

Creation of Answer Proposals to the Open Task Using Substance-Field Analysis and Standard Solutions

Japan TRIZ Society, NPO
Educational Research Subcommittee of a New Era

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What is the Educational Research Subcommittee of a New Era?

- In November, 2013, the "Educational Research Subcommittee of a New Era" (Japanese TRIZ Society, NPO) launched.
- Chair: Shinsuke Kurosawa
- In this study group, the research and guidance construction to utilize TRIZ such as application methods and case studies aiming "Way of Teaching TRIZ" and "Utilizing TRIZ to Increase the Effectiveness of General Education" are set out, and activities are carried on intending to spread and develop TRIZ.



Spread and development of TRIZ

Spread and development of TRIZ

Outline

- One of the study themes is to design workbooks and explanatory casebooks based on "Utilizing TRIZ to Increase the Effectiveness of General Education" for students and general adults.
- Part of this study will be introduced.

【Contents】

1. Pick up an open task as the object for case designing.
2. Consider how to apply the "Substance-Field Analysis" and Standard Solutions, which are characteristic methods of TRIZ, to the problem definition and solution searching of the open task.
3. Apply "Substance-Field Analysis" and Standard Solutions to the open task.



1. Pic up an open task as the object for case designing

- An open task is "Problem of no learning of the answer as knowledge and searching for the answer voluntarily."
- TRIZ Master Anatoly Guin who advances the development and spread of law on education based on idea of TRIZ. "Education in a New Era" laboratory that he manages is advocating it.

Background and reason to take up open task

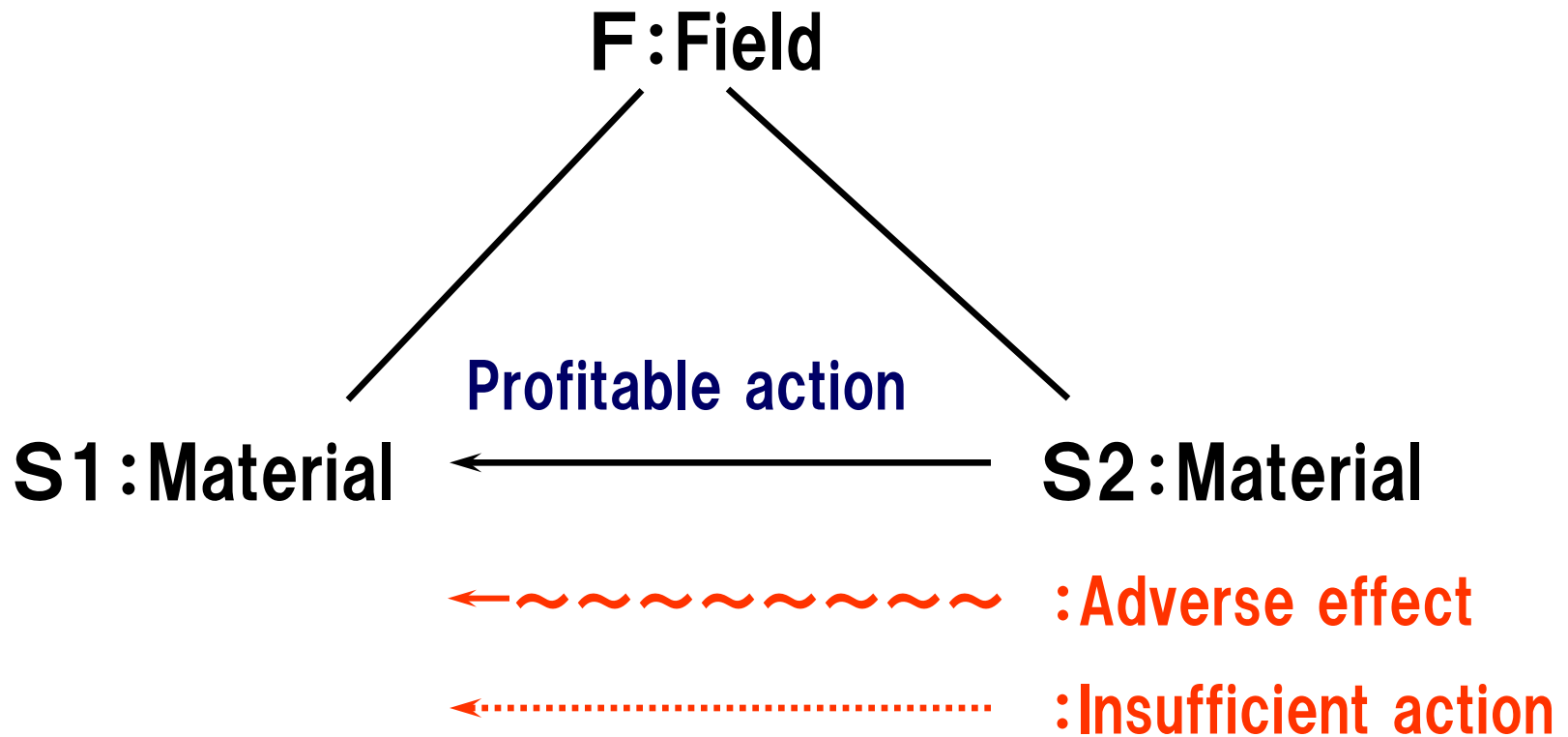
- **In the compulsory education and the higher education,**
- **The only solution of someone finding solution with set problem already. The problem where such a solution exists is often taken up.**
- **It is an education to teach answering so to speak. It is not an education that voluntarily looks for the answer.**
- **When from beginning to end of the education to teach answering, the possibility that it becomes impossible to do a creative idea rises.**
- **In daily life and the business accomplishment, oneself finds the problem according to the situation in which the many are put. It looks for the solution by making good use of creativity. The best action will be taken.**
- **Then, as a research theme of the case-making, It was assumed that "Open task collection" written by Anatoly Guin was treated.**

2. Consider how to apply the “Substance–Field Analysis” and Standard Solutions, which are characteristic methods of TRIZ, to the problem definition and solution searching of the open task

- “Place goods–analysis” is a feature technique of TRIZ. The structure of 【Substance–Field】 which has the adverse effect caused in the technological system and “problem of not functioning enough” is analyzed. It tries to derive the settlement plan according to the principle of the method of standard solutions.
- The Substance–Field model is a model to analyze 【Substance–Field】 structure. The triangular model by two materials (Substance) and places (Field) is composed.
- The technological systems such as the material, tools, and parts and the parts are called “Material”. And, persons, living things and the environment, etc. are included.
- Power and the energy that exists for the material to interact with one another and to function are called “Field”.

Material-field model

【Substance-Field Model】 or 【Su-Field Model】



“Material-field model” functions as a system, and is a model of the minimum technological system that can be controlled.

2-1. Problem setting method

① Resource analysis

a. Material resource: All of kinds of materials that compose system and the environment

- Flow and property of a substance etc. of waste, material, system element, and material

b. Place resource: All of kinds of places that can be used by existing in system or the ambient surrounding

- Place/gravity and hot and other sunlight/radiation in system
- Place in ambient surrounding of system including energy of the natural world such as electromagnetic fields in the earth
- Place that exists in various materials that can be used
- Energy etc. such as sound/hot/electromagnetic field discharged from system or process

c. Spatial resource: Free space in system or the circumference

- Arrangement from space and 2 dimensions in surroundings of system to 3 dimensions
- Space and space etc. of other objects in space and object in the back of multilayer arrangement and object that can be used

d. Beginning time resource: A part between cycles of time, time after it ends, and technological process

Or, the entire time not used.

