TRIZ Forum: Conference Report (23-C)

TRIZ シンポジウム 2010
The Sixth TRIZ Symposium in Japan

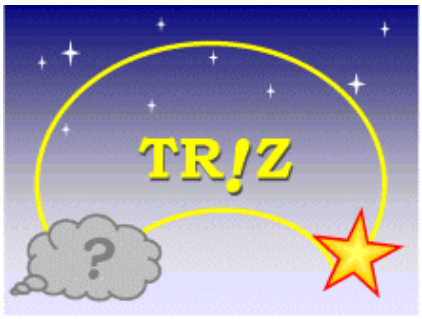
Personal Report of The Sixth TRIZ Symposium in Japan, 2010

Held by the Japan TRIZ Society, NPO,
on Sept. 9-11, 2010, at Kanagawa Institute of Technology , Atsugi, Kanagawa, Japan

Part C. Integral Use of TRIZ with Relevant Methods

Toru Nakagawa (Osaka Gakuin Univ., Japan),
Mar. 3, 2011

[Posted on Mar. 13, 2011]



TRIZ Home Page in Japan Jap.

For going to Japanese pages, press Jap. buttons. Japanese translation of this page is not scheduled.

Editor's Note (Toru Nakagawa, Mar. 3, 2011)

This page is Part C of my Personal Report of Japan TRIZ Symposium 2010. Please see the Parent page Engl for the overall description of the Symposium and the general introduction of the Personal Report. I am thankful to the Authors for their permitting me to cite their slides here for introduction. Click here for the PDF file of this page of Personal Report.

Code	Author(s)	Affiliation	Title of presentation	Agenda	Review	Posting of individual paper
J21	**Yuji Mihara**, Masahiro Kuwahara, Yojiro Fukushima, Manabu Sawaguchi , Tetsuya Hamaguchi, Hiroshi Osada	Creative Technology Institute Co., Ltd., IDEA Ltd., - Waseda University, The University of Tokyo, Tokyo Institute of Technology	The Techniques to Detect and Solve Innovative Problems — The Proposal regarding "Two types of Redesigned Contradiction Matrix" for TRIZ Beginners —	3rd day PM O-19 RB	(Mar. 13, 2011)	JTS Official site (Dec. 1, 2010) TRIZ HP in Japan: slides , Full paper (Mar. 13, 2011)

Part C. Integral Use of TRIZ with Relevant Methods

Yuji Mihara (Creative Technology Institute Co.), Masahiro Kuwahara (IDEA Ltd.), Yojiro Fukushima ( ), Manabu Sawaguchi (Waseda University), Tetsuya Hamaguchi (The University of Tokyo), and Hiroshi Osada (Tokyo Institute of Technology) [J21, O-19] gave an Oral presentation with the title of "**The Techniques to Detect and Solve Innovative Problems — The Proposal regarding "Two types of Redesigned Contradiction Matrix" for TRIZ Beginners —**". This is a discussion group of experts having quite different backgrounds, e.g. TQM, AD, Expansion of Thinking Method, VE, QFD, IE, TRIZ, USIT, IT, etc., and coming from both industries and academia. This diversity of specialty has contributed uniquely to criticize some dogmas in the TRIZ community, as you will see soon. This presentation was chosen one of the four for the Award of 'Best presentation for me' by the voting of the Symposium participants. Official Web site of Japan TRIZ Society has publicly posted the presentation slides both in English and in Japanese. Here in "TRIZ Home Page in Japan" are posted their presentation slides in English and in Japanese and their full paper in Japanese. The Authors' Abstracts is quoted here first:

