

Common sense in TRIZ and MAGIC

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Summary

We have met TRIZ and Magic at different place and time. We have met TRIZ to solve engineering problems in the factory or to solve business problem in the market and Magic to enjoy itself in the art hall. But TRIZ and Magic have much in common. They use scientific and mathematics principles, art and engineering technics in common. Magic also use tools of psychological barrier, systematic thinking, materials and fields, contradiction principles and so on. But they are different in the direction of using the principles with each other. We two authors solved the direction contradiction between the TRIZ and Magic and called it as MagTRIZ. Now, you can simultaneously meet TRIZ and Magic at the schools, art halls, companies, home, and outdoors. By MagTRIZ, TRIZ will be kept staying in the mind and five senses of anyone regardless of age, gender or language.

Keywords: Magic; Common sense; Education, Science; TRIZ

1. Motivation / State of the Art

I, Mr. Kim have worked a patent and TRIZ specialist over twenty years, and this special field needs broad and deep knowledge. But customers always need easy explanation of professional knowledge. I continuously studied how to explain it easily for customer and realized that easy explanation needs wisdom based on the deep knowledge. Motivation of this theme is how to teach TRIZ easily to anyone regardless of age, gender or language. TRIZ seems too difficult and serious for children and foreigners to access it. But Magic is too easy and merry for anyone to access. By Magic, anyone can learn TRIZ very easily and merrily. In fact TRIZ and Magic has many common principles. Accordingly we two authors tried to match them with each other. We believe this is first trial, since we cannot find any research about this in the world.^{[1][2]} We could not find any paper for TRIZ and Magic collaboration.

2. Experimental

2.1. Relation of TRIZ and Magic

We taught TRIZ in Dongguk University and Korea Standard Associations in Korea and intentionally inserted Magical performance to increase the understanding of TRIZ. TRIZ and Magic uses common principles, but the process and direction are different each other. TRIZ consistently strive to open principles and apply them to solve problems under phenomena, while Magic consistently strive to conceal principles and apply them to show phenomena. It seems impossible for TRIZ professional and Magician to cooperate each other. Here contradiction is. Nevertheless, TRIZ and Magic want all people happy day by day, month by month, and year by year. This situation motivate us to cooperate with each other.

2.2. Common sense of TRIZ and Magic

We reviewed four magic principles in the view of seven TRIZ principles. Table 1 shows the Match table of TRIZ and Magic. According to table 1, the column consist of Psychological inertia, Systematic thinking, Materials and fields, Ideal final result, Technical contradiction, Physical contradiction, Scientific effect and the raw consist of the category of magic principles in science, mathematics, psychology and living field. They are well matched with each other. The box of matching table shows a typical example of magic. Of course, many alternative cases can be filled with the boxes. For example, “water” means the magic using water and “emotion” means the magic of using personal emotion.

Table.1 Match table of TRIZ and Magic

| TRIZ principles | Magic principles | | | |
|--------------------------------|------------------|-------------|------------|------------|
| | Science | Mathematics | Psychology | Living |
| 1. Psychological inertia(PI) | water | money | emotion | straw |
| 2. Systematic thinking(ST) | balloon | phone | cube | cup |
| 3. Resources and fields(RF) | water | calculator | paper | matchstick |
| 4. Ideal final result(IFR) | material | card | lady | band |
| 5. Technical contradiction(TC) | card | card | mind | lady |
| 6. Physical contradiction(PC) | sponge | sponge | card | bead |
| 7. Scientific effect(SE) | ring | block | speaker | coins |

