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ñDevelopment of Multifunctional Nano-Crystals Technology for Medical Application using TRIZò

ñABSTRACTò

A special TRIZ consulting team "GEN3 Partners Korea" in QM&E Consulting Co., Ltd. successfully completed a real prediction project for a big joint R&D project by Korea University, KISTI and others. The research team had been developing new technologies of making and using nano-particles in medical area including diagnostic and treatment of cancer diseases. It was necessary to show the next steps of development for this technology with realistic solutions.

There are main tools for prediction project: TESE (Trends of Engineering System Evolution) and FOS (Function Oriented Search) [1,2] in modern TRIZ. But, certain laws of TESE have different rule, effects and phenomena if you consider task in micro level. According to specifics of micro level, authors of article have found new phenomena and examples for different rules and modified tools.:

1. Using the trend of increasing conductivity according to sub trend "point – line–surface–volume", authors found opposite trend for surgery area: "volume – surface – line – point".
2. Using the trend of ideality in medicine area, authors elaborated on important functions for merging: Step 1 = only diagnostic, Step 2 =only treatment, Step 3 = diagnostic and treatment.
3. Using the trend of increasing level of field MATChEm, authors have elaborated and adapted it for use on micro-level, authors built more detailed field classification system for medicine: {"MATChEm-Light-Radiation-Bio}.
4. Used FOS and MATHEM together as a special diagram to search useful technologies in other areas of medicine or in other industry.

Due to the NDA with customer we cannot show our ideas themselves. We can show only theoretical approach as helper for work in micro level. According to opinion of customer, this project was successful and we recommend our approach to apply in micro level, for example nano, bio or medical area.

Key Words : TRIZ, TESE, FOS, Nano, Medicine, Bio, GEN3, technology prediction, forecast

1. Introduction

TRIZ is well known for its strength in inventive problem solving area but not very many people know that TRIZ is also very good in technology forecasting area. Furthermore, examples of TRIZ application in frontier research areas like nano, bio and medical technologies are harder to find than examples in macroscopic technology areas.

A special TRIZ consulting team "GEN3 Partners Korea" in QM&E Consulting Co., Ltd. successfully completed a real prediction project for a big joint R&D project in nano and medical area by Korea University, KISTI and other universities. The research team had been developing new technologies of making and using multifunctional (magnetic & optical etc.) nano-crystals in medical area including diagnostic and treatment of cancer diseases. The TRIZ consulting consisted of three themes, and the first two themes were about solving the bottleneck problems and improving yield in development of new technologies and the consulting team used our creative problem solving methodology.

The third theme, however, was not a problem solving but a technology forecasting task – to show the next steps of technology development around the research area with very realistic solutions. The authors used several very useful methods for prediction in modern TRIZ to set a general strategic direction for research and also to generate specific and realistic ideas for new research. In this article, the method of application, not the resulting ideas, is described.

2. Main Tools for Prediction

The main tools chosen for prediction in this project were: TESE (acronym from Trends of Engineering System Evolution) and FOS (acronym from Function Oriented Search) [1,2] in modern TRIZ.

2.1 Trends of Engineering System Evolution

TESE is based on numerous observations from the evolution history of various technical systems that found a few common patterns or trends across different area of industries. These trends have statistical root in the history and therefore reliable and useful in predicting the future of current technologies.

Every trend has one or more sequence of stages in design and operation principles. We consider and inspect this sequence in real historical situation and identify "empty zone". "Empty zone" can be often used to create new product according to ideas from "Blue ocean" approach.

For example, if you need to create and invent new weapons, first you review the history of evolution of weapons according to a trend of TESE, for example, the trend of increasing level of field, MATChEm.

