For Establishing A General Methodology of Creative Problem-Solving / Task-Achieving

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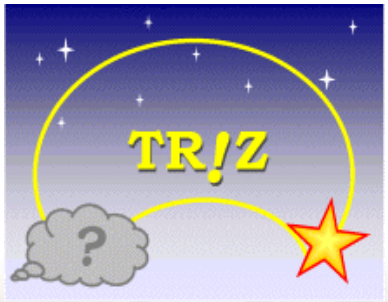


Introduction:

Part I. Why a new target?

How TRIZ can be learned and mastered widely?

To whom and where TRIZ wants to go?

Do people want TRIZ? or what?

Part II. How can we evolve from TRIZ to the new target?

TRIZ -- reconsider the Four-Box Scheme

USIT -- Unified concepts and Six-Box Scheme

General methodology for creative problem solving

Part I: Why a new target?
- General methodology for creative problem solving

Motivation: Why the creative problem solving method, TRIZ, does not penetrate more smoothly among people?

I build up a number of models to consider this problem.

Model of a person to learn TRIZ

Model of an engineer and an industry to learn and accept TRIZ

Model of activities of TRIZ promoters (in Japan)

Model of areas where the application of TRIZ is desired

==> People in the wide range of application areas of TRIZ want not TRIZ itself but more general methodology effective for creative problem solving

Model (a) of a person to learn and master a technique like TRIZ

Advanced Science & technology

General Technological Information

Industry information

Society & Culture

Advanced Technological development

Practice in industries

Specialized/ Engineer education

University education

Liberal arts education

High school / middle school Education

Elementary school Education

Family education

Common understan... in the society

(Common sense)

Examination Study

A Person

(creative engineer)

(engineer)

(student)

(high school student)

(pupil)

(young child)