At first, we consider Psychological Inertia (PI). The psychological meaning of the word "inertia" implies an indisposition to change - a certain "stuckness" due to human programming. It represents the inevitability of behaving in a certain way - the way that has been indelibly inscribed somewhere in the brain. It also represents the impossibility - as long as a person is guided by his habits - of ever behaving in a better way. Psychological Inertia represents the many barriers to personal creativity and problem-solving ability, barriers that have as their roots "the way that I am used to doing it." In solving a problem, it is the inner, automatic voice of PI whispering "You are not allowed to do that!" Or, "Tradition demands that it be done this way!" Or even, "You have been given the information, and the information is true." There many type of Psychological Inertia such as "The retarding power (or inertia) of a word", "A partial restriction becomes a blanket restriction", "Tradition cannot be broken", "Words and their assumed properties or characteristics", "Inadmissible range of data", "Association of objects with senses", "All information given is valid", and so on. Psychological Inertia make our five senses unable to recognize the real size, distance, number, color, position, sound, smell, taste, pain, touch and so on.

Psychological Inertia is predilection toward conventional ways to analyze and solve problems. Psychological Inertia retards the rate of progress of science. Therefore TRIZ professional try to overcome the Psychological Inertia to well analyze and solve problems. On the contrary, magician fully utilize the Psychological Inertia to conceal the principle under the fantastic phenomena. In TRIZ education, we show several magic and explain the principles. There are many PI Magic games such as card games to change mark patterns, card games to guess right ages, purse games to guess the amount of money, or straw games to cut. Figure 1 shows the card magic exercise by the author Mr. Ham. And then student can understand the mechanism of Psychological Inertia and have ability to overcome or utilize it. Now they can make many creative magic or invent good things to make people and themselves happier.



Fig.1 Card magic exercise by the author

At second, we consider Systematic thinking(ST). A system is composed of interrelated parts or components (structures) that cooperate in processes (behavior). Natural systems include biological entities, ocean currents, the climate, the solar system and ecosystems. Designed systems include airplanes, software systems, technologies and machines of all kinds, government agencies and business systems. Systematic thinking has at least some roots in the General System Theory that was advanced by an Austrian-born biologist Ludwig von Bertalanffy in the 1940s and furthered by Ross Ashby, who was born in 1903 in London, in the 1950s. The term Systematic thinking is sometimes used as a broad catch-all heading for the process of understanding how systems behave, interact with their environment and influence each other. The term is also used more narrowly as a heading for thinking about social organizations, be they natural or designed, healthy or unhealthy. Often the focus is on a government or business organization that is viewed as containing people, processes and technologies.

In TRIZ, Systematic thinking has been applied to problem solving, by viewing "problems" as parts of an overall system, rather than reacting to specific parts, outcomes or events and potentially contributing to further development of unintended consequences. Systematic thinking is not one thing but a set of habits or practices^[3] within a framework that is based on the belief that the component parts of a system can best be understood in the context of relationships with each other and with other systems, rather than in isolation. Systematic thinking focuses on cyclical rather than linear cause and effect. TRIZ utilize Systematic thinking tool for finding operating zone and operating time of problem, and analyzing substance and field.

Systematic thinking is a never-ending process. According to street dictionary^[5], Systematic thinking consists four steps as follows. 1) Identify and analyze the problem before jumping into action. 2) Formulate multiple option. 3) Define and establish a selection criteria. 4) Be bold and make a final decision. To realize ST, we realize five steps as follows. Systematic thinking allows you to solve problems by coming to practical, workable solutions, whether in business or in life. Following the below steps will give you the tools you need for your thinking and problem solving to be more efficient and effective. 1) Set the bar high. With each hurdle crossed you can begin to think in small steps in order to pave the way to your bigger goal. 2) Give thought its due time. Short thoughts may generate wonderful solutions, but not always. With business and life problems getting more and more complex as we move further down the road, looking for the quick way out can be a grave mistake. Hard, long thinking about problems can open avenues to helpful information. 3) Defy the myths. Complex problems sometimes call for radical thinking. Dare to defy the myths. Galileo uprooted the natural belief that earth was not round. Going around the earth wouldn't have revealed to Galileo that the earth is round. Instead, he chose to think in radical ways. Throughout history, those who have failed to challenge the status quo have often been proven wrong. 4) Channelize our thoughts. Documenting and recording your thoughts helps to put things in perspective and saves them for future examination. Many ideas and thoughts cross everyone's mind every day. Even the impractical thoughts deserve to be examined before discarding them. Thomas Edison took several years to develop that light bulb, trying out various options - but he never forgot to record each one of his steps, including failures, which ultimately prevented him from duplicating his efforts. 5) Work within a time frame. Give ourselves a specific timeframe within to solve a specific problem. Otherwise, we may never come to the end.

