“How People Interact with Objects using TRIZ and ASIT”

TAKAHARA Toshio
takahara-t@m.ieice.org

0. Preface

I discussed “technology” and “institution” in human life in a previous article, then on this basis I made clear the position of “object” especially “process object” in problem solving and gave the grounds to the application area to which problem solving tools could apply. [1]

In this article I consider how and when human being relates with “technology/institution”, which means how and when human being behaves in his/her life of operating on the outside world. Then I discuss the role of “process object” and “system object” which are the key concepts connecting life with problem solving tools. These will help each problem to be solved appropriately.

ASIT (the acronym for “Advanced Systematic Inventive Thinking”) [3,4,5,7] is a thinking method derived from TRIZ (the Russian acronym for “Theory of Inventive Problem Solving”) to form the subset of TRIZ (“ASIT should be viewed more as complementing TRIZ than a replacement” [3]).
I examine ASIT from the consideration mentioned above.
Afterwards related examination on “the 40 principles” [9] of TRIZ and their relations with ASIT were also given.

1. “Technology” and “institution” in human being

Among other creatures, the human being is characterized as having the indirect way of recognition and operation via medium. Mankind is the existence that has been accumulating these media between human being and the outside world. We call these increasing indirectness “culture”. What mediate between human being and the outside world are “common notion” or “entity”. Without these media human being recognize from or operate on the outside world only by personal notion and his/her body. Via this indirectness born by “entity” or “common notion” outside of his/her personal notion and body, human being could have been recognizing and operating much better than without these and also much better than other creatures. “Culture” born by “entity” and “common notion” is the essence of the human being. [1,2]

As to “culture” in the area of human’s operation on the outside world we have three axes to consider.
The first axis is by what they are born. What mediate between the human being and the outside world in the area of operation on the outside world?
What is the “entity” by which the human being operates on the outside world and expands his/her ability of operation? It is the “technical means” or “technical system” as a set of “technical means”.

Examples of “technical system”:
A hammer, an arrow, a folk and a spoon, clothes, a house, a motor car, a computer
And the phase of “culture” born by “technical means” or “technical system” is called “technology”.

Second question is what the “common notion” by which the human being operates on the outside world and expands his/her ability of operation is. The human being made up “common notion” arbitrarily to get along with others concerning his/her behavior. The phase of “culture” born by “common notion” or “institutional system” as a set of “common notions” made up arbitrarily is called “institution”. [2]

Examples of “Institutional system”:
Law, language, moral, government, company, home, group

In the area of operation on the outside world “technology” born by the “technical means” or “technical system” and “institution” born by “common notion” or “institutional system” are made and made use of. [1,2]

The second axis is the affecting direction between “technology/institution” and the human being. This axis is for how “technology/institution” works.
We have five phases as to direction.
1) “make” phase
2) “manage” phase
3) “use” phase
In these three phases the human being has intentional relation with “technology/institution”.
4) “affect” phase
5) “be affected” phase
In these two phases the human being has unintentional relation with “technology/institution”.

In “make” phase we actively construct or change technical systems or institutional systems.
In “manage” phase we manage to work out well using current technical systems or institutional systems.
In “use” phase we simply make use of existing technical systems or institutional systems.
In “affect” phase, we affect “technology”, “institution” and the outside world without intentional use of technical systems or institutional systems. “Technical system” or “Institutional system” can be changed or destroyed not intentionally in “affect” phase.
In “be affected” phase, we are passively and affected by “technology”, “institution” and the outside world not intentionally.

The third axis is time. This axis is for when “technology/institution” works.
In “use” phase, “affect” phase and “be affected” phase we perform simply in real-time domain.
In “manage” phase, we manage to go well according to the situation, in other word we collect information about the situation and decide the images of “object” by which we should act in advance then immediately realize that image in the real world. In this sense we perform in semi-real-time domain in “manage” phase.

