7 Solutions to extend the application of TRIZ
- Including the prevention of design risk -

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Presentation of Today

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3. Reaction of the developers for scientific methods
4. Aim of providing 7 solutions
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1. About Olympus

**Medical systems**
- Small intestinal capsule endoscope
- Deflectable tip of 3D laparoscope

**Imaging systems**
- PEN E-P5
- XZ-10

**Life science & Industrial systems**
- New laser scanning microscopes「FV1200」
- Omni Scan phased array systems

Established: October 12, 1919
Head office: Shinjuku-ku, Tokyo, Japan
Capital: ¥73,332 million (As of March 31, 2013)
Consolidated net sales: ¥743,851 million (Fiscal Year Ended March 2013)
Consolidated headcount: 39,937 (As of March 31, 2013)

Next-generation gastrointestinal endoscopy system
EVIS LUCERA ELITE

The World's Only Vessel Sealing and Tissue Cutting Device. Integrated with both Advanced Bipolar and Ultrasonic Energy “THUNDERBEAT”
2. Promotion of scientific methods in Olympus

Providing a solution, depending on the purpose and period of the theme

Typical Use of Methods

Using various types of methods according to the problem

90 min Basic Training, applied to the theme

Solution for

Fuzzy Frontend
Setting Theme
Fast Cause Analysis
Making Strong Patent
Cost Reduction
Evaluation & Experiment
Risk Prevention

Providing optimal solutions to the problem
3. Reaction of the engineers for scientific methods

◆ Engineers are busy, and have no time for their training.
  ⇒ They can not have the time for training. 90 minutes training is their limit.

◆ We can not grasp the engineer’s heart by the scientific methods. They want the best approach for the purpose.
  ⇒ Engineers want to know what method is used for their problem.
     Their aim is not to take advantage of the method, but to grow in efficiency.
     Experienced engineers hope someone will tell them how to solve problems immediately without learning the basics of the method.

◆ Many engineers have an allergy to the scientific method.
  ⇒ Almost all manager class engineers have failed experiences by using QFD, TRIZ and TM in the past.

◆ We can not resolve problems by only one method.
  However, it is difficult for us to connect several methods.
  ⇒ Evangelists of the method say they can resolve any problem by only one method. But they don’t shows us how to connect several methods.
4. Aim of providing 7 solutions

Using various methods naturally while deploying 7 solutions

Engineers should have many “Drawers” for the solution of problem

Mr. A knows the scientific method.
Mr. B relies on his knowledge and experience of the past

QC7? Statistical methods?

Learning by practice in close contact with the theme

Many “Drawers” for the purpose

Many “Drawers” for the purpose

Training solutions and 90 minutes Basic course

Support engineers at the seams of theme

Get the new “Drawer”!

Forcing to use the method is not our purpose!

Evangelist of the method is not required.
5. Possibility of expansion in 7 solutions

Concept of connecting Methods and 7 Solutions is important

※ TRIZ includes Functional approach and Root cause analysis.
6. 3 Key Elements of connection (1)

【Element 1】Limit the target area by Time and Space

Any theme has constraints of man-hours and time limit.

How can I limit the target area efficiency?

Against the Target area,

Do you cut out the area by Space?

Do you cut out the area by Time?
6. 3 Key Elements of connection (2)

The Fish Bone Chart for cutting out the target area by space and time

Space Approach

Time Approach

The Fish Bone Chart for cutting out the target area by space and time

The Space Fish bone chart

The Time Fish bone chart

Handling Area
6. 3 Key Elements of connection (3)

【Element 2】Simplification by functional approach

The target system is complex.

How can I simplify the problem effectively?

Against the Target problem,

Generalizing by Function

The Element S acts on (V) the Element O

Functional approach changes the mind

from "Why?" to "For what", "For the Customer"
6. 3 Key Elements of connection (4)

**Functional schematic can clarify the function**

Functional schematic can analyze the function along the thinking of the engineer.

**From the top of the system**
I chase the function
step-by-step

Deployment from the main function (Projector)

- Projector projects the electronic data on the screen.
- Lens Unit focuses the emitted light to the screen.
- Actuator moves the lens in the axial direction.
- Light source irradiates light to the optical Unit.

**Purpose**

- **S+V+O**
- **Means**
6. 3 Key Elements of connection (5)

[Element 3] 2 types of idea approaches by TRIZ to the purpose

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**Type of eradicating the problem**

Why can’t I supply sushi fast?

I found the cause of slow work.

Can I cut the fish quickly without remainder on the kitchen knife?

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**Type of fulfilling the desire**

Why can’t I supply the sushi fast?

Expression of desire: Can I cut the fish quickly without remainder on the kitchen knife?

Brewery: Got it!

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In Sushi Bar
New type of Kitchen Knife

You can solve the problem concretely. However, the range of ideas is narrow.

Belt-conveyor Sushi bar

You can obtain a wide innovative idea. However, the idea lacks detail or specifics.
7. 7 Solutions (1) Fuzzy Frontend

Matching Needs and Seeds through the Function

- I want you to level up \( \bigcirc \bigcirc \) more
- I want you to add \( \triangle \triangle \) more
- I want you to eliminate the problem \( \times \times \)

Requirement for an accelerated level of the function

Requirement for functions which the current system does not have

Reduction request of the side effects of the function

Matching Needs and Seeds and actualizing them in Fuzzy Frontend

Vague Needs → Vague Seeds → Actualized Seeds

Arranging Seeds (technology) by the Function
7. 7 Solutions (2) Fuzzy Frontend

Visualizing the Fuzzy Frontend process by matching Needs and Seeds

Visualization Map of Fuzzy Front End

1. Seeds Push Type
2. Needs Pull Type

Methods for Actualization of Needs
1. Concept mining QFD
2. Seeds-driven QFD
+ Usability Evaluation, Market research etc.