Real tasks of development

Methods of creative problem solving

TRIZ

Knowledge and Technique in specialty field

Methods of R&D and Industrial activities

Consciousness for creativity

Spirit as researcher / engineer

Necessary to train Creative thinking

Basics of science & technology

Logical thinking

Establishment of proactiveness

Basic Mathematics and science

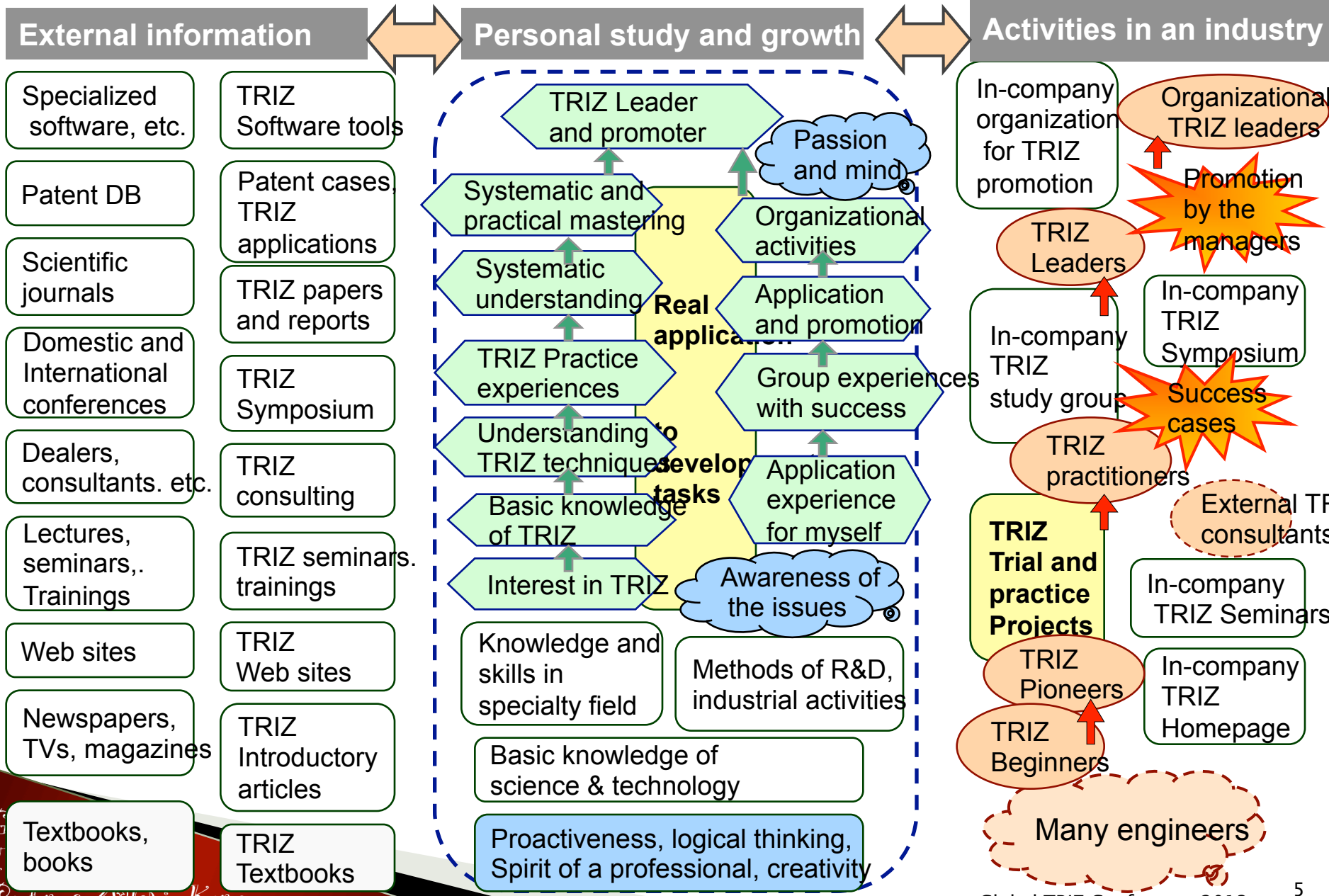
Suppressed, undeveloped creativity

Interests in nature and technology

Creativity in the childhood

Intellectual curiosity

Model (b) of activities for an engineer and a company to learn and master TRIZ



Model (c) of overall activities of TRIZ promoters in Japan (Merged)

"TRIZ Home Page in Japan"

Editor

"TRIZ Home Page in Japan"

- Papers, articles
- Conference Reports
- English pages
- Overseas papers
- Links, References
- Update announcements

Japan TRIZ Society

- Board Members
- Management Members
- Secretariat
- Information exchange/sharing
- JTS members
- Executiing teams
- TRIZ Symposium
- Study groups
- Seminars
- JTS HP (Symposium papers)
- News letters]

User companies

- In-company organization for TRIZ promotion
- Organizational TRIZ leaders
- Promotion by the managers
- TRIZ Leaders
- In-company TRIZ Symposium
- In-company TRIZ study group
- Success cases
- TRIZ practitoners
- External TRIZ consultants
- TRIZ Trial and practice Projects
- In-company TRIZ Seminars
- TRIZ Pioneers
- In-company TRIZ Homepage
- TRIZ Beginners
- Many engineers

Hitachi | Panasonic | Sony | Toshiba | Pioneer | ····

Overseas TRIZ information

- Specialized software, etc.
- Patent DB
- Scientific journals
- Domestic and International conferences
- Dealers, consultants. etc.
- Lectures, seminars,. Trainings
- Web sites
- Newspapers TVs, magazines
- Textbooks, books

Publishers, Journalism

Nikkei BP

Academia and conferences

Conferences

Mechanical Engineering Society

Creativity Society

VE Association

Universities

Waseda Univ.

Kanagawa I. T.

Univ. of Tokyo

Venders, Consultants

SANNO | SKI | IDEA | Ideation

Cyber Net | IMC | Individual consu

Study groups (voluntary)