On the other hand “make” phase is to select and decide the image of “object” as to “technology” and “institution” before their realization in the real world in advance. This making action is done in semi-real-time domain or in batch environment.

Ordinarily making “technical system” consists of designing the image of “object” logically and afterwards manufacturing it physically in batch environment. These making actions are followed by their realization in the real world in real-time domain as a “use” phase. On the other hand usually making “institutional system” is in the semi-real-time domain soon followed by “manage” phase also in the semi-real-time domain.

These are shown in Table 1.

Table 1 “Technology/institution” in time domain

Culture	Phase	Time domain		
		Batch	Semi-real-time	Real-time
Technology	Make	X(usually)		
	Manage		X	
	Use			X
Institution	Make		X(usually)	
	Manage		X	
	Use			X

2. System object and process object

Here an “object” is everything to be selected and decided to solve a problem or to design something. Thus we can grasp that “object” is not only “system object” in space domain consisting of the element of technological system or institutional system to make but also “process object” in time domain consisting of the element of process of system action or human action. [1]
This classification is from the viewpoint of time domain and space domain.
As “process” is a series of action of system or human being, and large process itself may have several processes in it in some cases, therefore “process object” is process itself or action as element of process. [1]

“System design” is simply to decide the contents of “system object” or to solve a “system problem”.
“Process design” is simply to decide the contents of “process object” or to solve a “process problem”.

The relations between applied area and “object” are shown in table 2.
Technical area has component of technical system as system object and process or action of technical system as process object.
Institutional area has component of institutional system as system object and process or action of institutional system as process object.
Personal area has process or action of human being as process object only. [1]

Table 2 Applied area and “object”

Object / Area	System Object		Process Object		
	Component of Technical System	Component of Institutional System	Process of Technical system	Process of Institutional System	Process of Human being
Technical	X		X		
Institutional		X		X	
Personal					X

3. The role of system object and process object

The relations between five phases and "object" are shown in table 3.
In "make" phase we actively construct or change "system object" and "process object" by using existing "system object" and "process object".
In "manage" phase we manage to go well by using existing "system object" and "process object" and changing "process object" according to the situation.
In "use" phase we make use of current systems by using existing "system object" and "process object" but do not change any object except "state"("state" in process object can be changed in "use" phase).
In "affect" phase, table 3 shows that we affect "technology", "institution" and the outside world without intentional dealing with technical systems or institutional systems. "Technical system" or "Institutional system" can be changed or destroyed not intentionally in "affect" phase.

Table 3 Five phases of "technology and institution" and "object"

Phase	Time Domain			Used Object		Changed Object	
	Batch	Semi-real-time	Real -Time	System Object	Process Object	System Object	Process Object
"Make"	X	X		X	X	X	X
"Manage"		X		X	X		X
"Use"			X	X	X		(X)
"Affect"			X			(X)	(X)
"Be Affected"			X				

From table 2and table 3 we obtain table 4 in "make/manage/use" phase.

Table 4 Applied area, Five phases of "technology and institution" and "object"

Area	Phase	Time Domain			Used Object		Changed Object	
		Batch	Semi-real-time	Real -Time	System Object	Process Object	System Object	Process Object
Technical	"Make"	X (usually)			X	X	X	X
	"Manage"		X		X	X		X
	"Use"			X	X	X		(X)
Institutional	"Make"		X (usually)		X	X	X	X
	"Manage"		X		X	X		X
	"Use"			X	X	X		(X)
Personal	"Make"		X (usually)			X		X
	"Manage"		X			X		X
	"Use"			X		X		(X)

Table 3 and 4 tell us importance of real-time or semi-real-time domain and "process object" in problem solving tools.
Especially in institutional area and personal area, practically "manage" phase has an important role in problem solving tools, as compared with technical area that has usually great importance in "make" phase.

Some examples are as follows.

