

Radical Thinking for Enumeration and Contradiction

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1. Introduction

Correct thinking consists of setting correct granularity of object and method from among enumerated objects and methods and adapting correct logic under correct value.

One of requirements of correct thinking are to manage granularity of object, enumeration of objects.

Granularity is size, magnitude or scope in space and/ or time and degree of abstraction of attributes of something which is specified by points of view.

Granularity and enumeration have mutually related constraint. We can get correct granularity of object only from among the perfectly enumerated objects. Without enumeration of objects we might miss the adequate granularity of object.

Granularity of object and enumeration of objects is the base of relation between objects and movement of object. At first sight granularity and enumeration are important only in the situation of changing objects adequately. But we will later notice the importance of them in the situation of making a discovery of a type or law from among various phenomena.

Usually we do an act of changing objects remaining unconscious of granularity of object, enumeration of objects and value.

In this paper I propose a way to manage granularity of object and enumeration of objects consciously. In this context constraints between granularity and enumeration are also shown.

Contradiction is re-formulated by managing granularity and enumeration.

Contradiction is either generalized "Physical Contradiction" which two attributes are going together or "Technical Contradiction" which two values are resolving differences. All movement is contradiction and all change is caused by movement.

In Chapter 3 I propose some method of managing granularity and enumeration of objects consciously, which gives a formal ground of Radical Thinking of previous papers[TS2009] [TS2011].

In Chapter 4 I re-formulate contradiction by managing granularity and enumeration.

In Chapter 5 I summarize methods of resolving differences.

2. Review of Basic Concepts

Anything perceptible is called **Object**. I recognize three kinds of Objects as follows. [TS2006] [TS2007]

1. Matter: System Object

2. "Idea": System Object

21. Information of individual or common notion which is taken by physical entity

22. My idea

3. Movement or Action: Process Object

Movement is process from a viewpoint of time and action from a viewpoint of relation between itself and other thing to change itself and other thing.

Object is I, Other Person, Matter and Movement at different granularity.

Let us summarize some other basic concept of my previous paper. [TS2006] [TS2007] [TS2008]

Granularity is size, magnitude or scope in space and/ or time and degree of abstraction.

Density is density of inner structure.

Function is primarily meaning of Process Object, secondly meaning of attributes of Object.

Structure is granularity and inner structure.

Attributes is content of Object with specific description. Attribute of Object should be grasped accurately and treated at adequate granularity.

We have three granularities of attributes in Object.

Attributes 1 is everything that concretely describe Object.

Attributes 1 includes attributes 2 in narrow sense and inner Structure.

Attributes 2 in narrow sense shown as **Attributes** in Fig.1 includes attributes 3 in most narrow sense which is difficult to change and state which is easy to change. [TS2008]

Object has inner structure and attributes which produce function to the outside.

Structure is an assemblage of elements and their relations. Structure of something consists of the relation between the whole and itself and inner structure of the one. The granularity of Object is a part of structure because it provides the relation between the whole and itself.