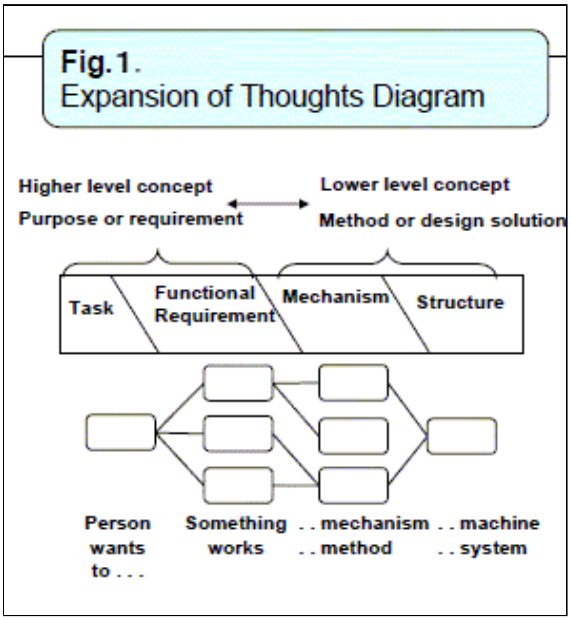
> We think that skilled TRIZ practitioners studying and implementing some of TRIZ techniques several times are accustomed to a series of procedures to define each problem, formulate some challenges and create highly-valued ideas. On the other hand, it's very hard for TRIZ beginners to reach effective solutions through utilization of existing TRIZ techniques. Therefore, in this paper, we would like to

propose “Two types of Redesigned Contradiction Matrix (RCM)” developed by us as one of effective TRIZ techniques for TRIZ beginners.

Firstly in the paper, we want to make “Real Required Functions (RRFs) for TRIZ practitioners” clear. In other words, we try to define “What do we have to do in our minds?” and “ What should we do right now ?” with thinking deployment about “RRFs”. Secondly, we would like to introduce two types of “RCM” for TRIZ beginners to understand and utilize easily. Because we noticed that not only skilled TRIZ practitioners but also some of TRIZ beginners actively use “Contradiction Matrix developed by Altshuller (Original CM)” as a convenient technique to select some applicable principles from “40 principles” and create ideas by utilizing them.

We basically focus on “a series of Functions” in the system and consider “Required Functions (RFs)” for each component in it at the upstream stage of product development activities. That is to say, we are required to define the challenges related to “Functional Parameters (FPs)”at this stage. At next stage after development design of product, we have to search the challenges regarding to “Concrete Implementation Tools (CITs)” to realize the system. That is why we decided to prepare two types of “RCM”. In order to develop them, we tried to analyze “Original CM” and categorize “39 parameters” on it as “two types of “Redesigned New Parameters (RNPs) for two types of “RCM” from the standpoint of TRIZ beginners. In addition, we have the guidelines for beginners to use two types of “RCM” easily at our fingertips. We expect to be used proposed “RCM” for TRIZ beginners as the gate to enter “attractive TRIZ world” without having a resistance to utilize a series of TRIZ techniques.

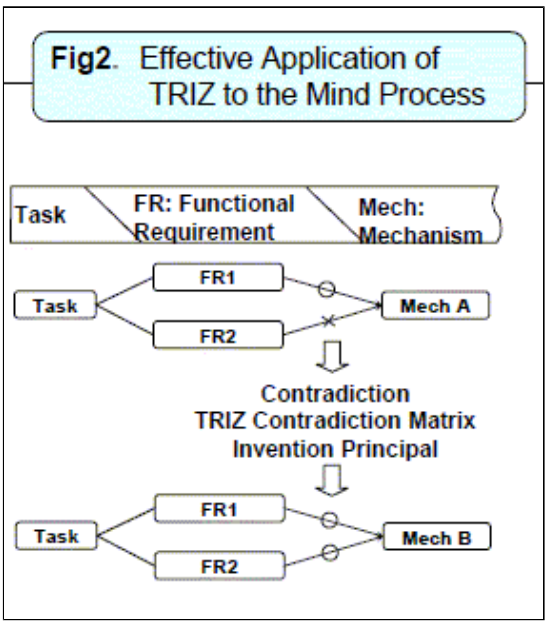
The main framework of this presentation is "Expansion of Thoughts Diagram" as shown in the slide (right). This is a widely recognized/understood framework in the field of design engineering.