Example 1
Technical system: a motor car
System object: technical means consisting of hardware and software (in case of design)
Process object: running process
Process object: ---(in case of driving operation)

Example 2
Technical system: operating system
System object: technical means consisting of software (in case of design)
Process object: running process
Process object: ---(in case of operation of PC)

Example 3
Technical system: medical care system
System object: technical means consisting of medical instruments and knowledge base
Process object: service processes of examination, diagnosis and treatment

Example 4
Institutional system: an organization of company
System object: “common notion” with regard to an organization of company born by members of company and the other concerned people.
Process object: business processes of management

Example 5
Institutional system: the law in the nation
System object: “common notion” with regard to the law in the nation born by the members of the nation
Process object: processes of prosecution, defense and trial.

4. ASIT

In ‘‘Introduction to ASIT’’ Roni Horowitz said simply and wonderfully about the transformation from the problem world into the solution world as follows.

‘‘How are problems solved?
Changes are made to the problem world. Objects are added, removed and changed until we reach the new world in which the problem disappears or is dramatically reduced.
This is the solution world.’’ [5]

To adapt ASIT to “process object” explicitly under “the Closed World Condition” (“The inventive solution world does not introduce new kinds of objects that do not appear in the problem world.” [5 p.33]), the framework is as follows.

For both “process object” and “system object”, we can
#1 add “system object” or “process object” using multiplication tool *1,

Example 1: The kid does not tell the story to the parent. To tell a new story about the day at kindergarten will make the kid tell his/her own story. [4] Note 1

Area: institutional--home
Phase: manage
Object: process object

Note 1: In this example of "ASIT's Five Thinking Tools with Examples" [4] Roni Horowitz set a list of problem objects as follows
{Kid, Story about his/her day, TV, parent}.

But according to the intention of this article to deal with the "process object" explicitly the list ought to be
{Kid, action to tell story about his/her day, action to watch TV, parent}.

#2 add function of existing "system object" or "process object" using unification tool *2,

Example 2: Wheel game (part 1 tight bolt): I have a flat tire. I loosened three bolts of this tire. But one bolt is too tight to loosen. I must loosen this bolt by wrench and jack. (Solution: The system to put the wrench on the problematic bolt and to place the jack under the handle of the wrench using the power of the jack to unscrew the bolt. [8]) Note 2

Area: technical
Phase: make
Object: system object

Note 2: Among the twelve simulation games in "Creative Thinking" CD-ROM [8], ten games including above example are for "process design" problems. Only in "Prison game" and "Wheel game (part 1 tight bolt)", we design lighting system and system to loosen bolt respectively.

#3 remove "system object" or "process object" using object removal tool *3,

Example 3: "Currently, helicopter pilots are unable to escape the helicopter in case of technical problems. A good solution would be to eject the pilot upward before he parachutes down. But this is impossible because of the danger of being hit by the rotor. (Solution: The rotor will be removed just before the pilot is ejected)" [4]

Area: technical
Phase: make
Object: system object

#4 change "system object" or "process object" using division tool(including the case of changing object using "breaking symmetry" tool) *4,

Example 4: The Boomerang, a light twin-engine airplane having asymmetrical shape designed by Burt Rutan [6]

Area: technical
Phase: make
Object: system object

Example 5: Three men decided to have a barbecue. Their grill was only big enough for two steaks, and of course they wanted to barbecue three. Grilling each side of the steak takes 10 minutes. How is it possible to grill three steaks in 30 minutes? [5]

Area: technical
Phase: manage
Object: process object

and/or
#5 change attribute of "system object" or "process object" using breaking symmetry tool *5. (We need to check symmetry in space, in time or group symmetry. [5]). [3,4]

Example 6: The Millennium Bridge having curved shape [6]

Area: technical
Phase: make
Object: system object

Example 7: Coin game: There are six bags with gold coins. One of them contains the real gold coins. All the other contains the fake coins. Real gold coin weighs eleven grams. Fake coin weighs ten grams. There is a scale to measure them. You have only one chance to measure coins. Identify the bag with the real coins. [8]

Area: technical
Phase: manage
Object: process object

Example 8: Change the strength or speed of action according to the circumstance.