In systems science, it is argued that the only way to fully understand why a problem or element occurs and persists is to understand the parts in relation to the whole.^[4] Standing in contrast to Descartes's scientific reductionism and philosophical analysis, it proposes to view systems in a holistic manner. Consistent with systems philosophy, Systematic thinking concerns an understanding of a system by examining the linkages and interactions between the elements that compose the entirety of the system.

Systems science thinking attempts to illustrate how small catalytic events that are separated by distance and time can be the cause of significant changes in complex systems. Acknowledging that an improvement in one area of a system can adversely affect another area of the system, it promotes organizational communication at all levels in order to avoid the silo effect. Systematic thinking techniques may be used to study any kind of system such as physical, biological, social, scientific, engineered, human, or conceptual system.

TRIZ professional use the Systematic thinking techniques to well analyze and solve problems. Magician use Systematic thinking techniques too. But magician fully utilize the Systematic thinking techniques to conceal the principle under the fantastic phenomena. In TRIZ education, we show several magic and explain the principles. There are many ST Magic games such as balloon games to insert things without punching, phone games to guess right ages, cube games to guess the number, cup games to disappear on the table, or pigeon games to appear on the hand. Figure 2 shows the balloon magic

exercise by the student. And then student can understand the mechanism of Systematic thinking and have ability to overcome or utilize it. Now they can make many creative magic or invent good things to make people and themselves happier.



Figure 2. Balloon magic exercise by the student

At third, we consider Resources and Field (RF). The term of “resources” is widely used within many contexts to refer to natural resources, financial resources, human resources, etc. In TRIZ, the creative utilization of the resources available in a system to increase the system’s ideality is a cornerstone of inventive problem solving. The concept was introduced in 1985 by Genrich Altshuller in the form of “substance field resources”, a component in the Algorithm for Inventive Problem Solving (ARIZ). Later this concept was expanded to include other types of resources such as functions, information, space, time, changes, materials, fields, and so on. Recently, evolutionary resources has been introduced by Ideation International.

TRIZ emphasis usability of fields. Fields are mechanical field, thermal field, chemical field, electrical field, magnetic field, gravitational field, electromagnetic field, organic field, nuclear field, and so on. The innovative problem is modeled to show the relationships between the two substances and the field. Complex systems can be modeled by multiple, connected Su-field Models. There are four steps to follow in making the Su-field Model. 1) Identify the elements. The field is either acting upon both substances or is within substance 2 as a system. 2) Construct the model. After completing these two steps, stop to evaluate the completeness and effectiveness of the system. If some element is missing, try to identify what it is. 3) Consider solutions from the 76 Standard Solutions. 4) Develop a concept to support the solution.



Figure 3. flower magic exercise by the author

TRIZ professional use Resources and Field (RF) and Su-field Model techniques to well analyze and solve problems. Magician use them too. But magician fully utilize them to conceal the principle under the fantastic phenomena. In TRIZ education, we show several magic and explain the principles. There are many RF Magic games such as burning paper games to disappear without any ash, calculator games to guess right number, color paper games to change colors according to mind,

matchstick games never to burn out, or flower games to abruptly appear in the stick. Figure 3 shows the flower magic exercise by the author. And then student can understand the mechanism of Resources and Field and have ability to overcome or utilize it. Now they can make many creative magic or invent good things to make people and themselves happier.