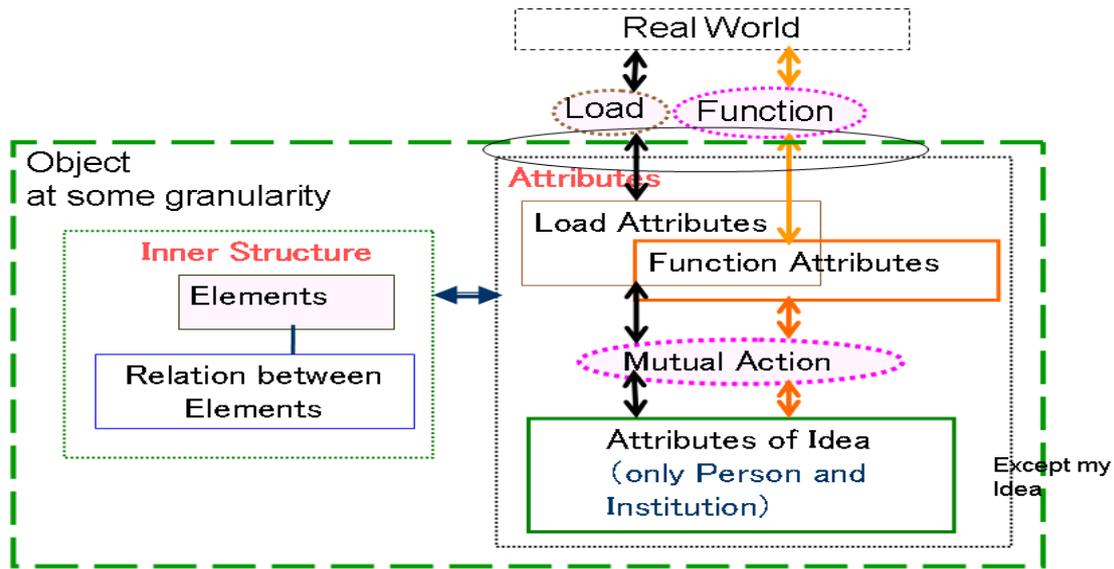


Fig. 1 Structure of Object [TS2008]

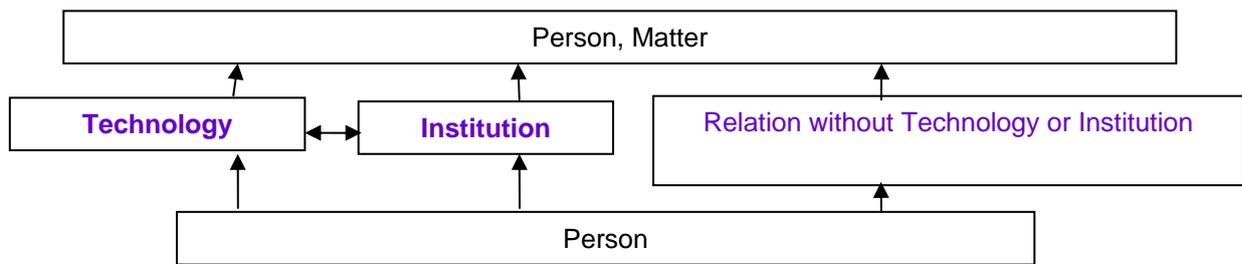


Fig.2 Human Life via Technology and Institution [TRIZJ2003Jun]

Technology is an assemblage of technical means and its process of movements. Institution is an assemblage of common idea and its process of movements.

Examples of institution: Politics, Economy, Family, Company, Religion.

3. Granularity and Enumeration

3.1 Object of Managing Granularity

1) What is Granularity?

Granularity is size, magnitude or scope in space and/ or time and degree of abstraction of attributes of object which is specified by points of view.

So what is object of granularity?

Object of granularity is everything. But we restrict our target to object and value.

Size, magnitude or scope in space of value is for whom the concerned object or change of object is useful.

Size, magnitude or scope in time of value is in what time range the concerned object or change of object is useful.

Degree of abstraction of attributes of value depends on what contents of attributes of the concerned object or change of object is useful.

2) Object of Managing Granularity

At first we have object of managing granularity. And it expands to relation between objects and movement of object as follows.

1. Object or sub-object and its attributes.
2. Relation between attributes, between object and its attributes and between objects.
3. Movement or change of value, attribute and object.

Relation and movement include objective one and that in idea.

“Object etc.” is defined as sub-object, object, relation between objects and/or movement of object.

3.2 Constraint between Granularity and Enumeration

1) Constraint that perfect enumeration is indispensable for correct granularity

We can get correct granularity of object only from among the perfectly enumerated objects. Without enumeration of objects we might miss the adequate granularity of object.

Under this presupposition that perfect enumeration is indispensable for correct granularity, we will have three constraints, which need type or kinds, relation and movement.

We already know relation and movement. But we don't know "type or kinds". So let us define type or kinds.

2) Constraint of type or kinds

Types or kinds are what satisfy the following constraints under the premises of complete enumeration of object etc.

If we could classify "object etc." into not so many kinds of "object etc." at adequate granularity in which we can deal with the same type in the same way and deal with the different type differently, and which cover all "object etc." without leakage, we get types or kinds.

For recognition and changing object it is important to recognize types or kinds of "object etc.".

For simplification we use "object etc.". Don't forget this means object, relation between objects and/or movement of object.

3) General Constraint between Granularity and Enumeration: Principle of Enumeration

Principle of Enumeration: Enumeration of "object etc." depends on total granularity of "object etc." and granularity of "object etc.".

