

Comparison of innovation methodologies and TRIZ

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Abstract: Innovation is an eternal topic and has become more and more important in each domain. Many useful innovation methodologies are discussed and studied comprehensively. Based on the comparison and contrast of the strength and weakness between many common innovation methodologies and TRIZ, it is pointed that TRIZ is the most powerful systematic innovation methodology among them, especially in Mechatronics domain.

Keywords: Innovation methodology, TRIZ, Product design

1. Innovation thinking

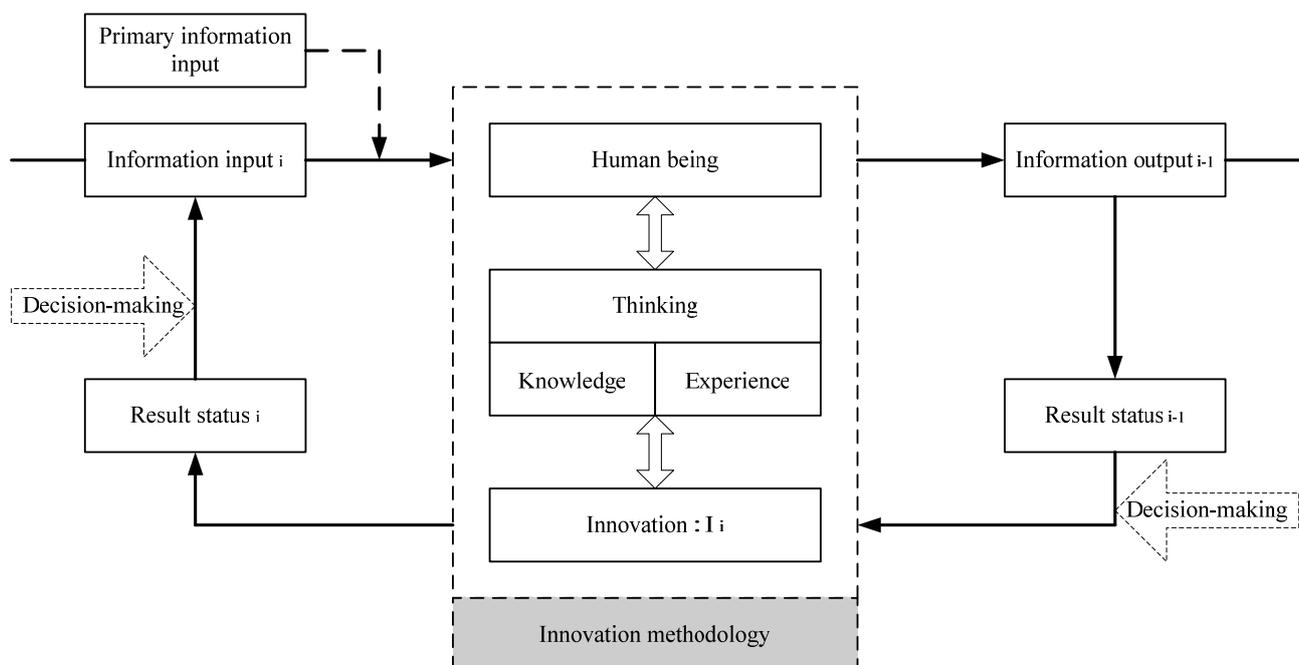


Fig. 1 Innovation thinking process

Innovation thinking means a breakthrough action, which can re-structure the related knowledge and

experience to get a brand new and valuable achievement. Innovation thinking process can be shown in Fig. 1.

Generally speaking, innovation thinking process is in a circle model. Based on the knowledge and experience, 'primary information input' can be transformed into 'information output' with innovation action 'I'. 'Rs' means the 'Result status' of thinking. Then, in a innovation thinking circle, the following formula can be gotten.

$$Rs_i = I_i + Rs_{i-1}$$

Different innovation methodologies have different ways to organise the knowledge and experience and different methods to deal with the information input. From 1930s to 1980s, more than 300 innovation methodologies had appeared. Until today, there are some common methods for innovation applied in different domains, such as BS, 5W1H, Bionic association and TRIZ, etc. Each innovation methodology has its strength and weakness. It is a meaningful thing to know the characteristics of each method. The common innovation methods are introduced in details in this paper. [1]

2. Innovation methodologies

2.1 BS (Brainstorming)

Brainstorming was put forward by Osborn. BS advocates that the persons in the symposium should express their ideas freely. BS points that it is very helpful to break through psychological inertia to gain many valuable conceptions. There are four rules for BS, which are 'Free association', 'Criticism-forbiddance', 'To improve quality by quantity' and 'To reform and improve the ideas continually'. By BS, the participators can exchange information and enlighten each other.

