A NEW METHOD FOR CREATING NON-TECHNOLOGICICAL PRINCIPLES OF TRIZ

Dr Mohammad.H Saliminamin
Professor of Industrial Engineering at Faculty of Industrial Engineering ,
Amirkabir Polytechnic University,Tehran,Iran
And
President of Iran Insitute of Innovation and Technology
WWW.IIITS.org

Navid Nezafati
PhD student of Industrial Engineering at Faculty of Industrial Engineering ,
Amirkabir Polytechnic University,Tehran,Iran
nnezafati@yahoo.com

Abstract

TRIZ enumerates as a popular subject of the improvement of industrial engineering that after high attention in technological areas has been expanded in non-technological areas and with no doubt non-technological TRIZ would cause strong development in this arena.

Generally, researchers attempts in the last decade in non-technologicical TRIZ have been based on Altshuller's 40 innovation principles, trying to find the examples and illustrations of TRIZ applicable (with little or no change in them) in non-technological areas.

But it is not sufficient because lots of principles are not utilized in non-technologicical problems or lots of innovations in these subjects are not described with Altshuller's principles.

So a new method that creates new real non-technologicical principles must be presented.

In this article,two methods for achieving non-technologicical principles (and here social principles), as the major base of TRIZ are presented.

- First method; step by step repeat, as a method which was emphasized with Altsuller and includes running his way based on studying large amount of inventions in social subjects. This method is so hard and inapplicable because of loss of regular social patents.
- Second method; adoption methodology, as a innovation way which converts industrial principles to social principles with a special adoption method. Steps of this method consists of " industrial principles philosophy extraction, converting to social philosophy, presenting a dual principle and confirm with historical facts".

This article is conclusion of social and industrial specialists team efforts, that presents in final schedule of 40 dual TRIZ principles in social subjects.

At last validation of this entire 40 principles is tested with Cochran's test and with a statistics hypothetic test which based on specialists' opinions.

Introduction

TRIZ as a Russian abbreviation which is equal to “Theory of Innovative Problem Solving” (TIPS) was born in the second half of the twentieth century.
Before TRIZ , authorized thought about creative and human innovations was based on a paradigm that believed the creation as an unknown phenomena .but Altshuller who invent TRIZ believed That

-Creation is not an unknown and unreachable function.
-Creation followed a special and achievable principles.
-We can do the inventions with non-inventor persons ,if they learn the innovating principles and algorithms.[1]

Altshuller searched near to two million patents of Russian innovation center and other countries with his students and colleagues to achieving the common bases and principles between those innovations (that almost in technological arena).
Consequents of these researches are edited as below :

-Each innovation is begun from recognizing harmful conflicts.
-Solving the recognized conflicts without destroying the conflicts structure culminates in an innovative solution.
-The conflicts in technological problems are finite and consequents of fighting between some identities of things and functions.
-The solutions for solving conflicts from technological history are limited and categorical (although achievable).

With this view, Altshuller developed this algorithm for innovative problem solving.

- Extraction of 39 parameters that are conflicted with each other in technological problems and suggesting a 39*39 matrix that consist of all superseding conflicted parameters.[2]
- Bringing out 40 innovation principles that solve the conflicts between the 39 parameters and replace these 40 principles in the 39*39 matrix arrays so that for solving each junction between two conflicts, some principles of 40 principles are suggested.
- Presenting ways for problem formulation that provide a high currency view of problem and the conflicts places for inventors. [3]

Nowadays, Altshuller and his students and colleagues attempts in TRIZ result using this method in huge industries such as BMW, HONDA… And developing this method in lots of arenas in lots of universities such as MIT, Michigan State, U.C. Berkley, NCSU, and....
TRIZ is recognized in 25 country in all over the world and is educated in more than 35 university and lots of sites about that.[4]