Inner structure of "object etc." is the granularity of each sub-"object etc." and relations between them.

Let us enumerate objects in a large box. This box has a hundred balls in it. A hundred balls are divided into ten small boxes having ten balls each. In this case specifying the large box is to decide the granularity from among the total world. And whether the object is ten small boxes or a hundred balls depend on granularity of object or inner structure of the large box. In this case granularity depends on granularity of size, magnitude or scope in space.

If these a hundred balls have various colors, whether objects are divided into three kinds of red-group, blue-group and brown-group, thirty kinds of red, orange, etc. or a hundred objects of each color depends on granularity of attributes of the object in this case.

In Japan rainbow has seven colors. In some country it has five or six colors. Every country has color of rainbow as fixed notion.

4) Constraint of Specifying Granularity

Specifying granularity is useful in definition fixing something for the present and re-grasping something or changing something.

We have many ways of defining something which consists of definition by space enumeration, definition by

time enumeration and definition from outside and from inside.

Definition by time enumeration is somewhat different from the other definition. Throughout unlimited time range from birth to disappearance, essence remains unchanged. Therefore something is defined as the process that essence is generating and running.

Definition by space enumeration is to express differences only by enumerating "object etc.".

Definition from outside is to express differences by descript function of "object etc.".

Definition from inside is to express differences by descript inner structure of "object etc.".

We can descript definition by space enumeration, definition from outside and definition from inside according to the general constraint between granularity and enumeration from the other direction as follows.

Total "object etc." is specified by enumeration of "object etc.", function or granularity of total "object etc." or inner structure of "object etc.".

3.3 Attitudes for Granularity and Enumeration and a Role of Granularity and Enumeration

From the study of granularity and enumeration required for the change of objects, logical possibility of granularity and enumeration is revealed. Until now only a part of types of relation and movement and laws were found out. We need Radical Thinking for Enumeration [TS2011] to enumerate "object etc.".

1) Change of Recognition as Constraint Satisfaction

It is highly recommended to be conscious on granularity and enumeration but moreover we need to seek for granularity and enumeration of "object etc." especially types of relation and movement and laws.

1.1) Radical Review of Granularity

A granularity specifies something. For specifying something, constraint of specifying granularity by both granularity and enumeration can review granularity of "object etc." such as object itself, relation or movement.

For example we should review and re-construct concept of possessing something which will be a new attitude for my object, object for me, our object or object for us.

1.2) Discovery of Types of Object without Change

We have already types of objects such as animals consisting of cow, horse, dog and cat, etc.. We can have a new useful type of object.

1.3) Discovery of Types of “Object etc.” with Historical Change as Constraint Satisfaction

For example production is classified into two types which consist of productivity and relations of production.

Productivity is the ability of production and relations of production is relations between something useful producing products. Both productivity and relations of production is the complex of many objects.

These types are different from that of animals. Cow or horse is the notion which is unchanged both in contents and names throughout history.

Although the contents of productivity and relations of production are changing in each stage, the notion of productivity and relations of production are notions keeping unchanged in every stage of history. And relation or contradiction between productivity and relations of production works throughout every stage of history. Although the contents are changing in each stage, we have notions and relation keeping unchanged throughout the history.

As I will show later contradiction is a relation between two items. After enumeration of “object etc.” throughout the history, if type of object and the types of relation or movement of the concerned object went together that might cause combinatorial explosion, we could find the new type of object and new types of relation or new types of movement or law simultaneously.

An example of this is the compatibility of new concept of contradiction, unit of the world and unit of dialectical logic shown later.

2) Change Facts

We can change “object etc.” by changing granularity, value or relations of sub-“object etc.”.

This is a change by formal logic.

3) Timing of managing granularity and enumeration

We have two kinds of timing of managing granularity and enumeration.

We should review granularity and enumeration in advance.

And at present we decide granularity and enumeration. That is to live. And the way of life is the attitudes and method to decide granularity and enumeration.

4. Contradiction

I will re-formulate contradiction formulated already in [TS2011].

Requirements of approximating model of the world, which has moving elements and mutually related elements, is to have units whose synthesis makes approximation of a phenomenon of the world.

As logic is movement or relation of thinking, this unit will also become a unit of dialectical logic.

What is a unit which satisfies these constraints?