BS believes that innovation is a non-logical process. It depends on the participator's intuition and inspiration. There is no essential rule for the inventing activities. The searching for the solutions to the problems depends on large quantity of possible ideas. The quantity of possible ideas is the premise for the possibility of gaining the solutions with good quality.

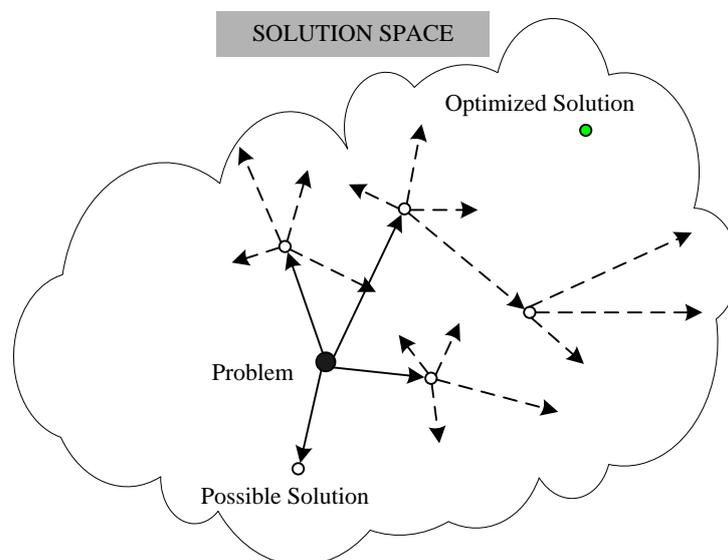


Fig. 2 Solution-searching by BS

The process of solution-searching by BS can be seen in Fig. 2. BS requires the participators from the different domains. It is easy to get various possible solutions because of free association. But Optimized Solution is hard to find. BS can usually get Local Optimized Solution. And there are always lots of un-useful solutions produced during the solution-searching process.

Since its birth, BS has been applied widely in many domains, such as technology innovation, management, market innovation and invention and so on because of its easy operation and science. The operation procedure of BS can be divided into five steps. It can be seen in Fig. 3. [2, 3]

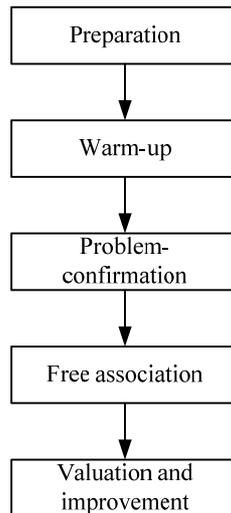


Fig. 3 Operation procedure of BS

Example: Managers usually apply BS as an effective method to collect the employees’ valuable suggestions to reduce the cost.

2.2 5W1H (5W2H)

5W1H suggests that problem can be analyzed based on 6 aspects, which are Why, What, Who, When, Where and How. The essence of 5W1H is to analyze problem systematically, including the essence of the object (What), the essence of the subject (Who), the problem-existence ways in time and space (When, Where), the solution of the problem (How).

Based on the improvement of 5W1H, ‘How’ can be divided into ‘How to’ and ‘How much’. ‘How to’ means the way to resolve the problem. ‘How much’ means the degree of the problem-resolving. Then it is called 5W2H. The meanings of 5W2H are listed in Table 1. [4]

Table 1 Meanings of 5W2H

	What	Who	When	Where	Why	How to	How much
Problem	Object		Time	Place	Reason	Way to do	Degree to do
Policy	Analysis	Manipulator			Principle	Solution	

The procedure of 5W2H can follow the steps:

1. Analyse the problem in 7 aspects

- Why is innovation needed? [**Why**]
- What is the object of the innovation? [**Where**]
- Who undertakes the innovation task? [**Who**]
- When to achieve the innovation? [**When**]
- Where is the place to start the task? [**Where**]
- How to deal with the problem? [**How to**]
- How much to resolve the problem? [**How much**]

2. *List the questions*

3. *Discuss the questions to search the solution*

Example: There was a store on the second floor of an aviation company building. And its sale was bad. The manager used 5w1H to find that ‘Who’ and ‘Where’ were the reasons for bad sale status. Most clients of the store are the passengers. And most of them leave the aviation company by the gate on the first floor. The second floor is not a necessary place to pass. So the store moved to the first floor near the gate and the sale became better.