Area: any
Phase: manage
Object: process object

Here five thinking tools are as follows.
*1: Multiplication: Solve a problem by introducing a slightly modified copy of an existing "system object" or "process object" into the current system or process [3-7] (I slightly changed that of [3,4]).

*2: Unification: Solve a problem by assigning a new use to an existing "system object" or "process object" [3-7] (I slightly changed that of [3,4]).

*3: Object Removal: Solve a problem by removing an object from the system or process [3-7] (I slightly changed that of [3,4]).

*4: Division : Solve a problem by dividing an object and reorganizing its parts (including the case of changing object using "breaking symmetry" tool) [3-7].

*5: Breaking Symmetry: Solve a problem by changing a symmetrical situation into an asymmetrical one [3-7].

We obtain table5 in summary.

Table 5 Operations of ASIT Tools and Objects

Operation \ Object			System Object	Process Object
Add	Object Using Multiplication Tool *1		X	X
Add	Function of Existing Object Using Unification Tool *2		X	X
Remove	Object Using Object Removal Tool *3		X	X
Change	Object Using Division Tool(including the case of Changing object using "breaking symmetry" tool) *4		X	X
Change	Object Using Breaking Symmetry Tool *5	(Symmetry in Space)	X	
		(Symmetry in Time)		X
		(Group Symmetry)	X	

x: available

Table 5 and some examples show ASIT has the great ability to deal explicitly with both "system object" and "process object" by its own logic without using analogy.

5. The 40 principles" in TRIZ and ASIT

Here I examine "the 40 principles" [9-14] of TRIZ from the viewpoint of the axis "function/structure" and the axis "abstract/concrete". Needless to say generally "principles" are always "abstract". On the other hand the difference between "abstract" and "concrete" is relative according to the situation, so here "abstract" level is set very high.
And as many of TRIZ practioners know, "the 40 principles" of TRIZ include apparently "physically specific" principles in them. But here I leave them as they are, although some of the versions of the 40 principles in TRIZ journal (such as [11,12]) deal with them in very abstract and sophisticated way.

These are shown in table 6.

Among "the 40 principles" in TRIZ, next ones are literally named "action" which is "process object" as "action as element of process".
Principle 09: Preliminary anti-action
Principle 10: Preliminary action
Principle 16: Partial or excessive actions
Principle 19: Periodic action
Principle 20: Continuity of useful action

The other principles (such as: Principle 13/15/18/21/22/23/24/25) also have many "process" factors to be treated as "process objects".

But considering the relation between "the 40 principles" of TRIZ and ASIT, I leave the difference between "system object" and "process object" both in "the 40 principles" and in ASIT out of consideration here.

Under this limitation the relation between "the 40 principles" of TRIZ and ASIT is as follows and also

shown in table 6.

Multiplication: (introduce a slightly modified copy of an existing object into the current system or process) refers to the next principles of TRIZ.
Principle 03: Local quality
Principle 05: Merging
Principle 08: Anti-weight
Principle 09: Preliminary anti-action
Principle 10: Preliminary action
Principle 11: Beforehand cushioning
Principle 12: Equipotentility
Principle 15: Dynamics
Principle 17: another dimension
Principle 18: Mechanical vibration
Principle 20: Continuity of useful action
Principle 22: "Blessing in disguise" or "Turn Lemons into Lemonade"
Principle 23: Feedback
Principle 24: "Intermediary"
Principle 25: Self-service
Principle 33: Homogeneity
Principle 36: Phase transitions
Principle 37: Thermal expansion

Unification: (assign a new use to an existing object) refers to the next principles of TRIZ.
Principle 06: Universality
Principle 20: Continuity of useful action
Principle 22: "Blessing in disguise" or "Turn Lemons into Lemonade"
Principle 25: Self-service
Principle 34: Discarding and recovering