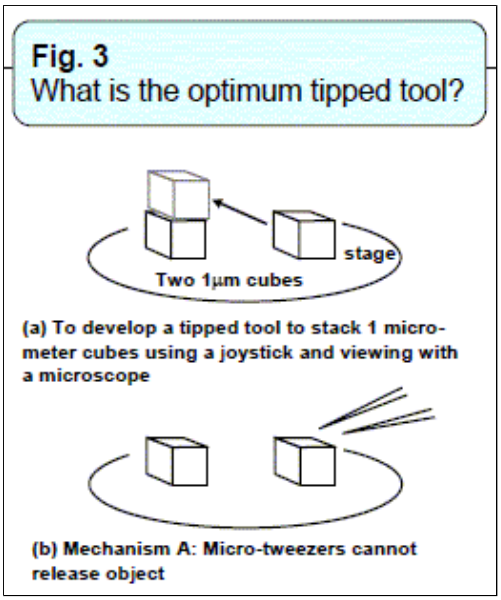
[*** Since I do not have orthodox education in engineering, I cannot trace well how it developed and how widely it has been approved. I just know that the group of mechanical engineers at The University of Tokyo has been using this framework for over 20 years. The group, Emeritus Professor Youjiro Hatamura, Professor Masayuki Nakao, Dr. Tetsuya Hamaguchi, et al., was once the pioneers in Japan in introducing TRIZ in mid-late 90s, but was rather critical on TRIZ for over these 10 years. Hence the present paper may be regarded as an important turning point in the relationship between the group and TRIZ, i.e. a kind of solution of contradiction between the two methodologies.]

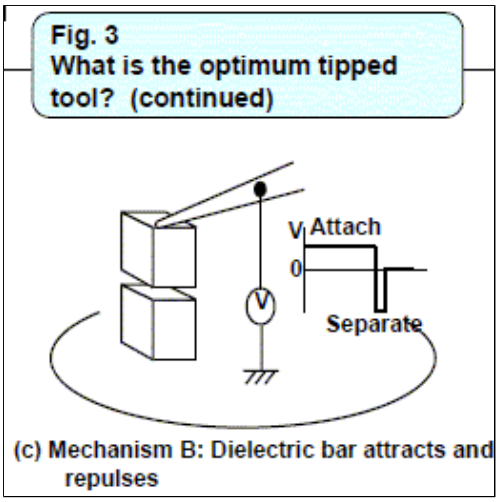
The framework advises that product development should be carried out by defining the higher-level concepts first and then going down to the lower level concepts step by step as shown in the slide. Distinguishing the concepts at the levels of Task, Function Requirement, Mechanism, and Structure is important. Any problem in technology may start at some level and we are apt to try to solve it at the level and lower; but we should better go up the level to some extent before going down in order to solve the problem in deeper sense.

The typical process of problem solving with TRIZ is characterized by the Authors as shown in the slide (right). The problem is typically formulated with TRIZ that a current (or proposed) mechanism (Mech A) is good for a Functional Requirement (FR1) but poor/unsatisfactory for another (FR2). The Contradiction (including both Technical and Physical Contradictions in TRIZ Terms) can hopefully be solved by using TRIZ Contradiction Matrix (and Separation Principle) and Inventive Principles, so that a newly proposed mechanism (Mech B) are good for both FR1 and FR2. This is a way of applying TRIZ effectively in the Mind Process, i.e. the development of ideas in the framework of "Expansion of Thoughts Diagram". [*** The positioning of TRIZ in this way is fair and clear, I feel.]



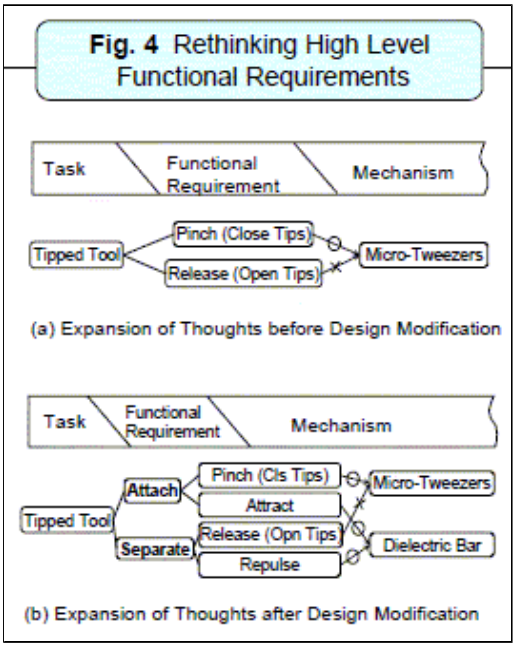
Then the Authors demonstrate a case study, taken from the work in the field of micro machines, i.e. a specialty of the group of The Univ. of Tokyo. The task is to develop a tool for stacking 1 micro-meter cubes under the view with a microscope (see slide (below-left)). A typical idea may be using micro-tweezers (Mech A). The tool was found good for holding the micro-cube but impossible for releasing it at the desired position. The cube actually stick to either tip of the micro-tweezers. This happens because the surface force of attraction is much larger than the gravity force of the cube in the world of micro-meter scale. A new tool (Mech B) has been developed where the micro-cube is attracted to a tipped dielectric bar with a certain, say positive, voltage and then is released from the bar by applying an opposite voltage to the bar (see slide (below-right)).