TRIZ Development in Non-Technological Areas

Although TRIZ has been developed in technological and industrial arenas, (because of more benefits in this cases) but non-technological TRIZ is followed in lots of scientific centers.
TRIZ could not rise in non-technologic subjects because of born in USSR and the Stalinists strangulated it. In that time and that place, researching about this subject was viewed as a crime. Never the less, attempts in this area have been done.
Before that Boris Zlotin and Alla Zusman began the research about evaluating the applications of TRIZ in social systems.
They defined social systems as below:[5]

- -Enterprise
- -Government agency
- -Professional association
- -Social institution
- -Educational institution
- -Family
- -Country
- -Society as a whole

But these attempts defeated because of communist's government pressures.
But after Perestroika, Zlotin and Zusman could publish their claims in non-technological arenas in some articles[6] . also in these years lots of scientists try searching for examples of creativity based on TRIZ principles in non- technological areas.
In the next years TRIZ was fortuned from the doctors, safety professionals, artists and even poems.[7]
They try to design examples and innovative solutions in their subjects by following Altshullers 40 principles.
Professionals in this arena adopted their problems with the TRIZ method and consequently know the useful applications of this methodology for solving the conflicts in non-technologic systems.[8]
It seems that with continuing this way, TRIZ could achieve large amount of success and this depends on the understanding between TRIZ men and non-technologic professionals.

Points of Weakness in Running Ways to Non-Technologic TRIZ

Although professionals were astonished at non- technological developments, it seems that these methods are adopted by today's fashions but may lose their values because of non-stability in them. We point to two main weaknesses:

Structure Fail

One of the phrases selected for TRIZ definition is "structural solving of innovative problems". It is important that this definition defends the algorithmic and structured shape of the TRIZ method but running ways in non-technological TRIZ usually do not accept as a independent way of technological TRIZ and the steps that have to run are not visible.[9]
For example to solve an industrial problem, those steps should be run:

- -Performing ISQ (innovation situation questionnaire)
- -Detecting HF and UF (Harmful Functions And Useful Functions)

-Designing UF-HF diagrams and finding the most effective HF and UF.
-Finding the conflict points (according to the 39 parameters)
-Using 40 Altshullers standard solutions for solving the conflicts.
-Presenting the last solution and testing

but in non- technological TRIZ, because of bases on facts and examples, only the spark in professionals minds during reading the technological TRIZ are used.

Basing on facts

Because of social scientists lower experience than Altshuller in TRIZ, they almost haven't *trizical* mind. so they use TRIZ facts in their works more than TRIZ methods[10]. It means that they understand the authorization of TRIZ on last solved problems, but they must know how to use them for solving new problems.
By this reason Altshuller reject the non-technologicical TRIZ that only based on finding non-technological facts for technological TRIZ principles.
It seems that this weakness causes reducing speed and utilization of non-technological TRIZ in comparison with technological TRIZ.

The Suggested Method for Structural Non-Technological TRIZ

According to the last discussions we have to design non-technological TRIZ that involved this characteristics:[11]

-Ended to a structural system for non-technological subjects.
-Facts and examples play as a supporter, not as a goal of that.
-Can solve some of problems in social and human arenas as case studies.
-Doesn't assist us to run Altshuller's hard way but use it extremely without copying.

The Steps of New Method

Maybe the most important part of TRIZ method is 40 Innovation principles.
So for presenting a non-technological TRIZ system, Before all the things and the most important thing is creation of non-technologic innovation principles.
A way to achieving this principles (according to Altshuller's opinion.) consists of steps as below.
We can name this method as "repeating step by step".

-First step: finding a suitable category in human sciences.
(because human sciences is vast greater them technologic subjects.)
-Second step: recognizing information banks in various parts (with attention that there is not any patent in human sciences and a selection of historical books should be selected.)
-Third step:bringing out principles (under various arenas' professors.)
-Fourth step: merging principles and achieving universal principles.
(because of giant numbers of principles that could be merge in each other.)