Object Removal: (remove an object from the system or process) refers to the next principles of TRIZ.
Principle 02: Taking out
Principle 34: Discarding and recovering

Division: (divide an object and reorganizing its parts) refers to the next principles of TRIZ.
Principle 01: Segmentation
Principle 07: "Nested doll"
Principle 13: "The other way round"
Principle 15: Dynamics
Principle 17: another dimension
Principle 23: Feedback

Breaking Symmetry: (change a symmetrical situation into an asymmetrical one) refers to the next principles of TRIZ.
Principle 03: Local quality
Principle 04: Asymmetry

Principle 07: “Nested doll”
Principle 11: Beforehand cushioning
Principle 14: Spheroidality - Curvature
Principle 15: Dynamics
Principle 16: Partial or excessive actions
Principle 18: Mechanical vibration
Principle 19: Periodic action
Principle 21: Skipping
Principle 32: Color changes
Principle 35: Parameter changes
Principle 37: Thermal expansion
Principle 40: Composite materials

Table 6 shows the following fact.

1. ASIT covers 32 principles.

Multiplication Tool:	18
Unification Tool:	5
Object Removal Tool:	2
Division Tool:	6
Breaking Symmetry Tool:	14
(Total	45:

13 principles are double counted)

2. The eight principles that ASIT does not cover are as follows.

Principle 26: Copying
Principle 27: Cheap short-living objects
Principle 28: Mechanics substitution
Principle 29: Pneumatics and hydraulics
Principle 30: Flexible shells and thin films
Principle 31: Porous materials
Principle 38: Strong oxidants
Principle 39: Inert atmosphere

All these principles refer to replacing or substituting, and many of them are “physically specific”. (And Roni Horowitz said “ASIT does not allow substituting at all because of the Closed World principle”. [15])

Table 6 The 40 Principles of TRIZ and ASIT

The 40 Principles of TRIZ	type of principles					ASIT tools				
	abstract structure	abstract function	concrete structure	concrete function	physically specific	*1 Multiplication (adding object)	*2 Unification (adding function of existing object)	*3 Object Removal	*4 division	*5 Breaking Symmetry
Principle 01: Segmentation	x	x							x	
Principle 02: Taking out			x	x				x		
Principle 03: Local quality	x	x				x				x
Principle 04: Asymmetry	x	x								x
Principle 05: Merging	x	x				x				
Principle 06: Universality	x	x					x			
Principle 07: "Nested doll"			x	x					x	x
Principle 08: Anti-weight			x	x		x				
Principle 09: Preliminary anti-action				x		x				
Principle 10: Preliminary action				x		x				
Principle 11: Beforehand cushioning				x		x				x
Principle 12: Equipotentiality					x	x				
Principle 13: "The other way round"			x	x					x	
Principle 14: Spheroidality - Curvature			x							x
Principle 15: Dynamics	x	x				x			x	x
Principle 16: Partial or excessive actions				x						x
Principle 17: another dimension	x	x				x			x	
Principle 18: Mechanical vibration					x	x				x
Principle 19: Periodic action				x						x
Principle 20: Continuity of useful action				x		x	x			
Principle 21: Skipping				x						x
Principle 22: "Blessing in disguise"				x		x	x			
Principle 23: Feedback		x				x			x	
Principle 24: "Intermediary"	x	x				x				
Principle 25: Self-service		x				x	x			
Principle 26: Copying			x	x						
Principle 27: Cheap short-living objects			x							
Principle 28: Mechanics substitution			x							
Principle 29: Pneumatics and hydraulics					x					
Principle 30: Flexible shells and thin films					x					
Principle 31: Porous materials					x					
Principle 32: Color changes				x						x
Principle 33: Homogeneity	x	x				x				
Principle 34: Discarding and recovering			x	x			x	x		
Principle 35: Parameter changes			x	x						x
Principle 36: Phase transitions					x	x				
Principle 37: Thermal expansion					x	x				x
Principle 38: Strong oxidants					x					
Principle 39: Inert atmosphere			x							
Principle 40: Composite materials			x							x

Note: "Object" contains both "system object" and "process object".