Contradiction is an assemblage of generating and movement of two terms and the outer movement that make them possible. Or contradiction is generation and movement of two terms which have relation with outer part.

Only outer movement can generate two terms. Outer movement consists of objective power and intentional personal will.

Two terms is two attributes of two objects, two attributes of one objects or two values of one object. Two terms are used to be called opposites.

This contradiction satisfies the requirements. This contradiction is the minimum unit which describes relation and movement of element and synthesis of units via attributes or state can approximate phenomenon to become model of the world. And it becomes a unit of dialectical logic.

We have four types of contradiction as follows. I will show some issues in dealing with beginning of barter which is one of the greatest inventions of the human being in the world in description of “The Capital” Chapter 1 by K. Marx

11) Contradiction or movement of two attributes which already exists going together and run autonomously, by objective power and/or by intentional human will.

Italic green letter shows the concerned part of [TS2011].

In [TS2011 3,

11) Structure of change in autonomous contradiction

111) Opposites are two attributes in one Object

112) Opposites are two attributes in two Objects

Productivity and relations of production each of which consist of many objects is two attributes of an object of this type of contradiction.

K. Marx deal with the beginning process of barter which generate coin from the state of

commodity having use value and exchange value as autonomous movement without considering outer power of urging people to seek for more efficient exchange. This stage is what I call the third stage of beginning barter. And K. Marx started description of “The Capital” with this stage. [DC]

Beginning barter has two movement or contradiction which is mutual action between notions of two people and the one having two attributes of useful thing. This third stage has two

movements or contradiction as in the first and second stage.

As many know the contradiction of the third stage of useful thing is resolved by separation of useful thing into coin by substantialization of exchange value. This is contradiction type 11).

On the contrary the other contradiction of mutual action between notions of two people who are representatives of the community is type 01) shown later.

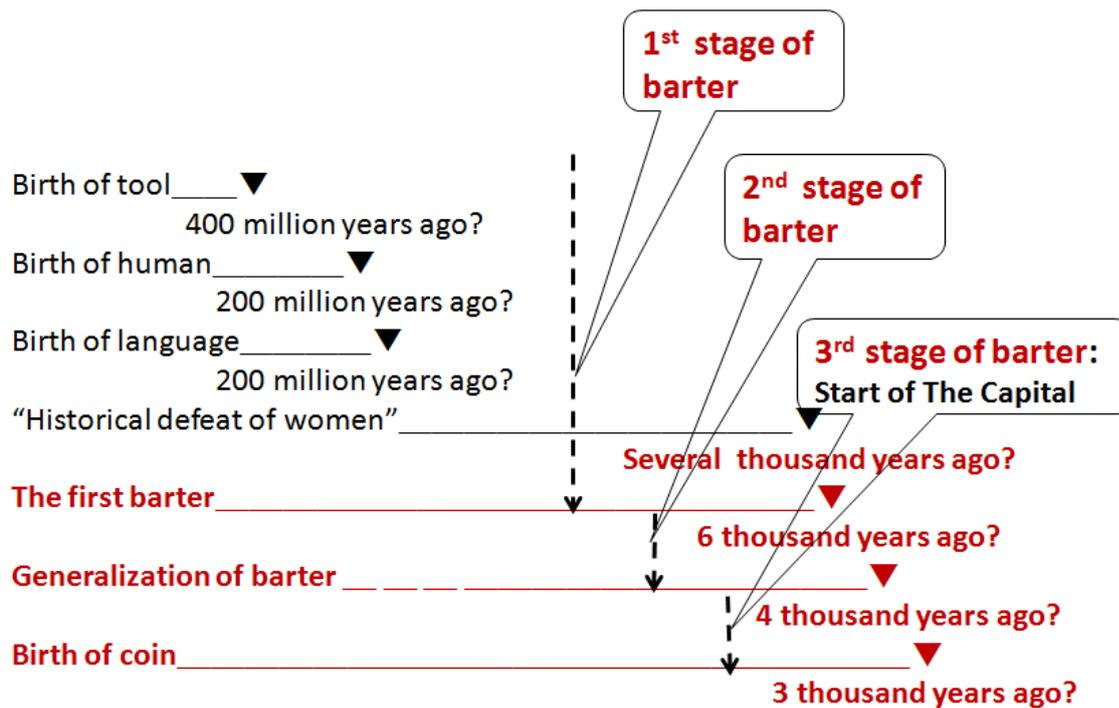


Fig.3 Stage of Beginning of Barter (Ages are not authorized)

10) **Contradiction or movement which objective power and/or intentional human will make two attributes go together.** [TS2011]

This is a movement of making relation. To share something is a special case that two values of two attributes going together are equal.