But "repeating step by step" is so hard and not faithfull, because of high volume of information sources and also not saving low levels of innovation.
We suggest here anew method which in that serious attempt focus on using Altshuller's 40 principles and writing the duals of them in social and human arenas.
Briefly in this method,we find the innovative philosophy of principles and convert these philosophies to social philosophies and then achieve the 40 dual principles.
These set could be made strong with facts and historical examples and could be tested in validity and utilization with validation with validation tests in statistics.
In continuation, the steps of this method will be discussed. This method assumes that Altshuller's 40 principles are universal.

A person who selects this way to achieve TRIZ social principles believes that although the 40 principles brought out of industrial patents, but could be popular and with some verifying use for human sciences.

First Step :Complete Recognization of Technological TRIZ Principles.

Principally when Altshuller's principles are studied for the first time, it seems that they are useless ,vague, very general(and not particular and useful), and sometimes obvious and valueless.
Whereas noteworthy uses of these principles and vast extending of TRIZ centers, up to now ,give reasons for TRIZ utilities.
In reality who wants to use TRIZ principles in best manner ,first of all has to learn how to work with them.
Major base of working with TRIZ is repeating the go and return circle between this principles and real facts.
It means that first of all we have to look at big and small innovations in all around ourselves and try to search general principles in particular parts of them and adopt the principles to facts and vice versa.
After nearly 100 or 200 general to particular inspections (it is better that they be in various levels of innovation) we can suggest systematic solutions which are based on TRIZ principles that form our minds.

Second Step: Recognizing Philosophical Elements of Altsuller's Principles

According to the past passage, second method is based on assumption of universally characteristic of 40 principles.
Before Altshuller theorem about algorithmic structure of genius, human genius was released of subjects and talented men were who have a innovation power in all subjects.
Generally invention is caused with two thing in inventor mind.

First: information and knowledge in that special subject.
Second: innovation.

Innovation means arranging information in a new sort for solving the problems conflicts. So innovation , separate of subjects, is a universal occur.
Also Altshuller's principles involve these universal principles and sometimes their results. Universal principles, entirely , have a hidden philosophy.
These philosophical roles as bases of these principles, which each principle is a solution for a conflict because of a reason. this reason is equal to philosophy.
Second step of adoption methodology, consists of recognizing reference philosophy of each principle. But Altshuller's principles have not homogenous structure in this case and some of them have obvious principles and some of them hide their philosophy in hidden layers. Also each these principles has individual elements which has to convert from technological system to human system. This recognition is important because it introduces us to the active factors in the principles. So the results of second step are universal philosophies of principles.
Sure these philosophies have technological shape that have to convert to non-technological and social shape which is discussed in next step.

Third Step: Finding Equal Social Philosophy

Second step separates TRIZ principles from industrial arena seriously, but in lots of cases, results are not suitable for social principles. So we need another step to reach social philosophy.

We have to refer to industrial principle elements and search for their duals in social arena, for finding social philosophy. After this referring, creating to social philosophy based on social elements is possible.

Forth Step: Dual Principle

After finding equal social philosophy, creating the dual principle in comparison to primary principle (Altshuller's principle) is became possible.
But these dual principles are more homogeneous than Altshuller's principles. Because these are brought out from universal philosophies and look like these philosophies. So they are at the same layer.

Fifth Step: Confirm with Facts

The desired result is concluded in the forth step and we have 40 principles in Non –technology arena (and in this article in social arena) .
But the lack ness is exist yet. As it said in the first step, at the first glimpse Altshuller's principles seemed indefinite and not suitable and unutilized. But after a come and back process between them and the example we can achieve to a *TRIZICAL* mind.
It is true and real for our social principles that there is not any direct referring to real social facts, so it is necessary for each of these principles that armed with historical facts. It is obvious that the invertors of this facts were not announced about these principles.
These facts can illustrate and reinforcement to social principles and be a good guidance for editing principles.
With studying these facts in addition to find evidences for validation of principles, a suitable way for making a *TRIZICAL* mind has been brought out.
Readers could create innovative suggestion with these facts, which is base on dual principles and this is TRIZ aim.