- Interval until processing and arrangement and processing's using prior time interrupting and continuing and useless operation time
- Processing and arrangement, etc. using time of postprocessing that can be used together with time (simultaneous and parallel) and time differences

e. Informational resource: Information where characteristic of material and place where production thing and system of system are composed originates

- Energy such as sound/hot/magnetism/electromagnetism/light discharged from object
- Characteristic etc. of material/place where change and system of material characteristic and material characteristic are passed

f. Functional resource: Ancillary function that exists besides the entire system and function component original

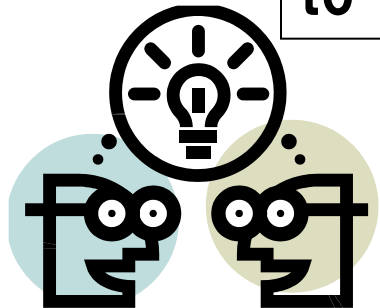
- Latent function of ancillary function and component that exists in the entire system and component not to be intended originally

2-1. Problem setting method

② The material-field model's construction

Place material-analysis (Su-Field Analysis)

Hard work in the business trip destination ended safely, and Mr. A returned to the hotel. To drink the whisky fully, the small bottle was obtained. However, the cap doesn't open easily. On the contrary, the hand seems to be damaged. Well, how should I do? The one that it is possible to use it is the indoor vessel.



Flow of goods–place model construction

STEP 1 : Clarification of element

The function: The cap is opened.

Material 1: Cap

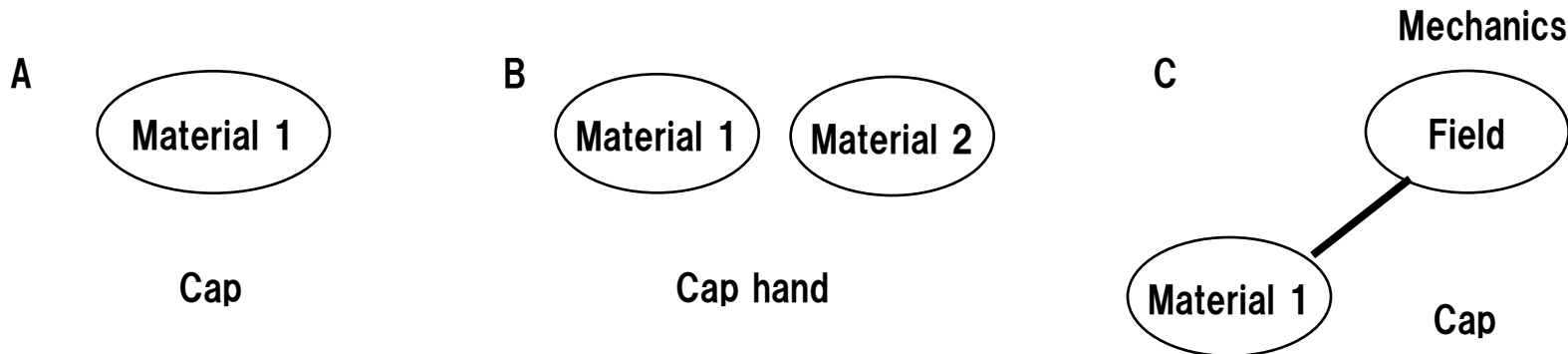
Material 2: Person

Place: Dynamic place (moment power)

⊠ The place as material 2 and the energy source is insufficient now.

STEP 2 : The model's construction

2-1. Imperfect system <A.B.C.>



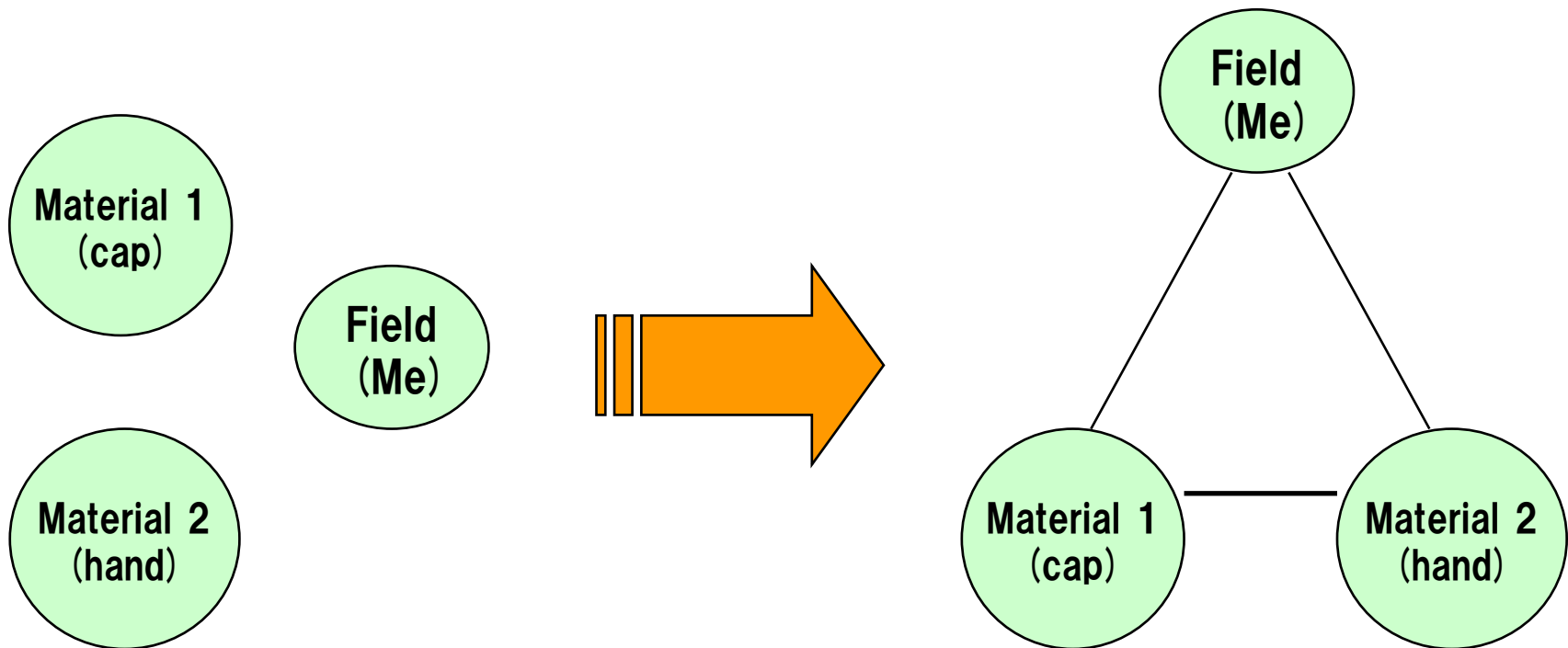
A letter cannot be opened with a cap alone.

Only the cap and the hand exist separately, and a letter cannot be opened.

There is only a place of the cap and mechanics. A letter cannot be opened.

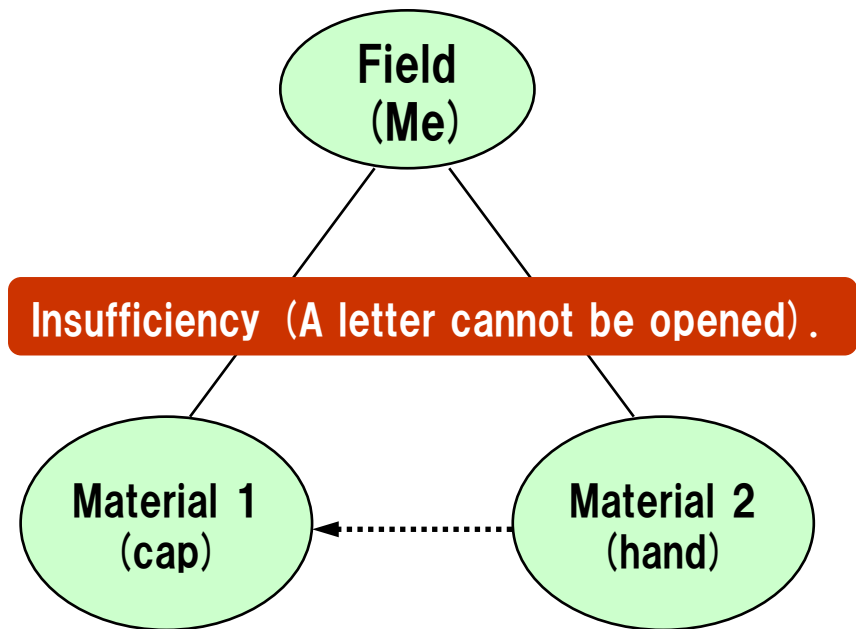
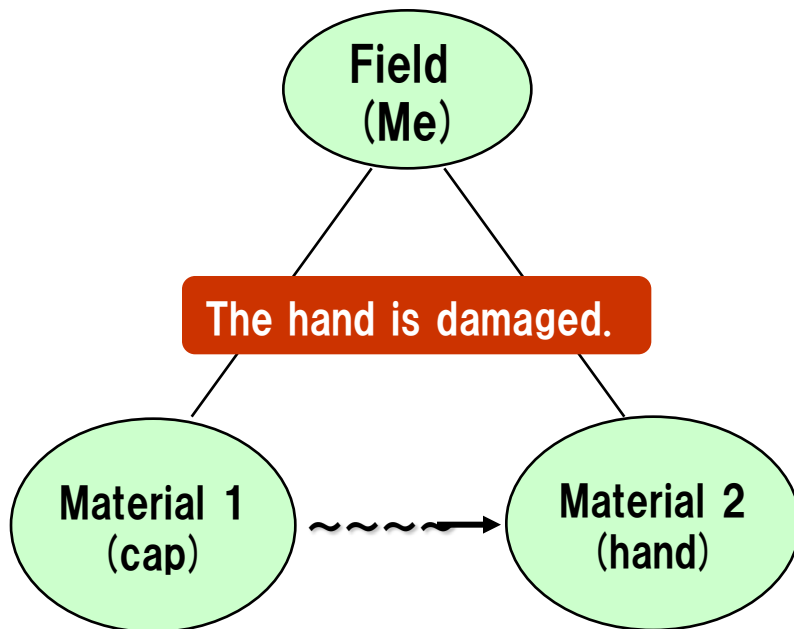
STEP 2: The model's construction