In [TS2011], 3.

21) “Technical Contradiction” TC having two attributes

211) “Technical Contradiction I”, TC1

This is usual “Technical Contradiction” in TRIZ.

212) “Technical Contradiction 2” TC2

2121) TC21

2122) TC22

21221) TC221

21222) TC222

22) **Contradiction of unity**

K. Marx does not deal with the next example as contradiction. [IEICE2012]

Example of contradiction generated by outer objective power or intentional will:

Invention of tool brings about labour and technology.
Invention of language brings about communication.

As same as tool and language, barter was invented at some stage of the history of human. What brings about barter? What barter brings about?

Before the age of barter, human being does not have the consciousness of individual, community nor possessing. But common idea of representatives of each community on next three items starts institution of barter. In the first stage of beginning barter, ideas of two representatives of communities share next three notions that make barter possible.

1. Recognition that my community has something and other community has another thing.

2. Image that we will give you something we have and you will give us something you have.

3. When, where and what quantity do we give and take? [TS2010]

The invention of barter is the most important one in so-called “non-technical” area of usual TRIZ in the human history. This invention brought about institution including economy, politics, company, family, religion and nation in human society.

The outer power or intentional will in this case is a will to reduce human losses in the case of getting products from the other community and

also surprisingly enough a will to enhance value of both communities or both representatives of communities. This is contradiction of type 10).

And also surprisingly enough at the moment ideas of two representatives of communities share notion that make barter possible, the concerned useful thing become to have two attributes of usefulness and exchangeability. This is also contradiction of type 10).

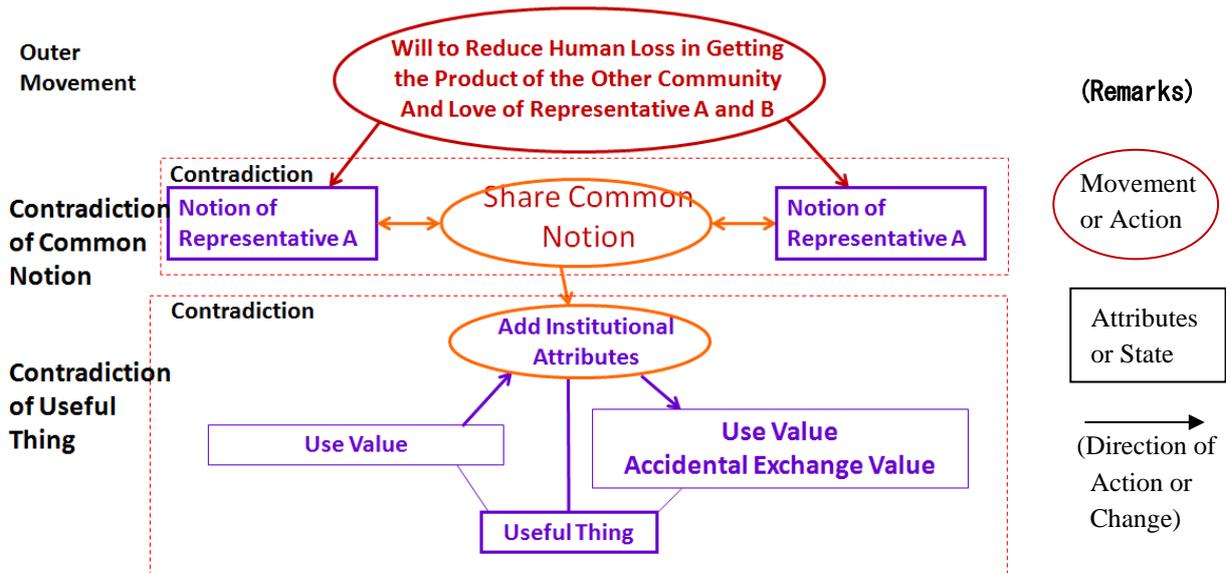


Fig.4 First Stage of Beginning of Barter

Generalizing the term of usual TRIZ the contradiction or movement of generating two terms or two terms going together is called “Technical Contradiction”. [TS2008]

01) Contradiction or movement which resolve differences between two values of one attribute autonomously, by objective power and/or intentional human will.

