we want

(2) How do we change the feature value of 'object'?

Generally, this question can be answered easily. If we have already a system, this stage is just construction of models according to TOP analysis for every relationship of system components.
If we do not know how to do so, we have to search for it. We propose the following steps;

① Is there any way to change the value of the feature(= dependent parameter) generally not just for 'object' of us?
② For each way to do so, identify the features(= independent parameters) of 'tool' for us to control.
③ Which way is the most convenient for us to get resources in order to control the features of 'tool'?

(In terms of experimental study, the feature of 'object' can be called as 'dependent parameter'. The features of 'tool' of TOP Analysis correspond to 'independent parameters' in experiment.)

(3) What problems happen if we adopt 'the way'? (How come we can't adopt 'the way'?)

'The way' indicates the method selected in the previous stage. In this stage, the situations vary according to what deteriorates after implementation of 'the way'. Therefore, we suggest the following steps;

① List phenomena unsatisfying us, which appear after application of 'the way'.
② For each phenomenon, discern product, tools, and functions based on TOP model.
(In this step, 'product' is a result of harmful functions, not what we want to get.)
③ For each phenomenon, list the differences between 'product' and 'object'.
④ Transform the differences into the name and the value of a certain feature.

As a result from this stage, the description of problems, which happen after applying 'the way', is as follows;

To change the value of a certain feature of 'product' to the value of the feature of 'object'.

(4) Contradiction Formulation

Now, we can formulate contradictions. Among the elements appearing in both of step 2.2 and step 2.3, some may be in contradictory situation. After identification of them, the formulation of contradictions should follow OTSM-TRIZ.

4. CONCLUSIONS

Before the formulation of contradictions, the way to deploy different problem descriptions of a problem was proposed for more effective problem analysis. The deployment of various problem descriptions is based on the core idea of 'Full Scheme' of OTSM-TRIZ. The axis for deployment could be 'Level of Purpose', 'Level of Abstraction', 'Cause-Effect', 'Level of Ideality', and 'Size', etc. Based on 'ENV model' and 'TOP analysis', a procedure of contradiction formulation was offered.

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