Methods for Actualization of Seeds
1. TRIZ 9-Window representation
2. TRIZ Trend analysis of the evolution
+ Patent search, Technical Tree etc.

*Reference: Toshiba Corporation Dr. Hitoshi Iwama

7. 7 Solutions (3) Setting Theme

Matching the vector of engineers while reducing Ambiguity of the theme

**The Fish Bone Chart**
Part 1

**QFD**

**The Fish Bone Chart**
Part 2

Ambiguity
**Big**

Making sure customers and the purpose by the bird's-eye view to set the target area

Extracting the priority of technical problems according to customer's needs

Setting the target area of challenges to level up and planning of solution

★ Output of TRIZ is consistent with the expected results by clarifying the issues.
Combining idea approach and cause analysis for each purpose

Approach of Analysis

Space and Time

Spatial approach
Study of the factors in the system

Time approach
Study of the factors in the process

Desire and Eradication

Smaller, Lighter, Lead time reduction, Cost reduction, etc.

Removal of the root cause

TRIZ Idea approach

Desire and Eradication
Case Study: Reducing the noise of the cooling fan to 20 dB or less

Why?

- **Projector** generates more than 20 dB noise during irradiation

- Because, **Housing System** can neither reduce the noise nor insulate

- Because, **Light Source System** can not send light efficiently to the optical switch

- Because, **Structural Parts** convey the vibration of the cooling fan to the housing

- Because, **Cooling Fan** conveys the vibration by stirring the air

- **Housing Case** has many holes
7. 7 Solutions (6) Making Strong Patent ①

Destroying the traditional constraints by Functional expression of desire

Attention to only the Function and Achieved level

Case study: Projector

- Lens wants to converge emitted light efficiently on the screen
- Actuator wants to move the lens at high speed in the axial direction
- Shutter wants to switch the light efficiently
- Light source wants to illuminate the light brightly to the optical system

Purpose, Desire

Projecting the electronic data clearly on the screen

TRIZ Example of Effects (Goldfire*)

* Invention Machine Corporation Innovation Support Software
Avoidance case by functional analysis of competitors' patent

Patent claim (Example)

撮像素子からレンズを通して得られる被検物の撮像を受像部に拡大表示する拡大表示装置において、撮像素子とレンズとの間の光路中にビームスプリッタを配して光路を撮像素子に、他方の光路に絞りを配し、感光部に、絞りに被検物を照明する照明光が入射されるように光源を配して成り、絞りの像が撮像素子の焦点位置と同位置に形成され、且つ照明範囲の大きさを撮像範囲と一致させるようにしたことを特徴とする拡大表示装置。

Step 1
Separate patent claims into $S+V+O$, and make Functional Model by using Goldfire*, and get many ideas by TRIZ.

Step 2
Search the disadvantages of the distinctive features by Goldfire*, and get many ideas by TRIZ.

For example, a basic patent of another company which consists of 48 claims is replaced by 4 patterns of Functional Model.

* Invention Machine Corporation
Innovation Support Software
7. 7 Solutions (8) Cost Reduction

Evaluating the cost of each function by the concept of VE in the customer’s point of view

\[ V = \frac{F}{C} \]

Value: \( V \) gets lower with the distance from the Basic functions:

- \( 1 > 2 \) or \( 3 > 4 \) or \( 5 \)

**C**: Cost of each functional element

Trimming by **TRIZ**: Value \( V \) is low

*Uncontrollable Factor*
Advantage of TRIZ to the interaction removal in experimental systems

Problem solving by TRIZ

Get ideas to improve the parallelism of 2 axes

Case of TM used directly

Design Parameter
- Parallelism of 2 axes
- Clearance between the gears
- The shape of the gears

Noise, Temperature, Load

Greater interaction between the two axes parallelism and gear shape

Optimal design TM

Design Parameter
- Clearance between the gears
- The shape of the gears

Optimal design can be reliable by using limited design parameters

Input power P

Output Power W

Input power P

Output Power W

7. 7 Solutions (9) Evaluation & Experiment
### Risk analysis by purpose

<table>
<thead>
<tr>
<th>Type of Human life priority</th>
<th>Product Improvement</th>
<th>New products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional part to handle the large energy And Design change part</td>
<td>Functional part to handle the large energy And Basic Function</td>
<td></td>
</tr>
<tr>
<td>Type of Quality priority</td>
<td>Important Function by the customer (Level up - Function) And Design change part</td>
<td>Important Function by the customer (Level up - Function) And Basic Function</td>
</tr>
</tbody>
</table>
7. 7 Solutions (11) Risk Prevention ②

Failure mode prediction by TRIZ (Reverse Thinking Method)

Reverse Thinking Method (TRIZ AFD*)
For example, the way to see the security system in the eyes of a thief

TRIZ AFD* Example
Using a Functional schematic for inhibiting the original function in Reverse Thinking Method

Mean function deployment to cause a failure

Stop the projection of electronic data to the screen

Lens does not condense the light on the screen

Actuator does not move the lens in the axial direction

Shutter does not switch the light

The light source does not irradiate light onto the optical system

Purpose

Means

* AFD (Anticipatory Failure Determination)
8. Summary

Summary

① In the promotion of scientific methods, the point of view of efficiency and time for engineers is important. And, providing solutions is effective for them to encourage the learning of scientific methods.

② For connecting smoothly between solutions and methods, the concept of customer thinking and objective thinking is important with a focus on the function of the system.

③ In 7 solutions, the range of TRIZ application spreads by using Type of fulfilling the desire and Type of eradicating the problem for each purpose.

Next challenge

In promoting the solution, it is a challenge how we systematically hand our knowledge and know-how on to promoters in our company.
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Thank you for your attention