2-2. Construction of complete system



STEP 2: The model's construction

2-3. Analysis of function accomplishment level of complete system

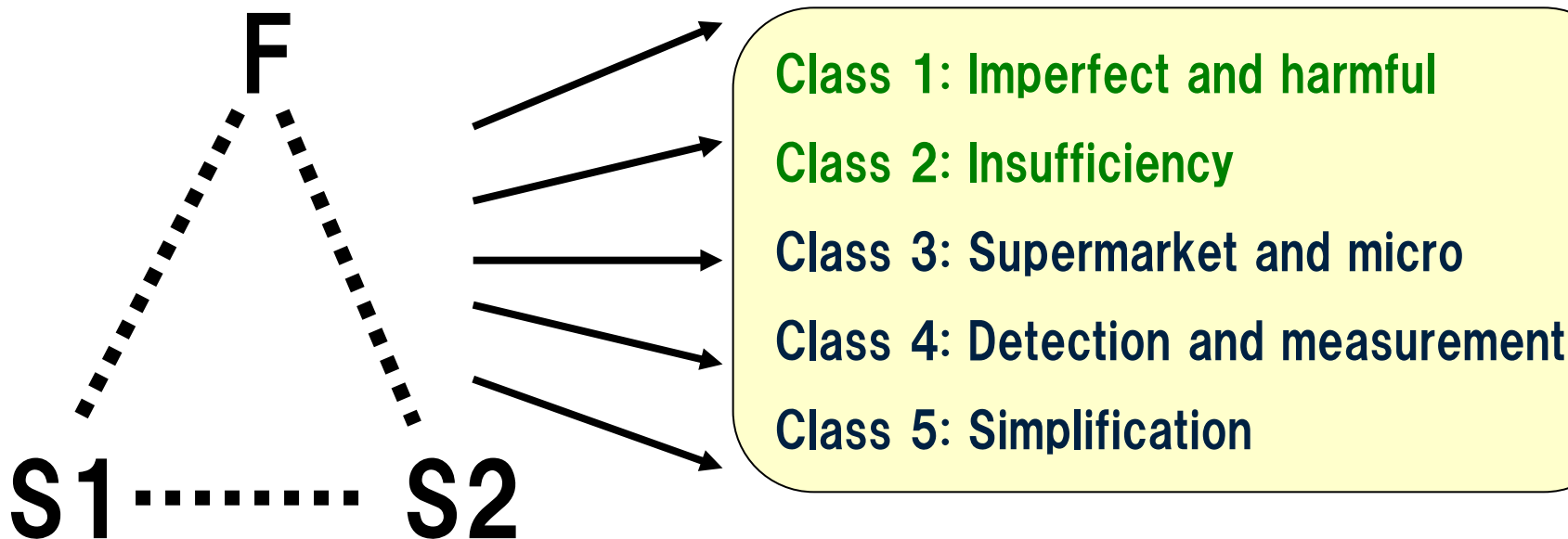


< harmful, complete system \times complete not effective, system >

2-2. Hint of solution search by creativity

- If the problem by “Place material-analysis” can be set, do not conceive the idea, and at random. **A systematic idea of free association can be expected regarding to Compulsion association that uses indicator that finds solution of standard solution & Idea conceived by compulsion association**
- **Standard solution \Rightarrow compulsion association \Rightarrow freedom association**
- The solution is found multipronged, and the best solution will be set.
- Everything need not be applied though it is said a standard solution of 76. Here, it thinks about application that selects a generality and high standard solution.

Standard solution of place analysis and material-76

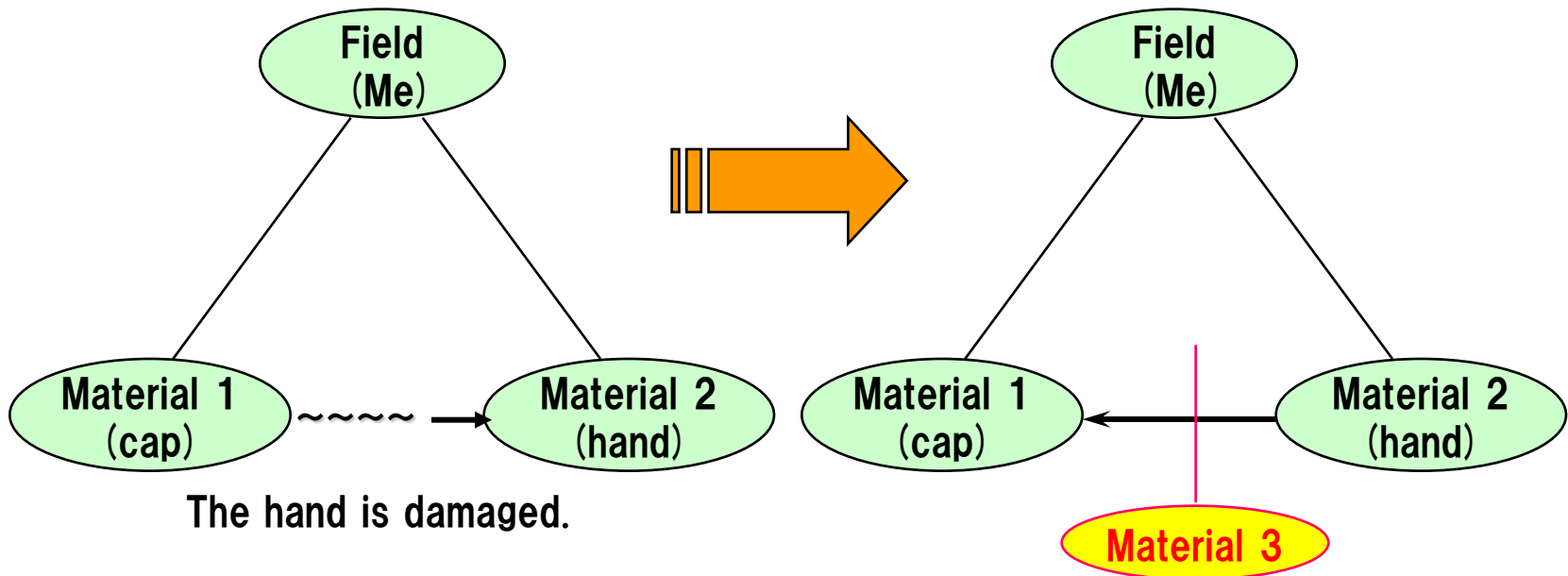


Solution in standard solution (application of typical standard solution)

* For a complete harmful system <Standard solution 1>

Standard solution (1-2-1)