At fourth, we consider Ideal Final Result (IFR). Ideality is one of the most powerful concepts of TRIZ. According to ideality, the ideal state of the system is where all its functions are achieved without causing any problem. The system is better, faster, low cost, low error, low maintenance and so on. In other words, an ideal system consists of all positives and no negatives. According to TRIZ, the Ideal System is a system that does not materially exist, while all its functions are achieved. In the absolute sense Ideality is impossible to achieve, but in a relative sense ideality is achievable. A lift is an ideal staircase so far the climbing functionality of the staircase is concerned, a motorcycle is an ideal bicycle so far its paddling aspect is concerned. But they are not absolutely ideal, as they possess other disadvantages.^[6]

According to Altshuller,^[7] "Ideal Final Result (IFR) is a fantasy, a dream. It cannot be reached, but it will allow us to build a path to the solution." An Ideal Final Result is a logical imagination which may never be practically achieved. It is the ultimate theoretical goal, a roadmap to the highest possible result. We can use the same concept of Ideality such as ideal final goal, ideal solution, ideal product, ideal process etc.

Although Ideality is not practically achievable, the concept of ideality is immensely useful to solve any problem. That's because although 100% of ideality is not achievable a lower level Ideality or partial Ideality is achievable. The good solutions are closer to the Ideal Final Result. It is possible to improve ideality as follows. 1) Increasing the useful functions in the numerator of the function. 2) Decreasing the harmful functions in the denominator of the function. 3) Increasing its main useful function. 4) If a system has harmful functions, it may have a subsystem which neutralizes its harmful functions for free. 5) Minimizing the cost

TRIZ professional use Ideal Final Result (IFR) concept to maximize effect and minimize cost of solution. Magician also use them for the same purpose like TRIZ professional. In TRIZ education, we show several magic and explain the principles. There are many RF Magic games such as ideal material to accomplish same result, card to appear by itself, lady to hang over in the air, or band to move finger by finger for itself, beads to separate in short time. Figure 4 shows the beads exercise by the author. In ideal solution, we show the Magic about automatically mixing and separating beads in the two transparent cups. And then student can understand the concept of Ideal Final Result (IFR) and have ability to utilize it. Ideality is very subjective and changing according to situation. Now they can make many ideal magic or invent good things to make people and themselves happier.



Figure 4. beads magic exercise by the author.

At fifth, we consider contradictions. The concept of contradiction is central to the TRIZ tool-kit and gives immediate confidence in finding successful and powerful solutions. Problem solving often involves understanding and resolving conflicting requirements - improvement in one part is at the expense of something else getting worse (technical contradictions), or we may want the same thing in opposite states but at different times or places e.g. an umbrella needs to be small and large (physical contradictions). Once we understand the conflict in our requirements then we can use TRIZ processes for uncovering contradictions and the tools for solving them.

The distillation of knowledge in these 40 Principles is a guide to powerful solution triggers. Familiarity with all 40 Principles is essential for future effective problem solving. Technical Contradiction (TC) can be typically solved by using 40 Prin-

principles with or without Contradiction Matrix. Physical Contradictions (PC) can be typically solved by using Separation principles. The 40 Principles are useful Physical Contradictions too.

Technical and Physical contradictions are the cornerstones of TRIZ. The formulation of the Technical Contradiction aids in understanding the root of a problem better and discovering the exact solution for the problem faster. If there is no technical or physical contradiction then it is not inventive (or TRIZ) problem. Technical contradictions are typically related to properties of the whole technical system but physical contradictions relate to physical properties of one characteristic of an element of the system.

TRIZ professional use 40 inventive principles and Separation principles to solve Technical and Physical contradictions. Magician can use them too. But magician fully utilize them to conceal the principle under the fantastic phenomena. In TRIZ education, we show several magic and explain the principles. There are many TC Magic games using 40 principles such as card games to change to the same color, coin games to appear and disappear, water cup games not to pour down, or newspaper ladder games to stand itself. Figure 5 shows the flower magic exercise by the author. And then student can understand and utilize the mechanism of Technical contradiction and 40 principles.