The case study is explained in the framework of "Expansion of Thought Diagram", as shown in the slide (below-right). The micro-tweezers (Mech A) tried to achieve the task by pinching the micro-cube (by closing the tips) and by releasing it (by opening the tips), but it does not work well for releasing. The dielectric bar is the new solution (Mech B). It attracts the cube by applying a certain voltage at the bar tip and repulse it by applying an opposite voltage; the mechanism achieved the both Functional Requirements well. The Authors explain that the initial understanding of Functional Requirements as Pinching/Releasing the object (or more specifically Closing/Opening the tips) was too specific, and that if we revise them as Attract/Repulse the objects (by applying Positive/Negative voltage to the bar) our understanding is still at the same specific level. The Authors advise to go higher level (or generalized level) of Functional Requirements by using the words of Attach/Separate the object. [*** I agree with their advice, but the wording of

Hold/Release the object seems to be natural and general enough.]



On the basis of the general framework expressed by "Expansion of Thought Diagram", the Authors have proceeded to revise the framework of the TRIZ Contradiction Matrix. Their point is that the TRIZ Contradiction Matrix (both Altshuller's classical one and Darrell Mann's modernized ones) mixes up the two different levels, i.e. the Mechanism level (of qualitative nature) and the Structure level (of quantitative nature). They think that it is better to separate the two levels in thinking in solving the contradictions and to redesign the Contradiction Matrix into two simpler Redesigned Contradiction Matrices, RCM1 and RCM2. The 39 parameters by Altshuller have been reclassified into 24 parameters, and divided into two groups, one group for RCM1 and the other for RCM2.

RCM1 is shown in the slide (below). The 13 (reclassified) parameters used in this matrix are called "Parameters regarding performance". They include Reliability, Precision, Harmful effects, Operability, Control complexity, Maintenance/reparability, Adaptability/versatility, Durability, Manufacturability/productivity, Amount/loss of substance, Amount/loss of information, Amount/los of time, and Energy. The RCM1 Matrix shown in the slide (below) has been obtained by using the information of recommended Invention Principles accumulated in Altshuller's original Contradiction Matrix. In the diagonal cells, Separation Principles are indicated by B1 through B4.