Our Team

These five steps, were run in a process of a cooperative team consisting of:
TRIZ Expert: expert in TRIZ method with a *TRIZICAL* mind. He was the team's leader.
Industrial engineer: this man with almost complete knowledge in industrial problems, help us to extraction, industrial philosophy.
Economic specialist: this man with good knowledge in economic science, help us to creating a new philosophy for dual principles.
Social specialist: this man with good knowledge in social science, help us to creating a new philosophy for dual principles.
Politics specialist: this man with good knowledge in politic science, help us to creating a new philosophy for dual principles.
Philosophy specialist: this man with good knowledge in philosophy science, help us to creating a new philosophy for dual principles.
These persons run the adoption method in lots of meetings, that resulted the to dual principles.
Although these specialists were not sufficient to cover all parts of non-technologic and even human knowledge, but designed utilized principles in TRIZ. Next schedule presents Altshuller's primary principles and dual principles in human problems.
It is necessary to attention that for using these principles, reading the complete file "principles, definitions, and fact" (about 80 pages) is essential.
At last the sixth step discussed about a conceptual validation test.

number	Primary principles	Dual principles
1	Segmentation	Social intermediate
2	Extraction	Extraction
3	Local Quality	Dual purpose in parts of social system
4	Asymmetry	Controllable loss harmony
5	Combining	Combining and composing
6	Universality	Multipurpose uses of social bases
7	Nesting	Passive organizations ready for activation
8	Counterweight	Social balancers
9	Prior counter-action	Prior counter-action
10	Prior action	Recognizing and making necessary social situations for future
11	Cushion in advance	Cushion in advance
12	Equipotentiality	Changing the environment for changing social unit
13	Inversion	Considering social process inversion
14	Spheroidality	Defining social centers and social levels
15	Dynamicity	Dynamicity
16	Partial or overdone action	Confidence with more costs
17	Moving to a new dimension	Redefinition of social problem in political, economical, and cultural dimensions
18	Mechanical vibration	Preparing indefinite social situations
19	Periodic action	Periodic actions with calculated periods
20	Continuity of a useful action	Continuity of a useful action with small changes
21	Rushing through	Using passing the time and fast process in social crisis
22	Convert harm into benefit	Combining some harmful social factors to causing a benefit
23	Feedback	Feedback
24	Mediator	Mediator
25	Self-service	Independence
26	Copying	Recognizing similar systems and renewed program running
27	Inexpensive, short-lived	Temporary and small systems for old, permanent systems

	object for expensive, durable one	
28	Replacement of a mechanical system	Using more influence social process with less connection
29	Pneumatic or hydraulic construction	-
30	Flexible membranes or thin film	Social separators and flexibility in actions
31	Use of porous material	Using empty parts of social units
32	Changing the color	Changing the structure and renewed action
33	Homogeneity	Using fellow in social processes
34	Rejecting and regenerating parts	Fluid social units and destruction useless units in certain scheduling
35	Transformation of the physical and chemical states of an object	Transformation of the structure ,function or value in social process units
36	Phase transformation	Using transient situation of social systems
37	Thermal expansion	Social functions with unequal influence on social units
38	Use strong oxidizers	Using catalysts in social processes
39	Inert environment	Social isolated environments for testing and producing a social function
40	Composite materials	Composite social structures

Sixth Step: Validation Test

Utilization in real world is the most important benefit of TRIZ.
If the 40 principles could not influence in real world and be utilize for inventors, it would never have been developed like this in all the world.
Therefore, creative principles with an adoptable method in addition to adoption on Altshuller's principles and confirm with facts, must be suitable and utilized for who wanted to use them. So validation test with a defensible statistics test is necessary.
We select Cochran's test to test the validation, in this research.
Cochran's test is suitable because of conceptual adoption with our experiment. (testing reject or accept in specialists opinions) and also the simplifying for answering (yes-no). It is proportional with experiments which needed repeating observation.[12]
With this test we could compare some independent portions in a deductive manner.
Dependent variable only has two values:
$Yk = 0$ reject