In [TS2011], 3.

A) Contradiction having two values of one attribute to resolve differences

10) “Physical Contradiction 1”

Change itself in autonomous contradiction.

Contradiction of real world at density of change itself.

20) “Physical Contradiction” having two values of one attributes

201) “Physical Contradiction 3” PC3

Contradiction to start action having a value “a” at this time and a value “b” of simple purpose at different time.

202) “Physical Contradiction 2”, PC2 which is usual “Physical Contradiction” in TRIZ

20) Two Object formerly united is united by effort.

K. Marx does not also deal with the next example of generalization of barter as contradiction. Therefore he does not grasp whole movements as contradiction.

At the second stage of beginning barter shared notion of two representatives of communities has been deepened which is to be analyzed. This is contradiction of type 01). And shared notions are widely spread into community.

Accidental value of exchange which is one of two attributes in the other contradiction in the concerned useful thing is changing to fixed exchange value to become into existence of commodity. [TS2010]

This is also contradiction of type 01).

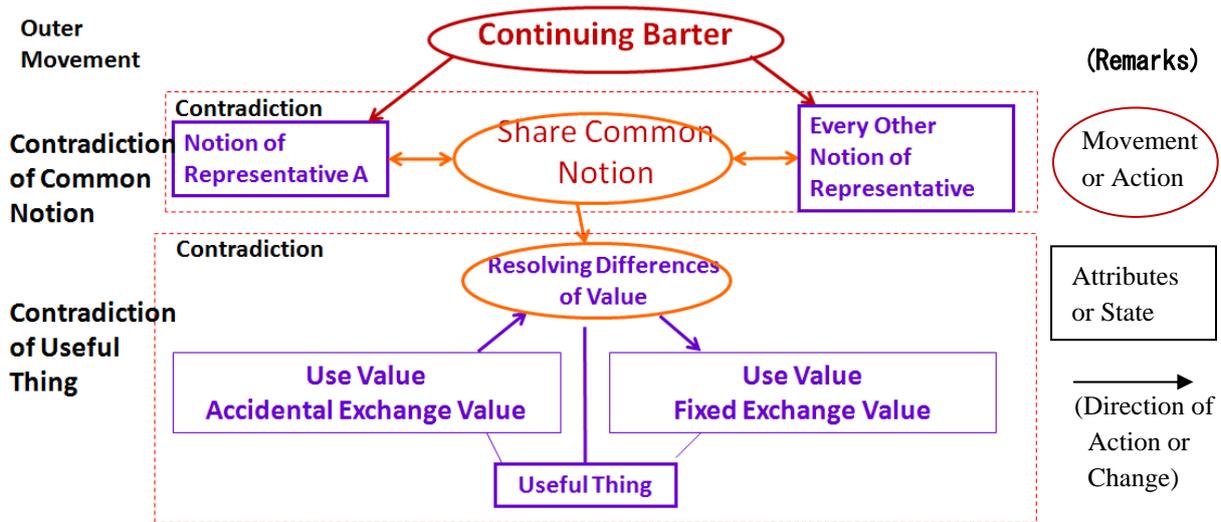


Fig.5 Second Stage of Beginning of Barter

After this second stage "The Capital" begins the story of the third stage. The contradiction of the commodity was shown formerly as type 11). The other movement or contradiction in this stage is mutual action between notions of two people who are representatives of the community. The shared notion is deepened into a spread of consciousness of other person, self-consciousness and consciousness of possessing. And shared notions are widely spread to all over community

This is contradiction type 01) which change value of attributes.

Example of contradiction of resolving differences by outer objective power or intentional will: Positional movement.

Example of contradiction of resolving differences by intentional will: To change the temperature of this room to the desired one.

Generalizing the term of usual TRIZ the contradiction or movement of generating two values or resolving differences of two values are called "Physical Contradiction" in broad sense. [TS2008].

00) Contradiction or movement which generates two values by objective power and/or intentional human will.

This contradiction or movement is newly added to [TS2011].