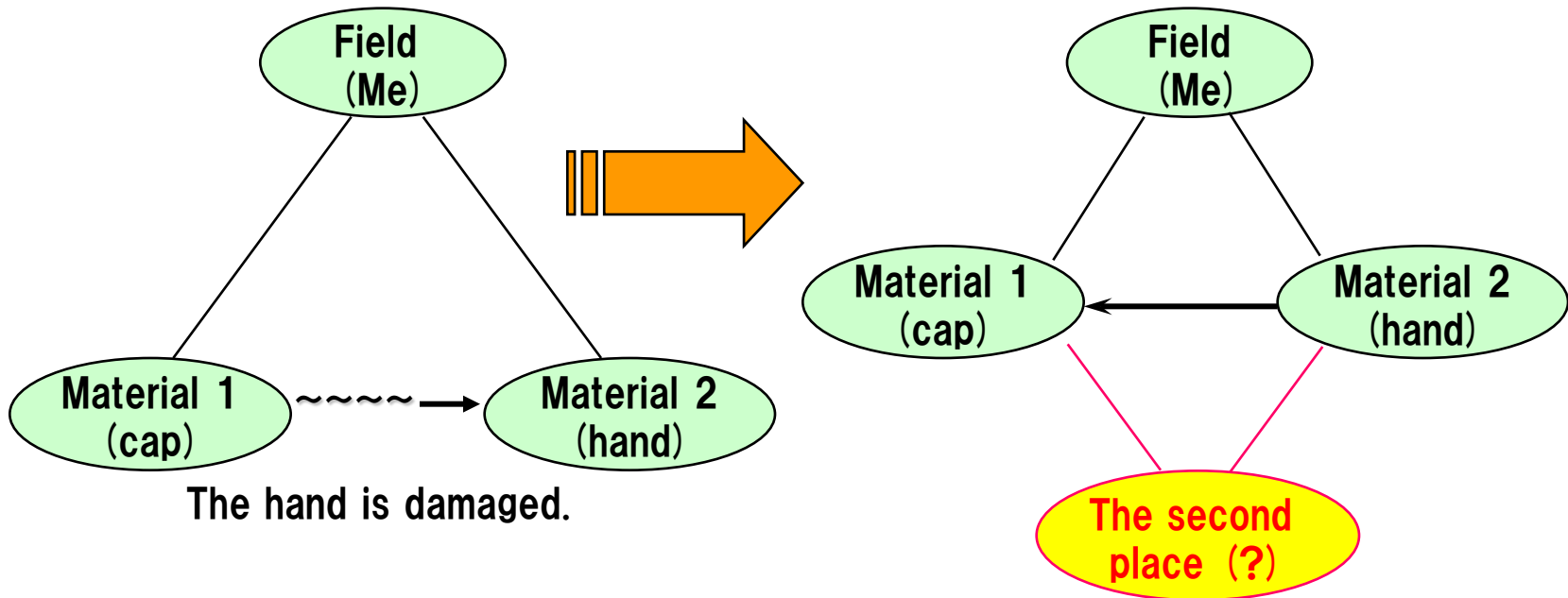
The third material is introduced and the adverse effect is prevented.



Solution in standard solution (application of typical standard solution)

*** For a complete harmful system <Standard solution 2>**

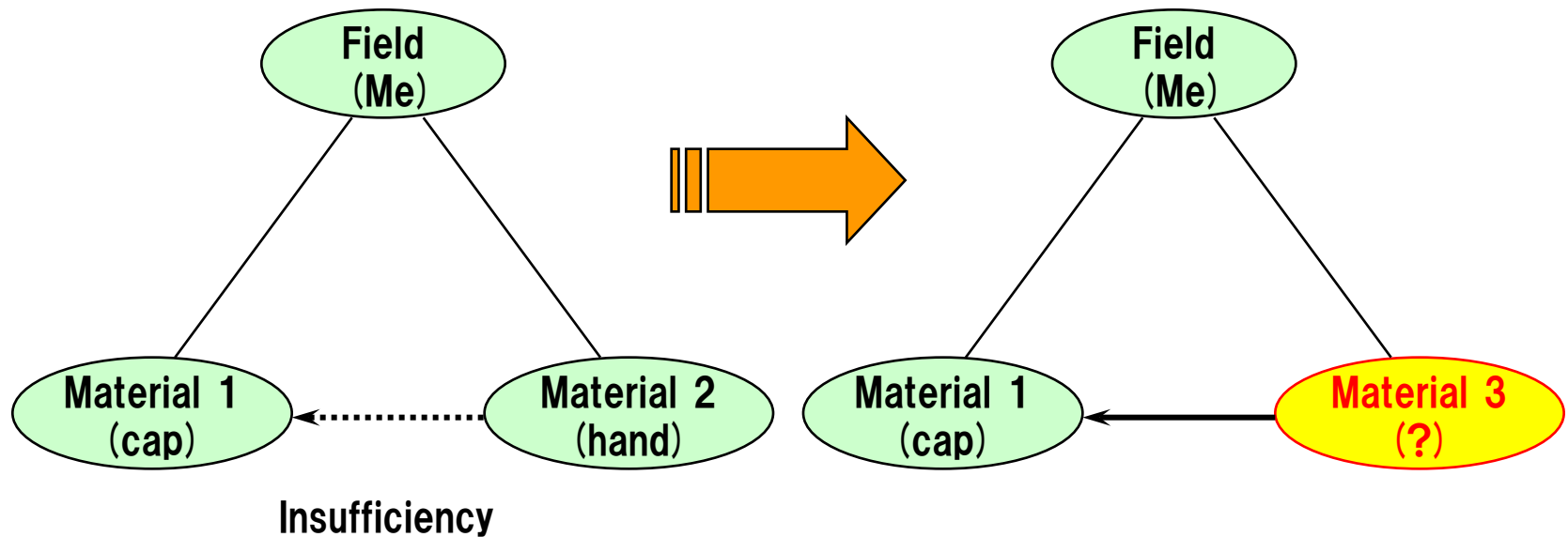
Standard solution (1-2-4)
 The second place is introduced and the adverse effect is prevented.



Solution in standard solution (application of typical standard solution)

❄ For a complete system not effective <Standard solution 1>

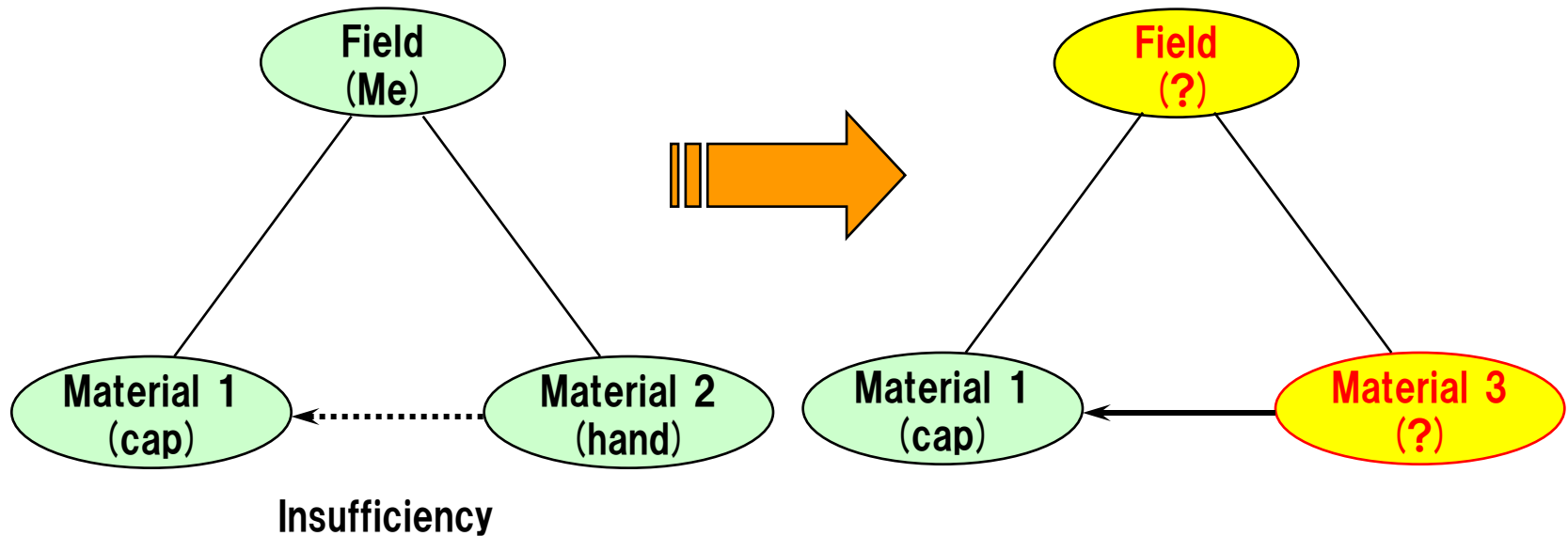
Standard solution (2-2-6)
The third effect material well is introduced.