Yk = 1 accept
So we can test k principles in n specialists opinion.
All the n=5 specialists answers to the all the k=36 principles validation questions.
Input provided with questionnaire was send to the specialists. They were specialists in industrial, social, politics, and economics subjects. “1” is the mark for accept the reality and utilization of dual principle and “0”is the reject mark.
At last each principle that more than or equal to 3 of 5 accepted, remark as “rule is accepted” and else “rejected”.
Rejected rules reformed with specialists’ suggestion until all of them accepted.
Also Cochran’s test with below formula must confirm H0 (between H0 and H1)
Two hypothesis:

H0: there is not meaning deference between the opinions.
H1: there is meaning deference between the opinions.

$$Q = \frac{K - [\, k\,ST - ST \,]}{SY(k-1)}$$

K=5

According to the next schedules we see that at first H0 was rejected with Q=11.87 (more the ?2 (5,36)) and after reforming Q=4.08 ,so H0 accepted.
Therefore the creating principals are utilized and valid.

rejected Cocran's test						
sum(t)	5th spec	4th spec.	3rd spec.	2nd spec.	1st spec.,	principles
2	0	1	0	0	1	1
3	1	0	1	0	1	3
3	1	0	1	0	1	4
2	0	1	1	0	0	5
4	1	1	0	1	1	6
3	1	0	1	0	1	7
3	1	0	1	0	1	8
3	1	0	1	0	1	9
3	1	0	1	1	0	10
4	1	0	1	1	1	11
2	1	0	0	0	1	12
5	1	1	1	1	1	13
4	0	1	1	1	1	14
3	1	1	1	0	0	15
3	1	0	1	0	1	16

3	0	1	0	1	1	17
3	1	1	1	0	0	19
3	1	0	1	0	1	20
3	0	1	1	1	0	21
3	0	0	1	1	1	22
5	1	1	1	1	1	23
3	0	1	0	1	1	25
3	1	1	1	0	0	26
3	0	1	1	0	1	27
3	1	0	1	1	0	28
2	1	0	0	0	1	30
3	1	0	0	1	1	31
3	0	1	1	0	1	32
3	1	0	1	0	1	33
4	0	1	1	1	1	34
3	0	1	0	1	1	35
4	1	1	0	1	1	36
3	1	1	1	0	0	37
3	1	0	1	0	1	38
3	1	1	1	0	0	39
3	1	0	1	0	1	40
113	25	19	27	15	27	T
	625	361	729	225	729	
k	5					
sum(t)	113					
(sum(t))^2	12769					
sum(t^2)	2669					
sum(y^2)	371					
Q	11.8762					
	reject H0					
there is not meanimng difference between opinions						H0
there is meanimng difference between opinions						H1

accepted Cocran's test

(sum(t))^2	sum(t)	5th spec	4th spec.	3rd spec.	2nd spec.	1st spec.,	principles		
9	3	0	1	0	1	1	1	0.6	rule is accepted
9	3	1	0	1	0	1	3	0.6	rule is accepted
9	3	1	0	1	0	1	4	0.6	rule is accepted
9	3	0	1	1	1	0	5	0.6	rule is accepted
16	4	1	1	0	1	1	6	0.8	rule is accepted
9	3	1	0	1	0	1	7	0.6	rule is accepted
9	3	1	0	1	0	1	8	0.6	rule is accepted
16	4	1	1	1	0	1	9	0.8	rule is