Contradiction is either generalized "Physical Contradiction" which two attributes are going together or "Technical Contradiction" which two values are resolving differences according to

density. Contradiction of use value and exchange value in the third stage of barter is "Technical Contradiction". It is also recognized as "Physical Contradiction" which makes efficiency of barter better.

We have types of contradictions which consist of autonomous contradiction, running and generating movement by objective force and intensive human will.

5. Resolving Differences

We get recognition of contradiction of changing of objects and related knowledge of unchanged objects. To change something is to generate a media of running or resolving contradiction by intentional will. The solution gives us compatibility or something going together or resolving differences to resolve problem.

As recognition at this time I have an individual recognition of accidental situation and inevitable situation and general recognition of inevitable situation.

Then I have a process of resolving differences and some issues to be solved are shown. [SSAA] is very informative.

1) I have types of purposes which consist of making new function, idealization and resolving problem in narrow sense [TS2007] [TS2008].

I can formulate any issues by any type of purposes to resolve "Physical Contradiction" in broad sense.

Example of acid attack: Cubes are placed in warm acid to investigate the effect of various acids on the cubes. Unfortunately, the container that holds the acid and cubes is corroded. The

container is made from a gold and is very expensive to replace. Because the acid is so reactive and the test is performed often, the pan must be replaced frequently. This operation is very expensive and we would like to reduce the cost of replacing the container. [TS2006] [RH] [LB]

We can enumerate facts, purposes and method at any granularity. Some of the granularity are shown as follows.

Enumeration of System Object: Matter

Cube, Acid,
Vessel (Attributes1: Material,
Attributes2: Weight,
Attributes3: Form,
Attributes4: Size,
Attributes5: Inner Structure,
Attributes6: Cost), Air

Enumeration of Process Object: Movement, Action or Process)

Test of Cube (Attributes1: Temperature,
Attributes2: Barometric Pressure,
Attributes3: Time of Test, its value t),
Retaining Cube,
Corrosion of Vessel (Attributes1: Operation Time, its time t,
Attributes2: Number n of Replaces in time t),
Replace Vessel (Attributes: Working Cost, its value Cr)

Purposes at Granularity of Solving Issues

Item 1 includes item 2 or 3.

1. To minimize cost of replace per unit time $(C + Cr) n / t$
2. To remove Process Object to corrode vessel by acid (To minimize C is to remove System Object to bring out C)
Minor change of 2: Remove vessel,
Minor change of 2: Replace to cheaper vessel such as air or water,
Minor change of 2: Not to corrode vessel,
Minor change of 2: Autonomous repairing vessel
3. To remove Process Object of replace vessel (To minimize Cr is to remove Process Object to bring out Cr)

Purposes at Granularity to idealize

To minimize resources is to cube itself huge acid or autonomous repairing vessel.

Purposes at Granularity to make a new function

To make a new function not to corrode vessel.

[RH] [TS2010 3.4]

2) Types of purposes which consist of making function, idealization and resolving problem in narrow sense are converted to types of object change. [TS2007] [TS2008]

Types of object change are attributes change, generating object and deleting object. [TS2007]

21) If we can do so using The 40 Principle, USIT Operator and Principle U,P,D, etc. we do so. [TS2008]

Example of acid attack: To remove Process Object to corrode vessel by acid we remove vessel by the principle P. [TS2008]

Or 22) If we should resolve usual “Physical Contradiction” in narrow sense we do so.

3) Usually these actions cause side effects to bring out “Technical Contradiction” because every object is mutually related. In this case we resolve “Technical Contradiction” by 40 Principle etc.

Example of acid attack: Removing vessel causes side effect of deleting sustaining cube and acid by vessel. So we must resolve “Technical Contradiction”.

We have various granularities of “Technical Contradiction”. [TS2006] [TS2009]

1. To realize compatibility of testing cube and removing vessel.
2. To realize compatibility of sustaining cube and acid and removing vessel.
3. To realize compatibility of contact of acid and cube and removing vessel.
4. To realize compatibility contact of acid and cube and no contact of acid and vessel.
5. To realize compatibility corrosion of cube and no corrosion of vessel.

4) If we cannot perform 2) 3), we have the next cases.

41) The case that we have no opposites.

This is the case that we are going to make entirely new function from the state without having anything. This is different from the situation of the case of acid attack and ASIT which make “new” function using the situation of the present from reversal point of view. In the case of acid attack opposites are in front of us and enumeration of objects is completed. But this difference is relative.