Solution in standard solution (application of typical standard solution)

* For a complete system not effective <Standard solution 2>

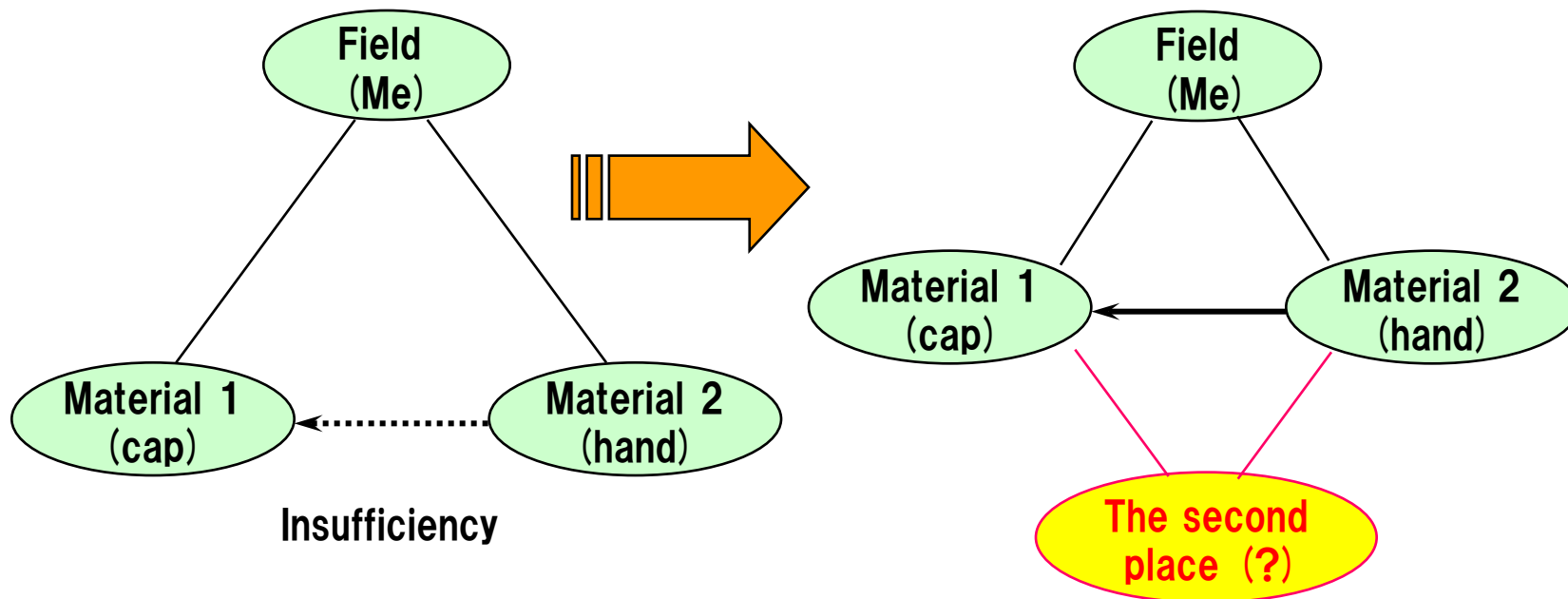
Standard solution (2-2-5,6)
 An effect place well and the third material are introduced.



Solution in standard solution (application of typical standard solution)

❄ For a complete system not effective <Standard solution 3>

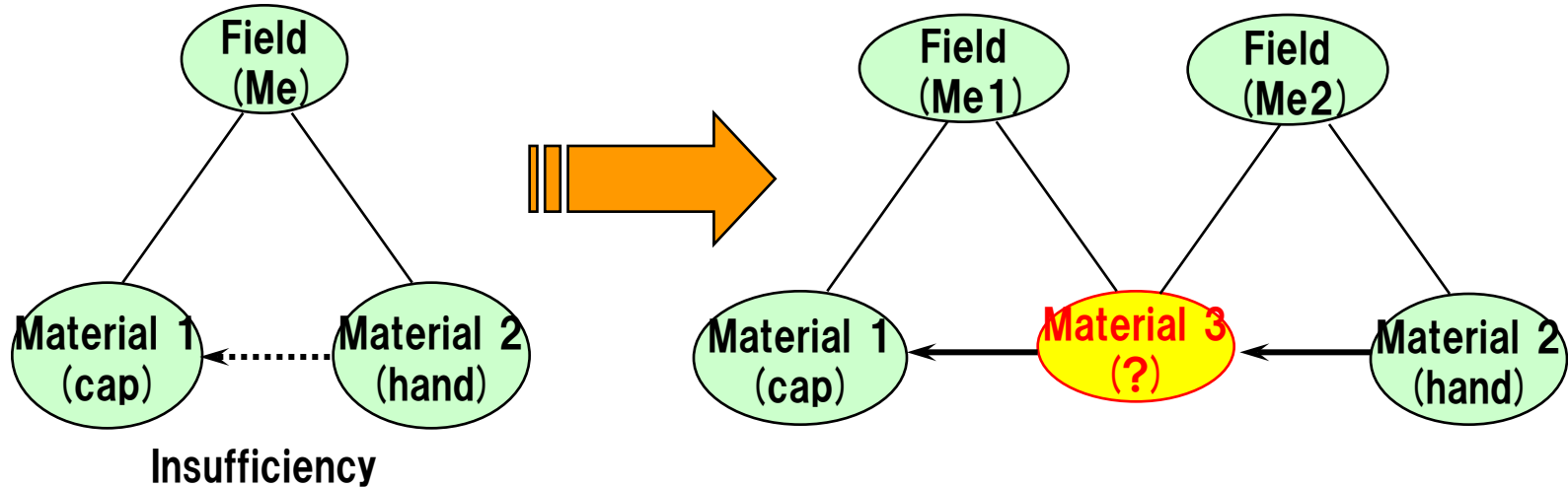
Standard solution (2-1-2)
The second place is added.



Solution in standard solution (application of typical standard solution)

❄ For a complete system not effective <Standard solution 4>

Standard solution (2-1-1)
The material the 1st and 3 is added.



3. "Field material-analysis" and a standard solution (Or, invention standard solution) are applied to an open task.

- **"Open task collection" written by Mr. Anatol Hin is treated.**
- **It applies to some open tasks.**
- **Place resource analysis and material-analysis, It introduces the solution case with an open task by it and the selected standard solution.**

Open task case 1

Anatol Hin, Alexandre カフトリヨーフ, 「Cannot explanation but explanation
The world pocket edition1」

「How did Beethoven who did not hear sound listen to music?」

- Major composer in Germany, Ludwig van Beethoven comes to have poor hearing due to sickness. It is known well to have lost hearing completely in later years. However, he finds the method of overcoming the predicament. It comes to be able to listen to piano music. The favor made the composition of a new tune possible. For instance, when he composes Symphony the most famous ninth, Beethoven did not hear of the sound at all.
- How was Beethoven that was not able to hear the sound able to hear a piano sound?