6. Conclusion

I considered the way human being behaved in life relating with "technology/institution". In this context I considered the role of "process object" and "system object". I examined ASIT from the consideration mentioned above to find ASIT has the great ability to deal explicitly with "process object" without using analogy. Afterwards, related examinations of "the 40 principles" of TRIZ and their relations with ASIT were also given. These explanations and tables may help students of TRIZ and ASIT decide what tools and methods to use in a variety of situations.

Lastly I express my most sincere gratitude to Dr. Roni Horowitz and Dr. Ellen Domb for their kind comments.

References

[1] Takahara Toshio, "Application Area of Thinking Tool or Problem Solving Tool", The TRIZ journal, http://www.triz-journal.com/archives/2003/06/e/05.pdf, Jun.2003.
[2] Takahara Toshio, "A Study on Ideal Technology and Information Network Systems", The Journal of the Japan Society of Applied Science, Vol.4 No.1, Feb.1990 (in Japanese).
[3] Roni Horowitz, "From TRIZ to ASIT in 4 Steps", The TRIZ journal, http://www.triz-journal.com/archives/2001/08/c/index.htm, Aug.2001.
[4] Roni Horowitz, "ASIT's Five Thinking Tools with Examples", The TRIZ journal, http://www.triz-journal.com/archives/2001/09/b/index.htm, Sept.2001.
[5] Roni Horowitz, "Introduction to ASIT", http://www.start2think.com/, Mar. 2003.
[6] Roni Horowitz, "ASIT newsletter e-book 1", http://www.start2think.com/, 2001.
[7] "ASIT Premier online course" http://www.start2think.com/
[8] "Creative Thinking" CD-ROM Professional Edition, http://www.invention-highway.com/, Compedia&BCI software, 1999.
[9] Genrich S. Altshuller, "40 Principles: TRIZ Keys to Technical Innovation", Translated by Lev Shulyak, Technical Innovation Center, Worcester, MA. 1998.
[10] Karen Tate and Ellen Domb, "40 Inventive Principles with Examples", The TRIZ journal, http://www.triz-journal.com/archives/1997/07/b/index.html, Jul.1997.
[11] Darrell Mann and Ellen Domb, "40 Inventive (Business) Principles with Examples", The TRIZ journal, http://www.triz-journal.com/archives/1999/09/a/index.htm, Sept.1999.
[12] John Terninko, "40 Inventive Principles with Social Examples", The TRIZ journal, http://www.triz-journal.com/archives/2001/06/a/index.htm, Jun.2001.
[13] Darrell Mann and Conall Ó Catháin, "40 Inventive (Architecture) Principles with Examples", The TRIZ journal, http://www.triz-journal.com/archives/2001/07/b/index.htm, Jul.2001.
[14] Darrell Mann and Barry Winkless, "40 Inventive (Food) Principles With Examples", The TRIZ journal, http://www.triz-journal.com/archives/2001/10/b/index.htm, Nov.2001.
[15] Richard Kaplan, "ASIT Compared to Scamper for Devising New Products", The TRIZ journal, http://www.triz-journal.com/archives/2001/12/d/index.htm, Dec.2001.

About the Author

TAKAHARA Toshio graduated in electric-communication engineering from Waseda University in

Tokyo Japan. He joined FUJITSU Limited where he mainly engaged in river management as a designing engineer and a consultant. Before retiring an affiliated company of FUJITSU in 2002 he engaged in quality management concerning ISO9001 for a few years. In the study of quality management and design method at the affiliated company of FUJITSU, he met TRIZ in 2001.
His today's interest is in culture theory, pre-communication processes, documents, design method and problem solving tools.

His e-mail address: takahara-t@m.ieice.org
His homepage URL: http://www.geocities.co.jp/WallStreet/2744/ (almost in Japanese)

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