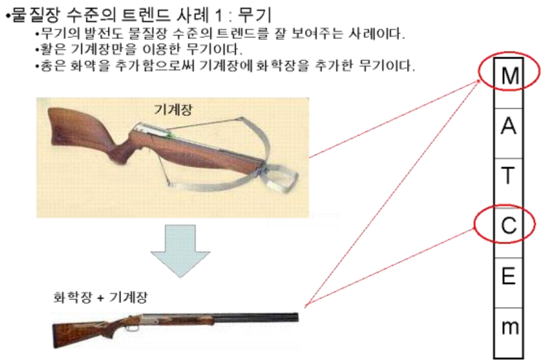


Fig. 1 Trend of MATChEm

We can define as "empty zone" position "A" (use acoustic field). It is creative impact for invention. We could have invented a stun grenade.

A stun grenade, also known as a flashbang, is a non-lethal weapon.[3] The first devices like this were created in the 1960s at the order of the British Special Air Service as an incapacitant.

Fig. 2 Stun Grenade

These grenades are used to temporally neutralize the combat effectiveness of enemies by usually disorienting their senses. The flash of light momentarily activates all light sensitive cells in the eye, making vision impossible for approximately five seconds until the eye restores itself to its normal, unstimulated state. The incredibly loud blast produced by the grenade adds to its incapacitating properties by disturbing the fluid in the ear. This example shows how we use the trend of change of field level (MATChEm) to predict new technologies.

We have more trends to use for technology prediction. Furthermore, each of the main nine trends listed below have more several more detailed subtrends.

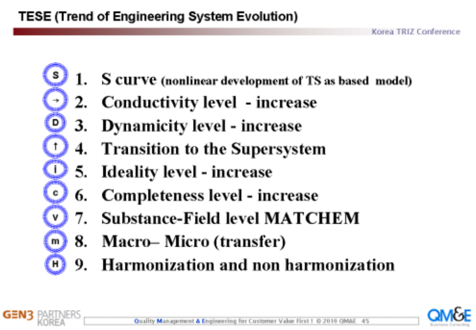
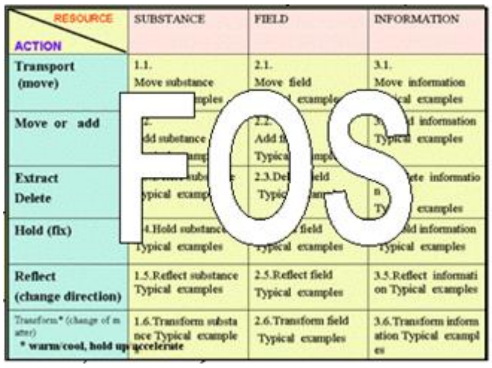


Fig. 3 Nine Main Trends of TESE

2.2 FOS (Function Oriented Search)

FOS is a method in modern TRIZ that borrows solutions from other industries. Generalizing the functions that we need to a more abstract and general form makes it possible to search solutions in other industries or other technical areas.



ACTION \ RESOURCE	SUBSTANCE	FIELD	INFORMATION
Transport (move)	1.1. Move substance [illegible] mples	2.1. Move field [illegible] example	3.1. Move information [illegible] cal examples
Move or add	[illegible] dd substance [illegible]	2.2. Add fi [illegible] Typica [illegible]	3. [illegible] d information Typical examples
Extract Delete	[illegible] ypical examp [illegible]	2.3.De [illegible] eld Typic [illegible]	[illegible] ete informatio n Ty [illegible] examples
Hold (fix)	[illegible] 4.Hold substanc [illegible] Typical examples	[illegible] field Typical examples	[illegible] ld information Typical examples
Reflect (change direction)	1.5.Reflect substance Typical examples	2.5.Reflect field Typical examples	3.5.Reflect informati on Typical examples
Transform* (change of m atter) * warm/cool, hold up accelerate	1.6.Transform substa nce Typical example	2.6.Transform field Typical examples	3.6.Transform inform ation Typical exampl es

Fig. 4 A table for Function Oriented Search

3. New Findings in Microscopic Area

Macro level (for example: mechanics, pneumatics and thermodynamics etc.) and micro level (optics, ultrasound, chemistry, biology, medicine, nano level of solid body etc.) are different according to phenomena in TESE. We researched the manifestation of some laws on microlevel and have got revision upon their using.