2.3 Bionic Association

Various organisms have evolved on the earth for about 5 billion years. They keep up changing their modality and function to meet the requirement of the nature to survive on the evolvement journey. In many aspects, organisms are very good examples to help human being to find a correct way to resolve the problems. [5]

As a kind of innovation methodology, bionic association means that human being observe the organisms’ behavior and use the organisms system as a reference to establish the artificial technology system to resolve the problems.

Bionic association can produce high-level innovation ideas. At present, the performance of most bionic-artificial technology system can’t reach the level of the corresponding organisms system.

Bionic association can be achieved by the following steps:

- Observe the organisms’ behavior carefully. Take the phenomena of the organisms as the association objects.
- Analyse the mechanism of the phenomena of the organisms system.
- Analyse the practical problem. Develop a bionic idea into a problem-solving method or product.

Example: Based on multi-eye of grasshopper, a special camera is developed, which can take thousands of pictures synchronously.

2.4 Combination Method

Combination innovation is to combine more than two technology elements together and get a new

product. Those technology elements are usually substance unit, technics, principles, structures, functions and so on.

Because the existing technology elements have been applied in different domains, combination of those technology elements is a method with large possibility. The idea from combination innovation is more feasible. According to the characteristics of combination innovation, it can be classified into 6 types. They are listed below. [6]

- Technology combination. It means to combine the different technology elements to get a new performance of a product.
- Material combination. Different materials are combined together to get a new material with new character. The new material always can meet the new engineering requirement.
- Product combination. More than two products are combined to get a new product with more functions.
- Suit combination. In order to get a new portable product, the products with different standards can be combined based on the structure re-design.
- Function combination. Many different functions are combined together to get a new product with multi-function.
- Structure combination. Based on the structure re-combination, a new product with compound function can be gotten.

Example: A special alloy with shape-memory function can be gotten with the combination of ‘titanium’ and ‘nickel’.

2.5 Reverse Innovation

Based on the analysis of existing product, a new product can be designed by improving the example product. This kind of innovation method is called reverse innovation.

Reverse innovation is employed widely in Japan and Korea. It is a very effective method sometimes.

Example: None.

2.6 Technology Transplant

Transplanting an advanced technology of one domain into the other domains or transplanting an advanced technology of one product into the other products to get a new product with wonderful performance. This kind of innovation method is called technology transplant. [7]

Example: Transplant laser technology of military use into the civil use. Laser cutting machine is a product by technology transplant.

3. TRIZ

TRIZ (the Russian acronym for the theory) is the knowledge-based, systematic approach to innovation. Developed in the former Soviet Union by Genrich S. Altshuller (1926-1998) and his school, TRIZ methods are drawn from analysis of the most innovative inventions in different industries, technologies, and fields of engineering.

It began in 1946 when the Russian engineer and scientist Genrich Altshuller discovered that the evolution of a technical system is not a random process, but is governed by certain objective laws. These laws can be used to consciously develop a system along its path of technical evolution.

TRIZ involves a systematic analysis of the system to be improved and the application of a series of guidelines for problem definition. TRIZ classifies innovative problems and offers corresponding problem-solving methods for each class of problem. It can provide some useful tools for us to analyze the problem, including Ideal Final Result, Laws of Engineering System Evolution, Altshuller's Matrix, Separation Principle, 76 standard solutions, Effects, etc. [8, 9, 10]

The general problem-resolving process is shown in Fig. 4.