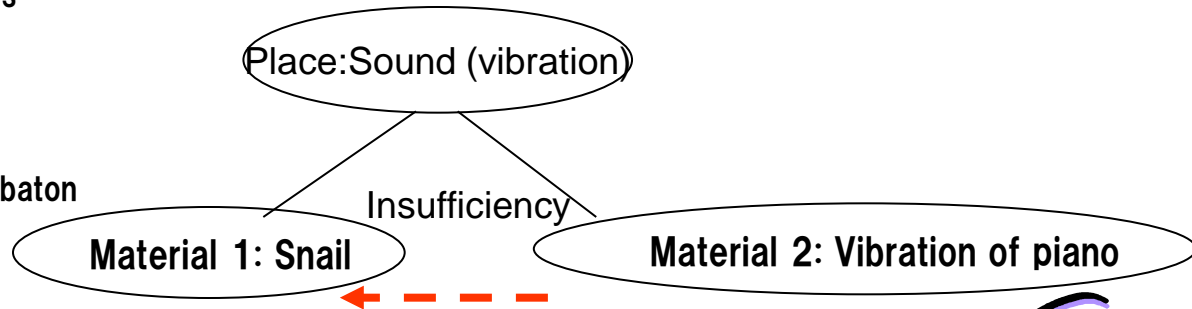


Beethoven who did not hear the sound, How did he listen to music?

① Resource analysis

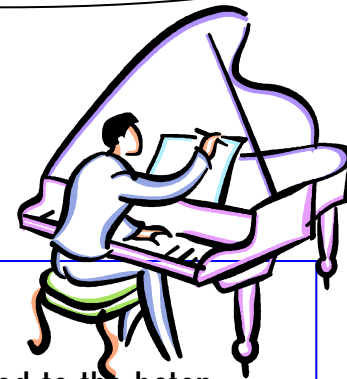
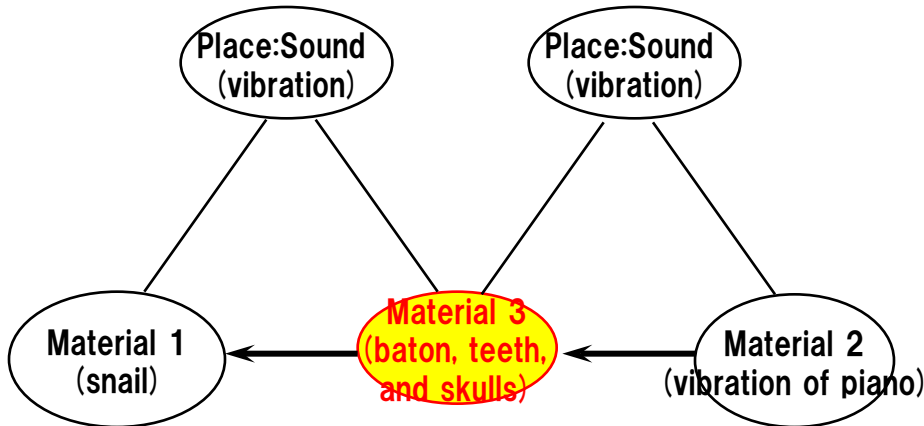
- Goods: Piano, baton, teeth, skulls, and snails
- Place: Vibration (place of sound)
- Space: Contact space of piano and baton
- Time: Velocity of conduction
- Information: Vibration of piano
- Function: Vibration transmission function of baton

② The goods-field model's construction



③ Solution by standard solution

Standard solution: 2-1-1



1. Beethoven beats the keyboard.
2. The piano trembles.
3. The vibration of the piano is transmitted to the baton.
4. The vibration of the baton (The baton was bitten) is transmitted to teeth.
5. The vibration is transmitted from teeth to the skull.
6. The vibration is transmitted from the skull to the snail.
7. Beethoven can listen.

Open task case 2

Anatol Hin、Irina アンドレジェーフスカヤ、「Problem of 150 of our surroundings」

- The cherry of Uncle Vanya ripened. The cherry in the garden of the house of Uncle Vanya has ripened savory. However, there is a problem. It is necessary to defend the cherry from starling's insect damage. When not only the cherry but also an American cherry and the grape ripen, the starling, the sparrow, and other birds fly and it inadvertently puts it away by the turn.
- Well, how can I defend the fruit of the case corner from bird's insect damage?



How can I defend the fruit of the case corner from bird's insect damage?

① Resource analysis

(a) Bird's sight

It says roughly, and bird's sight is ..the same level as the human.. a little excellent.

- The seen color ... For the human, three primary colors and birds are four primary colors.

(A lot of birds see ultraviolet rays.)

- Eyesight ... It is very steady with the human.

- View ... A lot of birds are wider than the human.

The range that can be the binocular vision instead is narrow.

- The bird is "Nighe-blindness" ? ... Becoming accustomed to darkness is late though it sees as much as the human.

(b) Aural of bird

Aural of the bird is more a little than human inferior.

(c) Taste and sense of smell

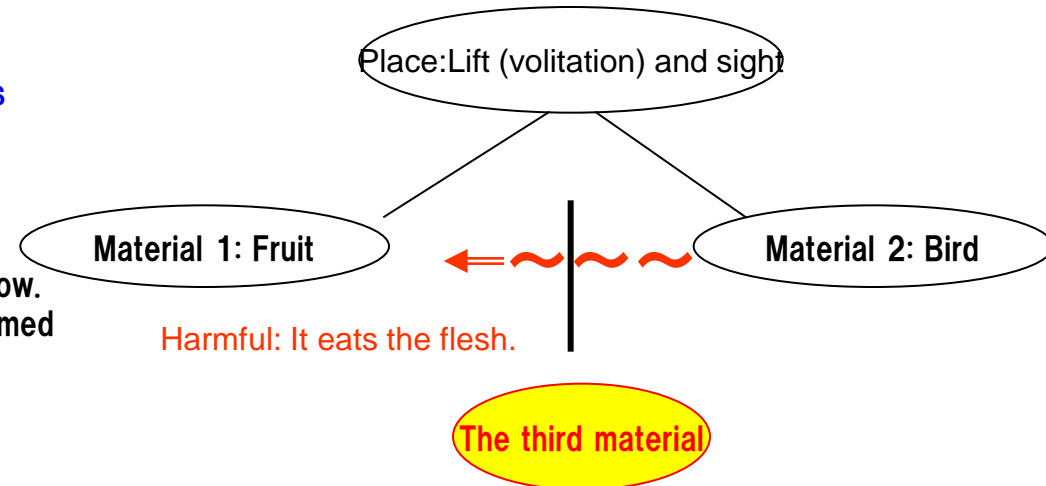
The number of cells (taste bud) that feel the taste is tens of pieces in chicken and pigeon, and it is far fewer than about 10,000 humans.

However, I can feel the taste as it chooses and it eats fruits with a high sugar concentration.

In general, bird's sense of smell is not sharp for a similar human.

The clue to which the crow finds meat in the garbage bag has the experiment example of confirming it is not a smell but it is a sight.

② The goods-field model's construction



Harmful: It eats the flesh.

Standard solution : 1-2-1

③ Solution by standard solution

- Correspondence to coming flying

• So as not to put it in the orchard, the net is put.

- Correspondence to sight

• The fruit is covered with the bag etc. and obscured.

• It throws up a smoke screen out and it obscures it.

Open task case 3

Anatol Hin, Irina **Андрей-Евгеньевич Скаря**, 「Mole measures」
from 「Problem of 150 of our surroundings」

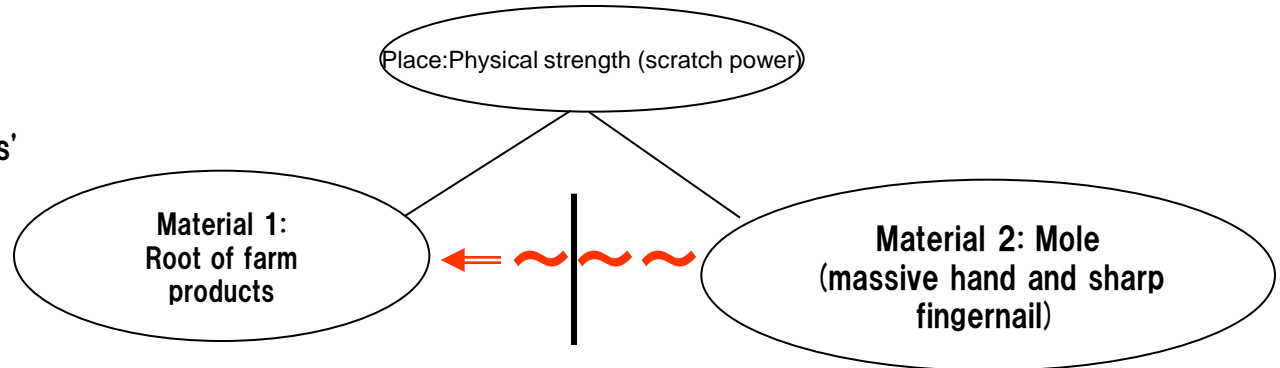
- Will you have seen the mole tomb in green in the one side of the field? It is the one that the soil that dug up the road and the air hole as shown by underground Sumi the mole was pushed out to surface of the earth. Even if the mole builds the nest, it is not harmful at all if it is neither a farmland it is nor a kitchen garden. However, when the mole settles in the kitchen garden and the root of farm products is damaged, the harvest is lost. Then, some measures are necessary. It has the acute hearing though eyesight is lost because there is a mole always under the soil.
- **Please think about measures to prevent the mole from building the nest in the kitchen garden.**

How can I defend farm products of the case corner from the mole?