According to specifics of micro level, authors of article have found new phenomena and examples for different rules and modified tools. In this section these new findings are described.

3.1 Inverse Trend of Increasing Conductivity

As a subtrend of trends of increasing conductivity, we observe, in many cases of macroscopic world, the trend of increasing dimensions through point-line-plane-volume. The figures below show two of such examples – one for system to change color of an object and the other for system to fix two sheets of fabric.

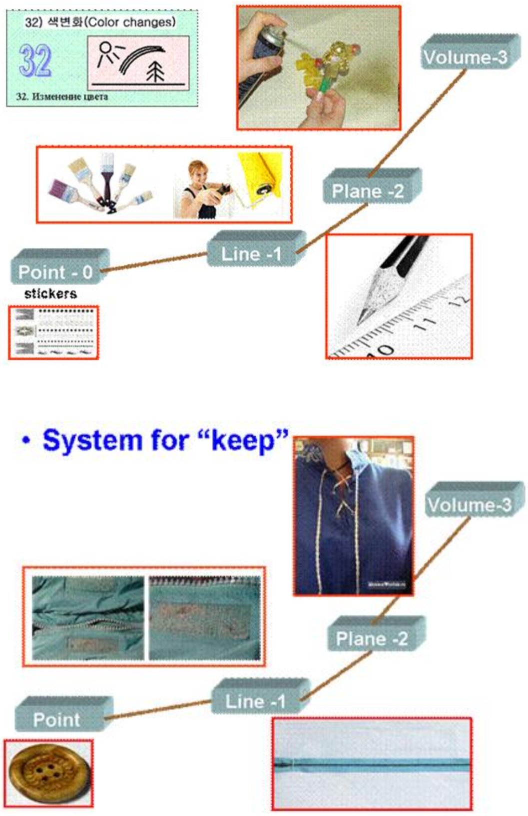


Fig.5 Normal trend of increasing conductivity

But we found a reverse trend in this project – in order to reduce damages and injury during treatment process the dimension changed from 3D to 0D, not from 0D to 3D as in macro level. Surgery(3D)–laparoscopy(2D)–chemotherapy(1D)- non invasive ultrasound(0D).

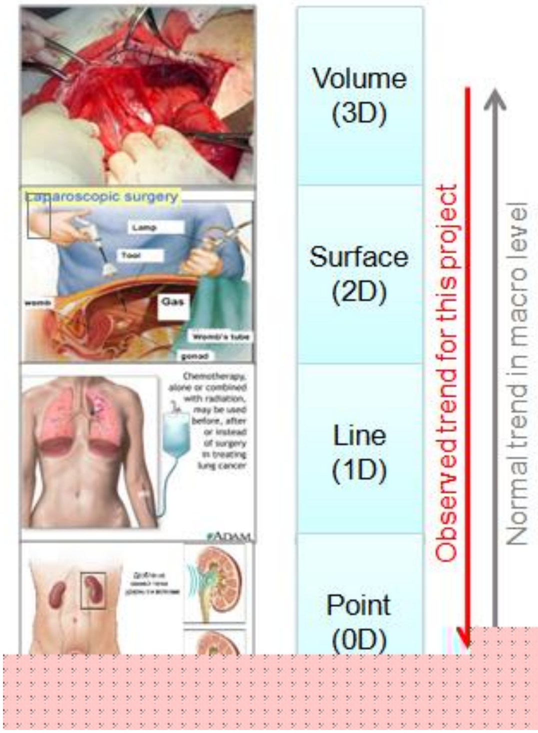


Fig.6 Inverse Trend of Conductivity

Interesting situation, we discovered opposite trend in micro level. We know similar situation in article of Alex Lubomirsky from GEN3 Partners. [4]

3.2 Application of the Trend of Ideality

A subtrend of increasing ideality says that as a technical system evolves in time, it tends to have more and more useful functions.

Some example of this subtrend in macro level are shown in Fig. 7 below.