Table1 Redesigned Contradiction Matrix1 (Parameter regarding performance): RCM1

Improveing Feature \ Worsening Feature				Performance												エネルギー性
				Reliability /Precision		Harmful Effects	Operability /Durability					Manufacturability	Amount/Loss			
				Reliability	Precision	Harmful Effects	Operability	Control Complexity	Maintenance /Repairability	Adaptability /Versatility	Durability	Manufacturability, Productivity	Amount /Loss of Substance	Amount /Loss of Information	Amount /Loss of Time	
				F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
Performance	Reliability /Precision	Reliability	F1	B1,B2, B3,B4	3,10, 23,1	27,35,1, 40,26	27,17,40, 10,13	27,40,26	1,10,13,35	13,35, 12,24	1,35,3,25, 34,27,26,40	1,35,26,24	20,26,40,3, 10,35,24	10,26	10,30,4	20,10,27,15, 35,23,
		Precision	F2	5,10,1, 23,3	B1,B2, B3,B4	26,24,22, 10,35,3,33, 4,17,34	1,13,17,34, 3,23,26, 10,34,15	26,24, 3,	1,3,13,10, 25,27,35, 34,26,15	13,35,1	26,3, 27,40,10, 24	26,35,25,15, 1,13,17,34, 3,23	1,26,3,30, 10,16,31, 35,24	13,10,2,34,7 ,24,25,37	24,34,26, 3,15	3,26, 1,13,
	Harmful Effects	Harmful Effects	F3	27,24, 1,40,	26,33,23, 3,10,15, 4,17,34	B1,B2, B3,B4	1,25,26,24, 33,3,34	22,15,26, 40,1,20, 27,	35,10,1,22, 15,26,40, 31	35,10, 22,31	22,35,33,26, 31,17,1,40, 20,24,16	24,35,1,22, 13,15,	35,33,26,31, 3,24,1,22, 15,40,10	22,10,1, 20,26,	35,15,34, 1,22	1,24,26,27, 35,10,22, 15,22,
	Operability /Durability	Operability	F4	17,27,12, 40,10,3,	25,13,1,34, 3,35,23, 26,10,15	1,25,26, 24,33	B1,B2,B3, B4,1,34,12, 3,26,13	34,27,25	12,26,1,3, 25,17,35,13, 24,10	34,1, 16,27,4, 35	26,3,12, 25,1,16, 10	1,5,12, 26,13, 35,	12,35,26,3, 1,24,13,10, 15,5	4,10,27, 22,35,33	4,26,10, 34,24,35, 30	1,13,24,15, 3,23,26
		Control Complexity	F5	27,40, 26,12	26,24,3	22,15,26, 1,20	1,5,34,20	B1,B2, B3,B4	12,26,35, 10,	1,35	15,26,25, 24,35	5,26,10, 35,15	3,27,26,15, 1,10,24	35,33,27, 22	15,26, 3,10	35,24,15, 16,3
		Maintenance /Repairability	F6	10,1, 26,13,35	10,2,13,1, 26,34,25, 24,3	35,10,1, 16,22,15, 26,40,	1,12,26, 27,10,24, 34,35,	35,10, 26	B1,B2,B3, B4, 35,1,13,10,	7,1,4,16, 26,35,	10,26, 27,4, 35,1	1,35,10, 27,26,13,3, 12,17,	2,26,10,25, 13,3,27,35, 34,	3,9,13,26,1	3,1,10, 25,26,	1,26,16, 27,3,15, 10,35,13
		Adaptability/ Versatility	F7	35,13, 12,24	35,5,1,10	35,10, 3,31	34,1,16, 27,35	1	1,16,7,4, 35,26,	B1,B2, B3,B4	13,1, 35,16	1,13,31, 35,26,	3,35,10, 1,13	7,3,10,26,37	35,26	15,35,26, 13,1
		Durability	F8	10,1,13, 34,27, 26,40	3,10,26,24, 27,16,40	22,35,33, 26,17,1,40, 20,24,16	12,27,1, 26,10	15,26,24, 35,25,34,	26,10,27, 1,4,35	1,35, 13,	B1,B2, B3,B4	27,1,4,35, 10,17,14,15, 20,16,24	3,35,10,40, 31,26,27,15, 16,24	10	20,10,26, 15,16	26,35,15
	Manufacturability, Productivity	Manufacturability, Productivity	F9	1,35, 10,24	1,35,12,15, 10,34,26,3	24,1,22, 35,13	5,13,16, 1,26,7,10, 12,35,	26,10, 1,35,15, 27,	35,1,10, 3,25,27,26, 12,17,24	13,1, 35,26,	27,1,4,35, 16,10,15, 20,24	B1,B2,B3, B4,35,1,10, 26,24	35,23,1,24, 34,33, 26,10	3,24,15, 16,13,35, 23	35,26, 34,4	26,27,1, 4,15,35, 10,24,
	Amount /Loss	Amount/Loss of Substance	F10	15,3,26, 40,10, 24,35	3,1,26,33,30, 16,34,31, 35,10,24	35,33,26,31, 3,40,24, 30,10,1,34,	35,26,10, 25,12,3, 1,24,15	3,27,26, 15,35, 10,13	1,3,10,25, 13,27,35, 34,26,24	35,3,26, 10,1	3,35,10,40, 31,26,27,15, 16,24	26,1,35,27, 13,3,34, 33,10,23	B1,B2,B3, B4, 26,3,10,24	24,26,35	35,24,15, 16,10	34,26,16,15, 3,35,31,7,25, 24,5,27, 12,31,1
		Amount/Loss of Information	F11	10,26,23	25,17,37,1, 4,32,10	22,10,1, 20	27,22,35	35,33	2,10,17,13,	24,5,25,9	10	3,13, 23,35	24,26,35,	B1,B2, B3,B4	24,26, 3	15,10
		Amount/Loss of Time	F12	10,30,4	24,34,26, 3,15	35,15,34, 22,24	4,26,10,34, 24,35,30	15,26, 3,10	3,1,10, 26,	35,26	20,10,26, 15,16	35,26,34,4	35,24,15, 16,10,	24,26, 3	B1,B2, B3,B4	35,24,15, 1,10,5,3
Energy			F13	15,20,10, 27,35,23,	3,1,	1,35,26,27, 10,22, 15,20	15,35,3, 1,22,	35,24,15, 16,25,3, 23	1,35,17,15, 26,27,7,23	35,17, 13,16	26,35, 15	1,4,26	34,23,16,15, 3,35,31,7, 25,24,5,26, 27,1,	15,10	35,24, 15,10, 3,7	B1,B2, B3,B4, 12,22,35,24