① Resource analysis

- (a) Aural of mole
 - It sensitively reacts to the sound of 250–3500 hertz.
- (b) Sense of touch of mole
 - It has the olfaction organ of sharp [aima-] organ. (It perceives and prey on small animals' of the earthworm etc. slight movements.)
- (c) Olfaction of mole
 - Sensitive
- (d) Movement and invasion of mole
 - Massive hand
 - Sharp fingernail
 - Mole tomb
 - Underground tunnel
 - Nest of mole
 - Land where farm products are grown (soil cultivated)
 - Moisture of soil
 - Food of mole (earthworm, insect, and the larva)
 - **The living activity is done only by one while making the range of 450m² a territory (If food is abundant, it is even 200m² unquestionable).**

② The goods-field model's construction



Harmful: The root of farm products is damaged.

The third material

Standard solution: 1-2-1

③ Solution by standard solution

- Correspondence to going into

- The wire net and the tinsplate are buried under the surrounding by about 50–60cm in depth, and it is made not to invade physically.

How can I defend farm products of the case corner from the mole?

① Resource analysis

(a) Aural of mole

- It sensitively reacts to the sound of 250–3500 hertz.

(b) Sense of touch of mole

- It has the olfaction organ of sharp [aima-] organ.

(It perceives and prey on small animals' of the earthworm etc. slight movements.)

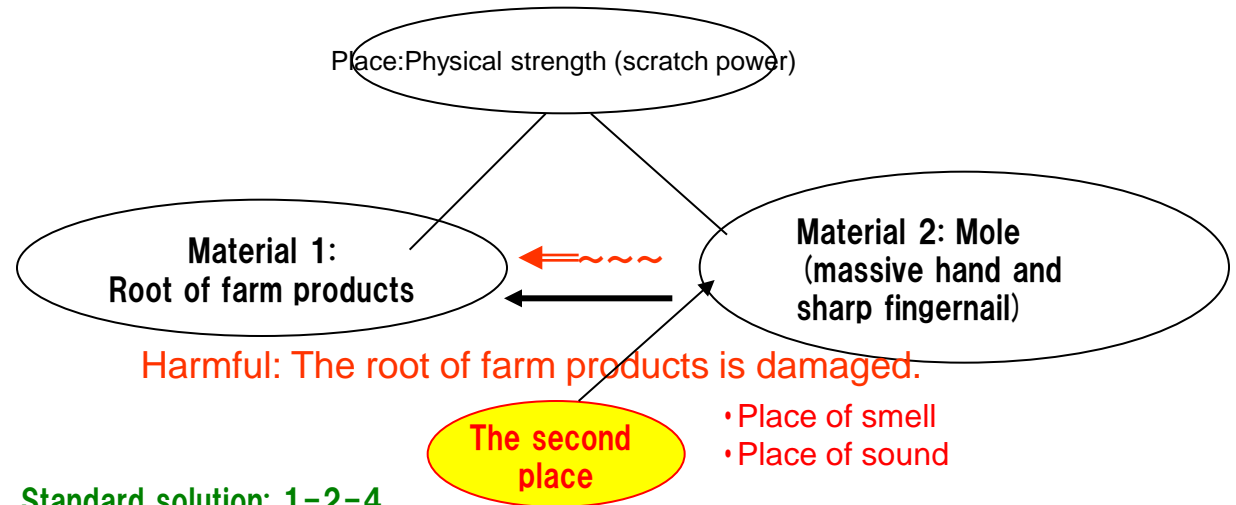
(c) Olfaction of mole

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② The goods-field model's construction



③ Solution by standard solution

- Correspondence to olfaction

- The rejectant such as smells of the naphthalene and the tree tar system and [youdo] is scattered and driven away.

(To defend bodying from the forest fire etc. , the smell of smoking is instinctively disliked.)

- Correspondence to aural

- A sound wave of the mole not good is put out, and it drives away to the different location. (300–400 hertz)

Open task case 4

Anatol Hin, Irina アンドレジェーフスカヤ、「Harvest of strawberry」 from 「Problem of 150 of our surroundings」

- The strawberry has borne fruit. It is a good harvest this year. The strawberry ripens quickly rather than every day every hour. The cherry also faced the time of the harvest. It grew up very greatly with the plum this year. 。 The berry has ripened, too. It ripens too much and it begins to fall on ground. **The harvest is busy anywhere and people are not worth in the fruit farmer. Pay cannot be high though there is a town to be near by depending of the person in the town on the part-time job.**
- Please think about measures from fruit farmer's aspect

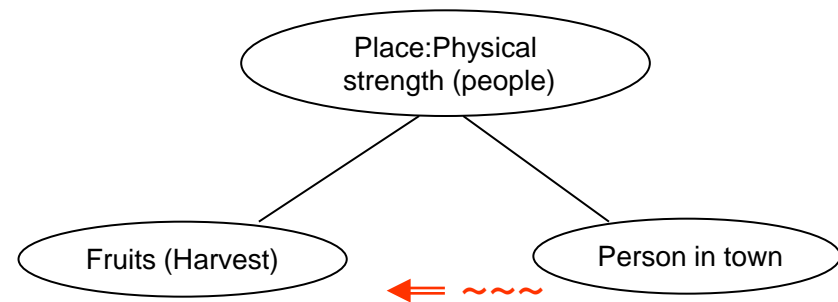
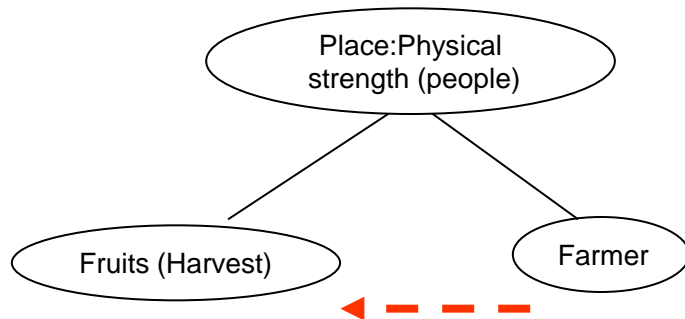


Harvest of fruit tree

① Resource analysis

- Material resource: A large amount of strawberry cherry plum berry Farmer and the number of people, and person and numbers of people of towns
- Place resource: Harvest power of farmer and harvest power of person in town
- Spatial resource: Area of farm and cultivation area of fruits
- Time resource: Difference of time of harvest at harvest time of fruits