As shown before, K. Marx deal with contradiction that opposites already exist. The 40

Principle don't include the one which generates opposites. But generating opposites is important both theoretically and practically. We have two cases.

411) The case that we have to decide someone or something to act.

412) The case that we have no objective opposites.

In the both cases we must select from among enumerated candidates, from among candidates not enumerated or we must decide to select the one with no candidates. We have no method to decide this.

42) The case that we have opposites but cannot transform them. The issue in this case is whether transformation belongs to same granularity or dimension or not. So we have next two cases.

421) We have the case that we have opposites but cannot transform them although transformation belongs to same granularity or dimension. As the present principles are not enumerated, we might miss the transformation.

We can divide the issue of acid attack into two stages. The first stage is how acid contact cube without vessel.

The second stage is how the contact is continuing. This stage will become 422).

422) We have the case that we cannot transform opposites because transformation belong to different granularity or dimension.

At present in this case we should seek for method of domain-dependent ones such as "Effects" data-base in TRIZ.

Example of acid attack: The second stage of acid attack is to seek for means that acid corrodes cube without vessel. We can use gravity, pressure of wind, wind flow, cyclic flow of acid, centrifugal force, buoyant force or surface tension. [SSAAN]

The cases that we don't have means have been enumerated. But we can take next issues into consideration.

43) We can have approximate solution or quasi-solution. Or we can improve issues if we don't have radical solutions and vice versa. These solutions depend on whether we are restricted to only use-mode or we can re-construct all systems.

6. Conclusion

Granularity is size, magnitude or scope in space and/ or time and degree of abstraction of attributes of object which is specified by points of view.

Enumeration of "object etc." depends on total granularity of "object etc." and granularity of "object etc."

It is highly recommended to be conscious on granularity and enumeration.

In the enumeration of "object etc." throughout the history, if type of object and relation or movement of the type of concerned object went together satisfying constraints that might cause combinatorial explosion, we could find the new type and new law.

The usual present contradiction or dialectical logic is for many people that of Hegel, autonomous contradiction by Marx or "Three Laws" by Engels. In reality some of "The TRIZ Journal" in early ages shows an introductory description of "Three Laws" by Engels.

Phan Dung said at keynote speech in TRIZCON2001 as follows. "Dialectics is the science of most common laws of nature, social and mental development. Creativity is associated with a development, so TRIZ has selected dialectical laws as its philosophical foundation. There are three basic laws of dialectics: 1. The law of the negation of negation, which conveys the direction of development. 2. The law of the mutual transformation of quantitative and qualitative changes, which demonstrates the mechanism of development. 3. The law of unity and struggle of opposites, which demonstrates the source of development. Of them, the third law is the nucleus of dialectics and the first two laws may be considered as particular cases." "Development, from the viewpoint of dialectics, can be understood as follows: Supposing at first the system was at some level of development where there was unity of opposites. This unity does not exist forever. Because of changes and a struggle (mutual interaction) between the contrary sides, the initial unity is broken and a contradiction arises. The contradiction is resolved so that the system turns to a new level of development (new unity)." [PD]

His view is splendid but narrow and restricted.

The re-formulation of contradiction which has a possibility of containing these usual ones is totally and only based on my generalization of contradiction of TRIZ by G. S. Altshuller which is

briefly summarized in “Essence of TRIZ in 50 Words” by NAKAGAWA. [NKGW]

Requirements of approximating model of the World, which has moving elements and mutually related elements, is to have units whose synthesis makes approximation of a phenomenon of the World.

Contradiction is generation and movement of two terms which have relation with outer part.

Only outer movement can generate two terms.

Two terms is two attributes of two objects or one objects or two values of one object.

This contradiction satisfies the requirements.

Synthesis of this contradiction via attributes or state can approximate phenomenon to become model of the world. And it becomes a unit of dialectical logic.

Contradiction is either generalized “Physical Contradiction” which two attributes are going together or “Technical Contradiction” which two values are resolving differences according to density. All movement is contradiction and all change is caused by movement. Therefore changing something is achieved either by making two attributes go together or making two values resolve differences.

I hope both Radical Thinking for Enumeration which manage granularity and enumeration and contradiction which is the unit of dialectical logic will be the base of the method of technology and institution and also the base of the way of life.

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