(We arranged it on the basis of a contradiction matrix of Altshuller[4] again. The part of F11 referred to Matrix2003[5].)

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The second Redesigned Contradiction Matrix RCM2 is shown in the slide (below). This matrix is related to the "Parameters regarding shape and design". The 11 parameters are: Weight of object, Length of object, Area of object, Volume of object, Speed, Force/torque, Stress or pressure, Shape, Strength, Temperature, and Illumination intensity. Thus the 39x39 Contradiction Matrix has been reduced into the two RCMs of size 13x13 and 11x11. The crossing cells between RCM1 and RCM2 parameters are simply neglected, with the consideration of the separation of the thinking levels.

3-1-2 Redesigned Contradiction Matrix2 : RCM2 (Parameter regarding shape & design)

Improveing Feature \ Worsening Feature		Weight of Object	Length of Object	Area of Object	Volume of Object	Speed	Force /Torque	Stress or Pressure	Shape	Strength	Temperature	Illumination Intensity
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
Weight of Object	D1	B1,B2, B3,B4	15, 12, 26,34, 10, 1,35	26,17,24, 34,35, 30,13, 1	26, 1,40, 5,35,14	1,12, 15,24	12,10, 15,35,	10,35,40 13,26,15	10,14,35, 40,13, 26,14	26,27, 15,40, 1,10	26,20, 4, 24,15, 3,22	15, 1, 3,35
Length of Object	D2	12,15,26, 34,35,40	B1,B2, B3,B4	15,17, 4, 7, 10,40	7,17, 4, 35,12, 1,14	13, 4, 12	17,10, 4,26,	1,12, 35,14	1,12,10, 26,13,14, 15, 7	12,35, 26,34, 15,14	10,15, 3, 35,24,	3,25
Area of Object	D3	1,17,26, 4,30, 14,15	14,15, 4, 26, 7, 10,24	B1,B2, B3,B4	7,14, 17, 4	26,30, 4,34	15,30, 35 ,1,	10,15, 35,26,	5,34, 26, 4	3,31, 40,14	1,15,16, 35,24	15, 3, 13
Volume of Object	D4	1,26,40, 35,10, 15,14	1, 7, 4, 35,15, 14, 12	1, 7, 4,17	B1,B2, B3,B4	26, 4, 24,34	15,35, 1,	26,35, 24	1,15,26, 4, 7, 35	10,14,15, 7,17	34,24,10, 15,35, 26, 4	1,13, 10
Speed	D5	1,26, 13,24	13,14, 12	26,30, 34	7,26, 34	B1,B2, B3,B4	13,26, 15,	26,15, 24,40	35,15,34	12, 3, 26,14	26,30, 35, 1	10,13, 15
Force/Torque	D6	12, 1,35, 15,13,26	17,15,10, 35,26,	15,10, 1,35	15,10, 12,35,1	13,26, 15,12	B1,B2, B3,B4	15,20, 10	10,35, 40,34	35,10, 14,27	35,10, 20	
Stress or Pressure	D7	10,35,40, 13,26,15	35,10, 1, 14,16	10,15, 35,25,	26,35, 10,24	26,35,	35,20	B1,B2, B3,B4	35, 4, 15,10	10,15, 3,40	35,24, 15, 1	
Shape	D8	12,10, 26,40, 15, 3	26,34, 5, 4,13,14, 10, 7	5,34, 4,10	14, 4,15, 22, 7, 1,35	35,15, 34,	35,10, 40	34,15, 10,14	B1,B2, B3,B4	30,14, 10,40	22,14, 15, 3	13,15, 3
Strength	D9	1, 12,40, 15,26,27,	1,15,12, 35,14,26	3,34,40, 26,10,	10,15,14, 7,17	12,13, 26,14	10,15, 3,14	10, 3, 15,40	10,30, 35,40	B1,B2, B3,B4	30,10, 40	35,15
Temperature	D10	35,22, 26,24, 3	15, 10	3,35, 24,15,	34,24, 40,15, 35,26,4	1,26, 35,30	35,10, 3,20	35,24, 15, 1	14,22, 15, 3	10,30, 22,40	B1,B2, B3,B4	3,30, 20,16
Illumination Intensity	D11	15, 1, 3,35	15, 3, 16	15, 3, 26	1,13, 10	10,13, 15	26,15,		3,30	35,15	3,35,15,	B1,B2, B3,B4