Fig 5. Newspaper magic exercise by the author

When dealing with a known Physical contradiction, one can use one of the four Principles. 1) Separation of contradictory properties in time 2) Separation of contradictory properties in space 3) Separation of condition or relationship 4) Separation of part and whole system.

There are many PC Magic games such as ring games to separate by themselves, sponge games to increase numbers, card games to separate, or beads games to separate automatically. Figure 6 shows the sponge magic exercise by the student. And then student can understand and utilize the mechanism of Physical contradiction and Separation principles.



Figure 6. The sponge magic exercise by the student

Finally, we consider Scientific effect (SE). Once we formulate a physical contradiction we can use it for deriving the formula for an ideal final result. The formula of the ideal solution represents a physical model for the development of future solutions. To satisfy opposing physical requirements contained in the model, we need to use separation principles and knowledge from database of scientific effects and phenomenon. According to TRIZ, the scientific effect is one of the principles for resolving physical contradiction and can be considered a transducer for transformation of one action or field to another with application of physical, chemical, biological, mathematical and geometrical phenomena. At present time, about 5,000 different effects and phenomena are known; 400-500 effects are the most applicable in the practical activity of engineers.

The application of scientific phenomenon leads us to the development of solution concepts of the highest innovation level since the formulated problem contradiction is being resolved on its physical level. Utilization of scientific phenomena and effects helps approach the ideal solution because these effects resolve intensified physical contradiction. Scientific effects are used together with other TRIZ tools including inventive principles and standard solutions.

TRIZ professional use Scientific effect (SE) to solve problems. Magician can variously use them too. But magician fully utilize them to conceal the principle under the fantastic phenomena. In TRIZ education, we show several magic and explain the principles. There are many SE Magic games using scientific effect such as ring games to separate themselves, block games, speaker games to alarm only a special person among crowd, or coins games. Figure 7 shows the flower magic exercise by the author. And then student can understand and utilize the mechanism of Scientific effect (SE).



Fig 7. Ring magic exercise by the author

3. Results and Discussion

We reviewed seven typical TRIZ principles in the view of TRIZ and Magic. The principles is common between TRIZ and magic, but the using direction is opposite to each other. We solve this Administrative contradiction (AC) by human collaboration between TRIZ and Magic professional. We two authors have deeply thought that the level of magic secrets should be open out so that all TRIZ and Magic professionals to synergistically survive and success. This is first trial and more study about principles and cases is needed.

Creativity is getting more and more important for a personnel or organization. TRIZ and Magic can create a synergy effect in many fields. To maximize the synergy, we can use many existing Magic and TRIZ tools and create new tools. Student can merrily and deeply understand science, technology and world structure by magic and TRIZ. We are writing guide books and creating new tools such as cards, blocks, and game tools, and so on. We have had many education and performance programs for MagTRIZ. This program is very useful especially for student, children and company beginner. After this program, people can make Magic games for themselves and merrily create many things by TRIZ and Magical view every day. For this we are preparing professional program to teach MagTRIZ tools, principles and technics. We will update more information in www.magtriz.com.

References

- [1] Pascal Sirea, Gilles Haefffeléb, Sebastien Dubois: TRIZ as a tool to develop a TRIZ educational method by learning it. TRIZ future, 4 (2012), 1–11
- [2] T. Nakagawa: Education and training of creative problem solving thinking with TRIZ/USIT, Procedia Engineering, 9 (2011), 582–595
- [3] <http://www.watersfoundation.org/index.cfm?fuseaction=materials.main>
- [4] Capra, F., The web of life: a new scientific understanding of living systems (1st Anchor Books ed). New York: Anchor Books. (1996), 30
- [5] <http://www.streetdirectory.com>
- [6] Umakant Mishra, Bangalore, Introduction to the Concept of Ideality in TRIZ, 1 (2013), 1-9
- [7] Altshuller G., And Suddenly the Inventor Appeared. Translated by Lev Shulyak, Technical Information Center