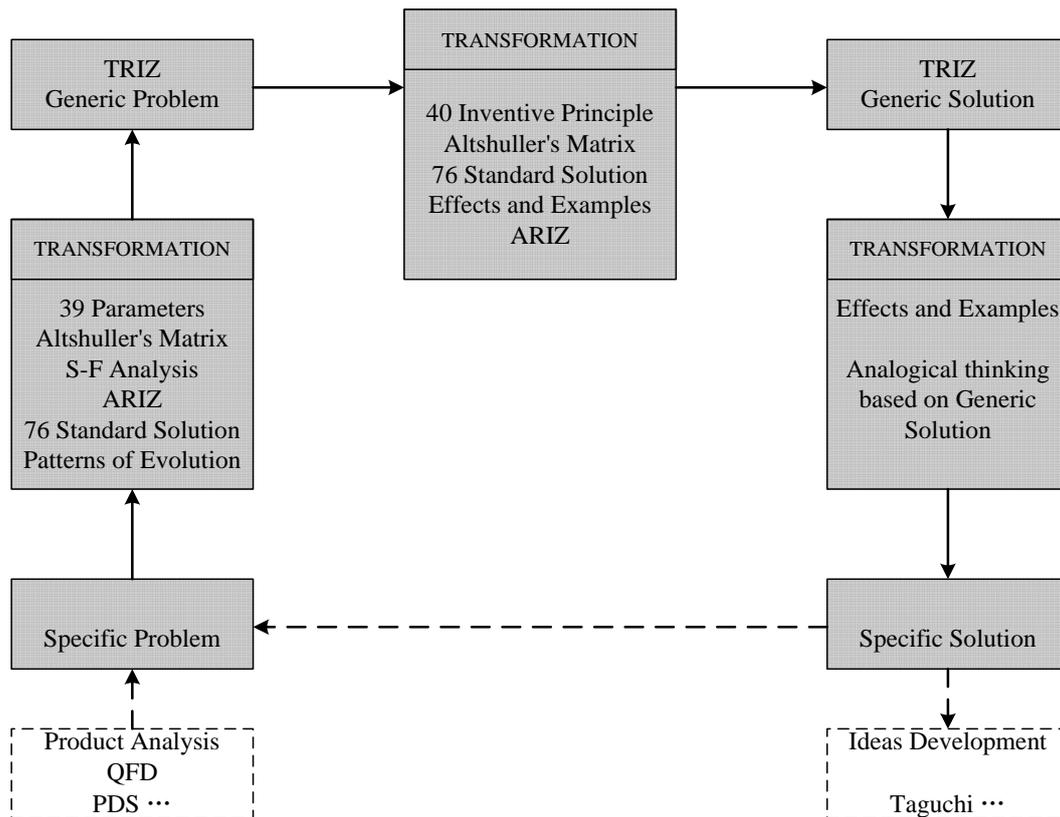


Fig.4 General problem-resolving process by TRIZ

4. Comparison and contrast of different innovation methodologies

Through the comparison and contrast of different innovation methodologies, it is clear to see that TRIZ is a more systematic innovation methodology than others. Knowledge base support is a very important factor for the innovation process. As an innovation method, only TRIZ have systematic Effects library for inventing. And TRIZ provide systematic problem-analysis tools. Because its ideas for invention usually come from the analysis of patents and Effects, it is easy to translating an innovation idea into practise. [11]

Currently, TRIZ is widely applied in technology domain for product innovation, especially for mechanical, electronic and constructional domains. The application of TRIZ in management and economy is relatively weak.

The comparison and contrast of different innovation methodologies is shown in Table 2.

Table 2 Comparison and contrast of different innovation methodologies

ASPECTS METHOD	Innovation Power	Thinking Pattern	knowledge base Support	Idea Generator	Quality of innovation idea	Translating an idea into practice	Adept at
Brainstorming	Intuition and divergence thinking.	Think in all directions.	None	Group thinking	Quantity produces quality.	Usually not easy.	Market, management, technology.
5W1H or 5W2H	Systematic question.	In 5W2H aspects of a problem.	None	Fundamentally individual	Usually find the main conflicts.	Depend on the operator.	Market, management, technology.
Bionic Association	Intuition and inspiration.	Inspiration based on organisms' behavior.	None	Fundamentally individual	Usually can get a good idea.	Depend on the operator.	Mainly in technology domain.
Combination Method	Combination result.	Combining two things.	None	Fundamentally individual	Usually can get a feasible idea.	Relatively easy to implement.	Mainly in technology domain.
Reverse Innovation	Ideas from the existing product.	Improving the existing product.	None	Usually by a group	Usually can get a feasible idea.	Relatively easy to implement.	Mainly in technology domain.
Technology Transplant	Transplant the technology.	Apply the technology in other way	None	Fundamentally individual	Usually can get a feasible idea.	Relatively easy to implement.	Technology domain.
TRIZ	Follow the rules for innovation.	By steps, scientific, logic, analogy	With powerful knowledge base.	Fundamentally individual	Usually can get a perfect idea based on the analysis of the patent or effects.	Easy to implement due to its scientific character.	Mainly in technology domain.

5. Conclusion

After more than 50-year-development, TRIZ is employed widely in the world. Contrary to other innovation methods, TRIZ is more practical with good operation.

Sometimes, other methods can be used with TRIZ together.

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