									accepted
9	3	1	0	1	1	0	10	0.6	rule is accepted
16	4	1	0	1	1	1	11	0.8	rule is accepted
9	3	1	0	0	1	1	12	0.6	rule is accepted
25	5	1	1	1	1	1	13	1	rule is accepted
16	4	0	1	1	1	1	14	0.8	rule is accepted
16	4	1	1	1	1	0	15	0.8	rule is accepted
9	3	1	0	1	0	1	16	0.6	rule is accepted
9	3	0	1	0	1	1	17	0.6	rule is accepted
9	3	1	1	1	0	0	19	0.6	rule is accepted
9	3	1	0	1	0	1	20	0.6	rule is accepted
9	3	0	1	1	1	0	21	0.6	rule is accepted
9	3	0	0	1	1	1	22	0.6	rule is accepted
25	5	1	1	1	1	1	23	1	rule is accepted
9	3	0	1	0	1	1	25	0.6	rule is accepted
9	3	1	1	1	0	0	26	0.6	rule is accepted
16	4	0	1	1	1	1	27	0.8	rule is accepted
9	3	1	0	1	1	0	28	0.6	rule is accepted
16	4	1	1	0	1	1	30	0.8	rule is accepted
9	3	1	0	0	1	1	31	0.6	rule is accepted
9	3	0	1	1	0	1	32	0.6	rule is accepted
9	3	1	0	1	0	1	33	0.6	rule is accepted
16	4	0	1	1	1	1	34	0.8	rule is accepted
9	3	0	1	1	0	1	35	0.6	rule is accepted
16	4	1	1	0	1	1	36	0.8	rule is accepted
9	3	1	1	1	0	0	37	0.6	rule is accepted

16	4	1	0	1	1	1	38	0.8	rule is accepted
9	3	1	1	1	0	0	39	0.6	rule is accepted
16	4	1	0	1	1	1	40	0.8	rule is accepted
	123	25	21	28	22	27	T		
		625	441	784	484	729			
k		5							
sum(t)		123							
(sum(t))^2		15129							
sum(t^2)		3063							
sum(y^2)		433							
accept H0									
there is not meanimng difference between opinions							H0		
there is meanimng difference between opinions							H1		

References

1- Genrich s.Altshuller/ and Suddenly the Inventor Appeared/Technical Innovation Center,INC/2000.

2- Glossary of TRIZ/victor fey/ TRIZ Journal/2001/3.

3- Lesson 4 Contraditions /Semyon D.Savransky / TRIZ Journal/1999/11.

4- www.hcmuns.edu.vn/cstc/weblinks/links-e.htm

5- Evaluation of Organizations and Social Systems /Boris Zlotin and Alla Zusman/ Journal of TRIZ 93.1:73-81(1993) and Creative Models for Business and Management :82-91.

6- Managing Innovation Knowledge /Boris Zlotin and Alla Zusman/ TRIZ in progress/(Ideation International,1999):123.

7- Techniques of Journalism :a bank of creative principles /Igor Vikentiev /Journal of TRIZ ,3.1.92:56-98.

- Analyzing Patterns in the evaluation of music/Esther zlotin(1947-1998).
- A Highly-Regarded TRIZ Specialist as well as a Cartoonist, Developed Methods For Inventing New High-Level Cartoons /Vladimir Gerosimov
- Patterns of Evaluation of THE Golden Age of Russian Poetry /Kirill Sklobovskiy.

8- TRIZ beyond Technology :The Theory and Practice of Applying TRIZ to non-technological Areas /Boris Zlotin , Alla Zusman,Len Kaplan,.../Ideation International INC,1999,Detroit.

9-40 Inventive Business Principles with Examples /Darell Mann,Ellen Domb/TRIZ Journal/1999.

10-40 principles-chemical illustration/Billy gierson,ailsa morrison,…/TRIZ journal/ 2003/7

11- TRIZ beyond Technology:The Theory and Practice of Applying TRIZ to non-technological Areas /Boris Zlotin , Alla Zusman,Len Kaplan/Ideation International INC/1999/Detroit.

12-Conver,W,J/Practical Nonparametric Statistics/1980/Newyork/ John wiley &sons