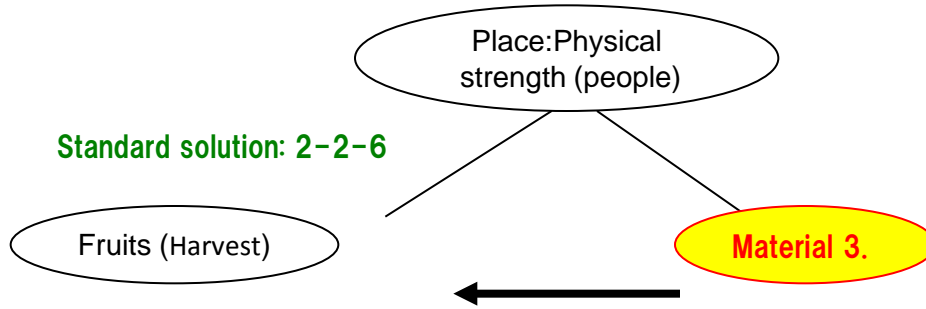
② The goods-field model's construction



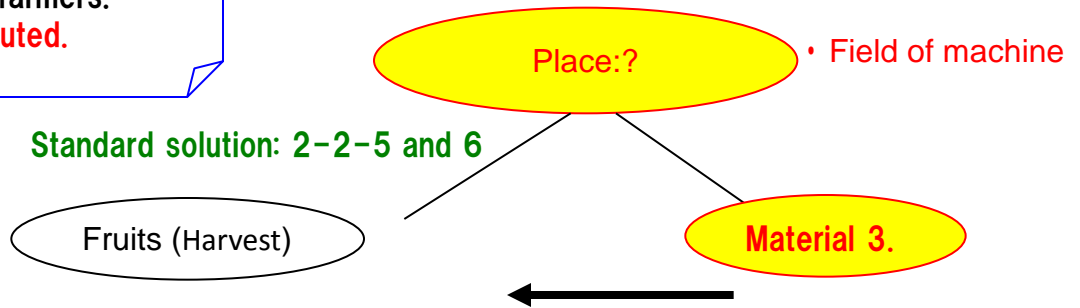
The insufficiency: The harvest is not in time due to the manpower shortage. Harmful: The labor pay is high and the profit is not suitable.

③ Solution by standard solution

The harvest of fruits is not in time only by the farmer. Well, how do you do?



- Correspondence to production
 - The person in the town is employed.
 - The farmer who is not the fruits farmer in the vicinity is employed.
 - People are lent between among the fruits farmers.
 - The owner system of the fruit tree is executed.

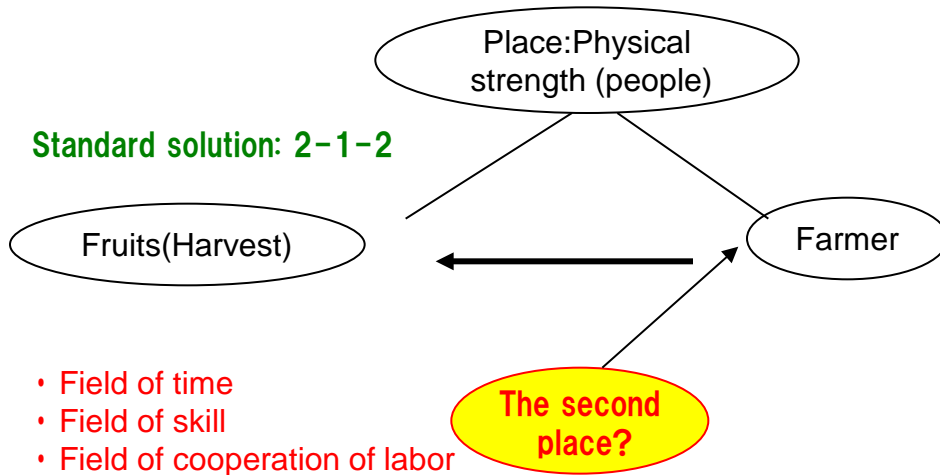


- Correspondence to production
 - The cherry, the plum, and the berry of each fruit tree are harvested with a machine for the harvest. (Production is manually few raised.)

③ Solution by standard solution

The harvest of fruits is not in time only by the farmer. Well, how do you do?

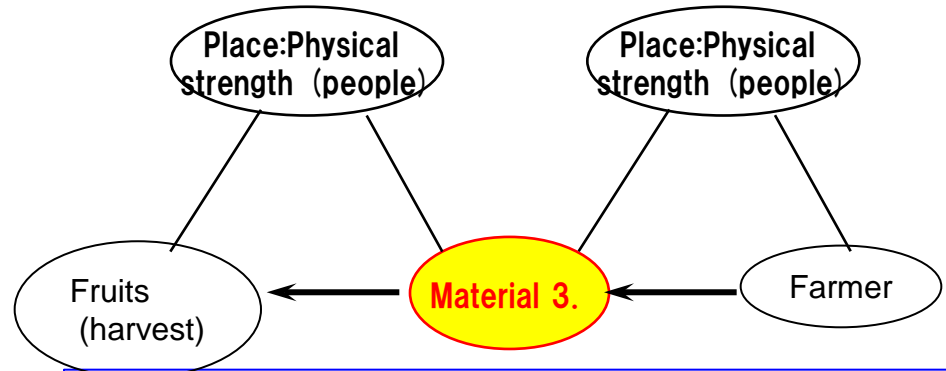
Standard solution: 2-1-2



- Field of time
- Field of skill
- Field of cooperation of labor

- Correspondence to time
 - Correspondence to * skill that adjusts people according to difference at harvest time of fruits (increase of production)
 - The skill level of the harvest of the farmer is raised.
- Correspondence to cooperation of labor (the people' reinforcement)
 - It is cooperation of labor [suru] according to the maturity situation of the fruit tree among farmers.

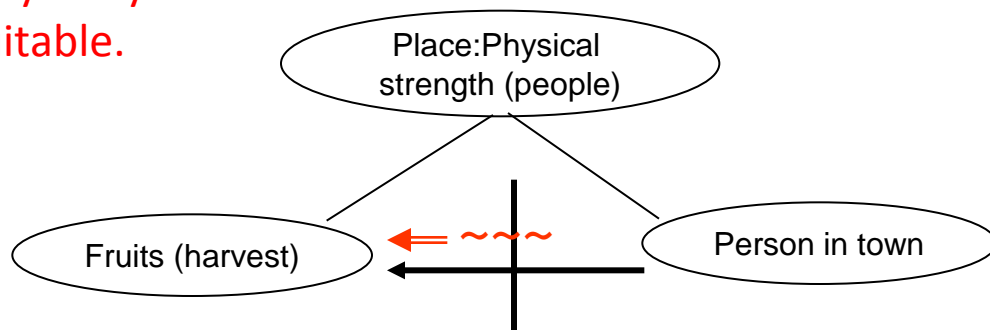
Standard solution: 2-2-1



- Correspondence to production
 - It puts up a net in each fruit tree, the fruit tree is shaken, and the cherry, the plum, and the berry are harvested. (Production is manually few raised.)

When the person in the town is employed by the part-time job, the profit is not suitable.
Well, how do you do?

③ Solution by standard solution

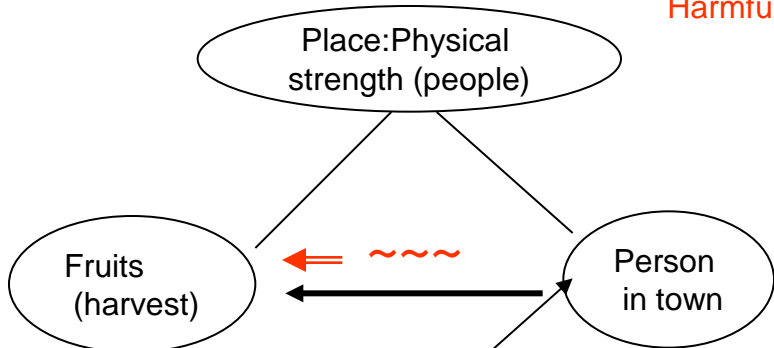


Harmful: The labor pay is high.

The third material

Standard solution: 1-2-1

- Correspondence to pay decrease
• ?



Harmful: The labor pay is high.

The second place

Standard solution: 1-2-4

- Field of time
- Field of skill
- Field of contract
- Field of job development

- Correspondence to time (improvement of profit)
• Correspondence to * skill that adjusts employment according to difference at harvest time of fruits (increase of production)
• The skill level of the harvest of the person in the town is raised.

- Correspondence to contract (decrease of labor pay)
• Fruits are made the consideration of labor.
• It is assumed consideration corresponding to production.

- Correspondence to subsidy (improvement of profit)
• The subsidy of the employment policy is applied for.

Thank you for listening.

**NPO Corporation Japanese TRIZ society
Working Group of Education Research in New Age**