(We arranged it on the basis of a contradiction matrix of Altshuller[4] again.)

The Inventive Principles shown in the RCM1 and RCM2 are similar but revised one from the original ones developed by Altshuller. The Authors believe it better to simplify the Altshuller's Inventive Principles by grouping similar, only-slightly different ones together. The table shown in the slide (right) summarizes their results of revision. The 40 Inventive Principles in the right-most column of the table are regrouped into 25 New Inventive Principles. For the purpose of keeping the compatibility with the original Principles, the New Principles have the numberings of representative ones. For example, the original two Principles (1) Segmentation and (2) Separation/taking out are unified into the New Inventive Principle (1); the number (2) is skipped in the table of New Inventive Principles. In this manner, the Redesigned Contradiction Matrices, RCM1 and RCM2, are easier to use for the beginners to TRIZ. A case study of using RCM's are demonstrated in the presentation, but is omitted in this review.

	New No.	New Inventive Principles(25)	40 Inventive Principles	
A method of the segmentation/separation and combination	1	Segmentation/Separation	1	Segmentation
			2	Separation/Taking out
	5	Merging	5	Merging
	7	"Nested doll"	7	"Nested doll"
	26	Substitution・Replacement	6	Universality
			26	Substitution
			28	Replacement of mechanical system
			29	Pneumatics and hydraulics
A change of the shape	4	Asymmetry	4	Asymmetry
	14	Curvature	14	Curvature
	17	Another Dimension	17	Another dimension
A change of the viewpoint and thought	10	Preliminary action	9	Preliminary anti-action
			10	Preliminary action
			11	Beforehand cushioning
	13	"The other way round"	13	"The other way round"
	16	About	16	About
	23	Feedback	23	Feedback
	25	Self-service	25	Self-service
	27	"Cheap Short-living Objects"	27	"Cheap short-living objects"
	22	"Blessing in Disguise"	22	"Blessing in disguise"
	34	Discarding and Recovering	34	Discarding and recovering
A change of the materials	3	Local Quality	3	Local quality
			32	Color changes
	31	Porous materials	31	Porous materials
	40	Composite Materials	40	Composite materials
	30	Flexible Shells and Thin Film	30	Flexible shells and thin films
	33	Homogeneity	33	Homogeneity
A change of how to give energy	12	Equipotentiality	8	Weight Compensation
			12	Equipotentiality
	15	Vibration	15	Dynamization
			18	Mechanical vibration
			19	Periodic action
	20	Continuity	20	Continuity
			21	Skipping
A change of the state and characteristic	35	Parameter changes	35	Parameter changes
			36	Phase transitions
			37	Thermal expansion
	24	Intermediary	24	Intermediary
			38	Strong Oxydants
			39	Inert atmosphere

[*** As you see, this presentation has a clear and standard framework in design engineering and uses it for clarifying some basic features in TRIZ, to make TRIZ easier for beginners. It is desirable to teach and apply the new RCM's to various examples for demonstrating its easiness in learning and its effectiveness in actual use. Anyway the ideas in this presentation are valuable, I suppose. The presentation slides are translated into English by the Authors, and are easy to follow in their logic. I recommend you to read them.]

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Last updated on Mar. 13 , 2011. *Access point:* *Editor:* nakagawa@ogu.ac.jp