VE Society TRIZ Study Group

MPUF USIT/TRIZ Study Group

Management and decision making

Events of presentations and discussions

Making cases of TRIZ application and promotion

TRIZ promotion

Establishing TRIZ

Communications, idea exchange

TRIZ research

Development of methods

In-company organizations for TRIZ promotion

TRIZ education

Development of software tools

Development of knowledge bases

Presentations at conferences

Lectures and seminars

Consulting

Success cases of product/service development with TRIZ

Journalism

International information

Training courses

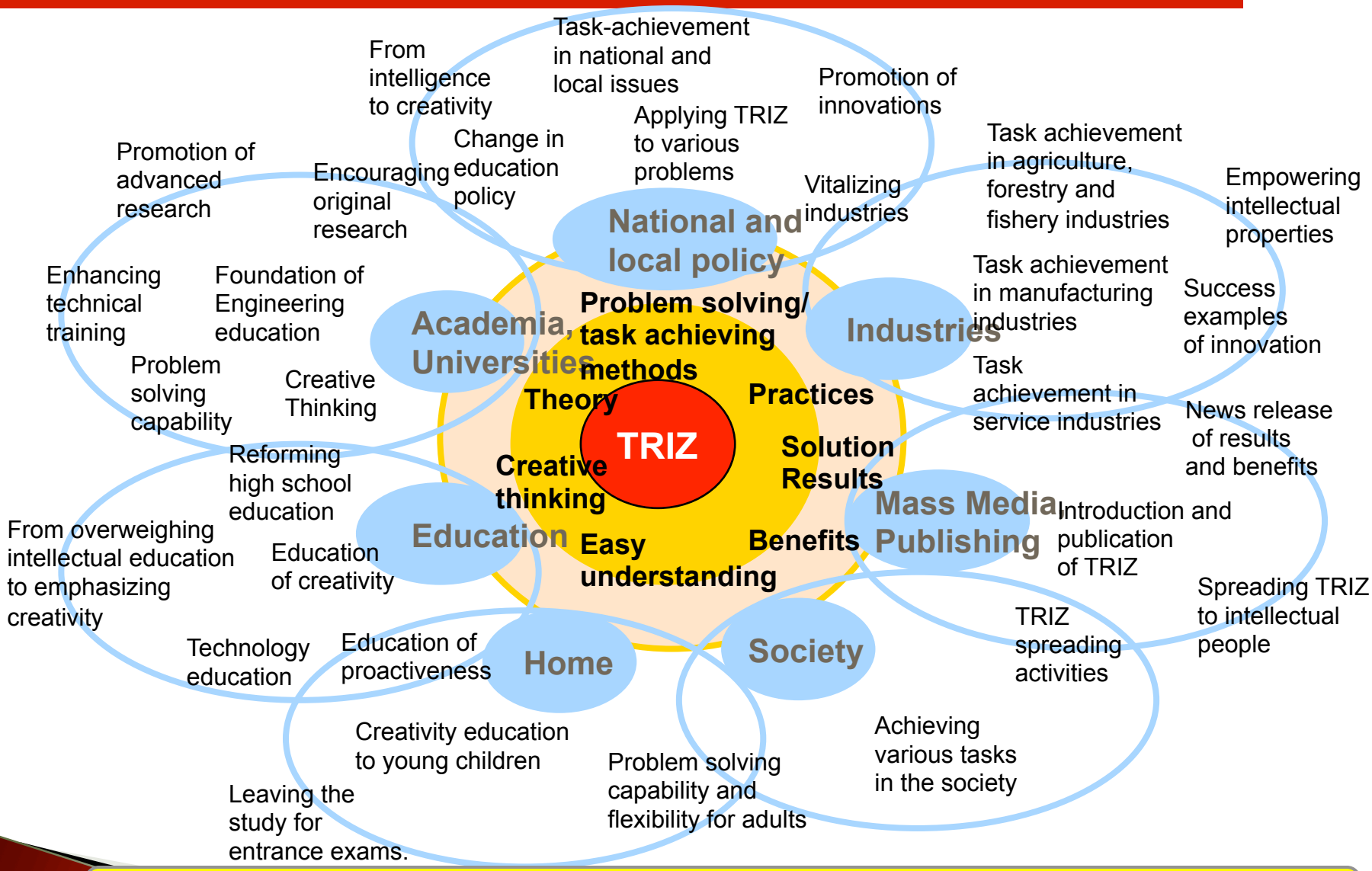
Reporting, news release

Web information

Introductory articles

Textbooks

Model (d) of areas for TRIZ application ➔ Our new general target



We put TRIZ in the center. But we need a more general method !

The models have guided us to a new target at a higher level.

General Target :

To establish a methodology of
creative problem-solving / task-achieving,

to spread it widely, and

to apply it
to problem-solving and task-achieving jobs
in various domains
in the whole country (and the world)".

Part II. How can we evolve from TRIZ to the new target?

Various approaches to creative problem solving

Basic paradigm in science and technology:
Four-Box Scheme of abstraction

TRIZ -- Knowledge bases and techniques across the fields

USIT (Unified Structured Inventive Thinking)
-- Unified concepts and Six-Box Scheme

General methodology for creative problem solving

Various conventional approaches/methods for Creative Problem Solving & Task Achieving:

(a) **Basic approach in science & technology**: Principles, theories, application & design methods in each discipline.

(b) **Approaches learning from cases**: Building and using case bases and knowledge bases

(c) **Approaches to analyze the problems and tasks:** Cause-effect, system, mechanism,

(d) **Approaches to support idea generation**: generating as widely and as freely as possible,

(e) **Approaches to arrange environment and take care of mental aspects:**

relaxed feeling, free atmosphere, thinking the ideals, etc.

(f) **Approaches for realizing the idea:** Selecting good ideas, designing & development, implementation, etc.: technologies in the discipline.

(g) **Approaches for thinking the future and suggesting the directions:**

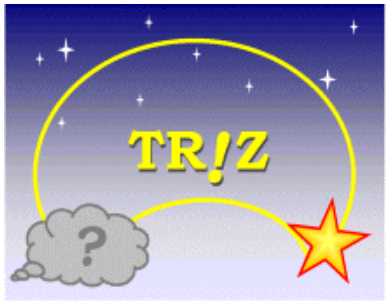
(h) Approaches towards general methodologies for problem solving:

Integrating all the approaches above to build a methodology useful and practical.

A system of methods suitable for each type/field of problems and tasks, and also a system of methods universally applicable to a wide range of types and fields.

TRIZ Methodology for Problem Solving

Toru Nakagawa
Nov. 1997



"TRIZ Home Page in Japan"
Since Nov. 1998
Editor: T. Nakagawa

World of Information in Science & Technology

Science & Technology DB

Set ups → Effects

Patents DB

Problem → Solution

World Extracted by TRIZ

Inverse retrieval of technology

Trends of Systems

Target → Method, Method, ...

solving contradictions

Contra-diction → Principles of Invention

Principles & Examples of Invention

Support of Problem Definition

World of Your Own Problem

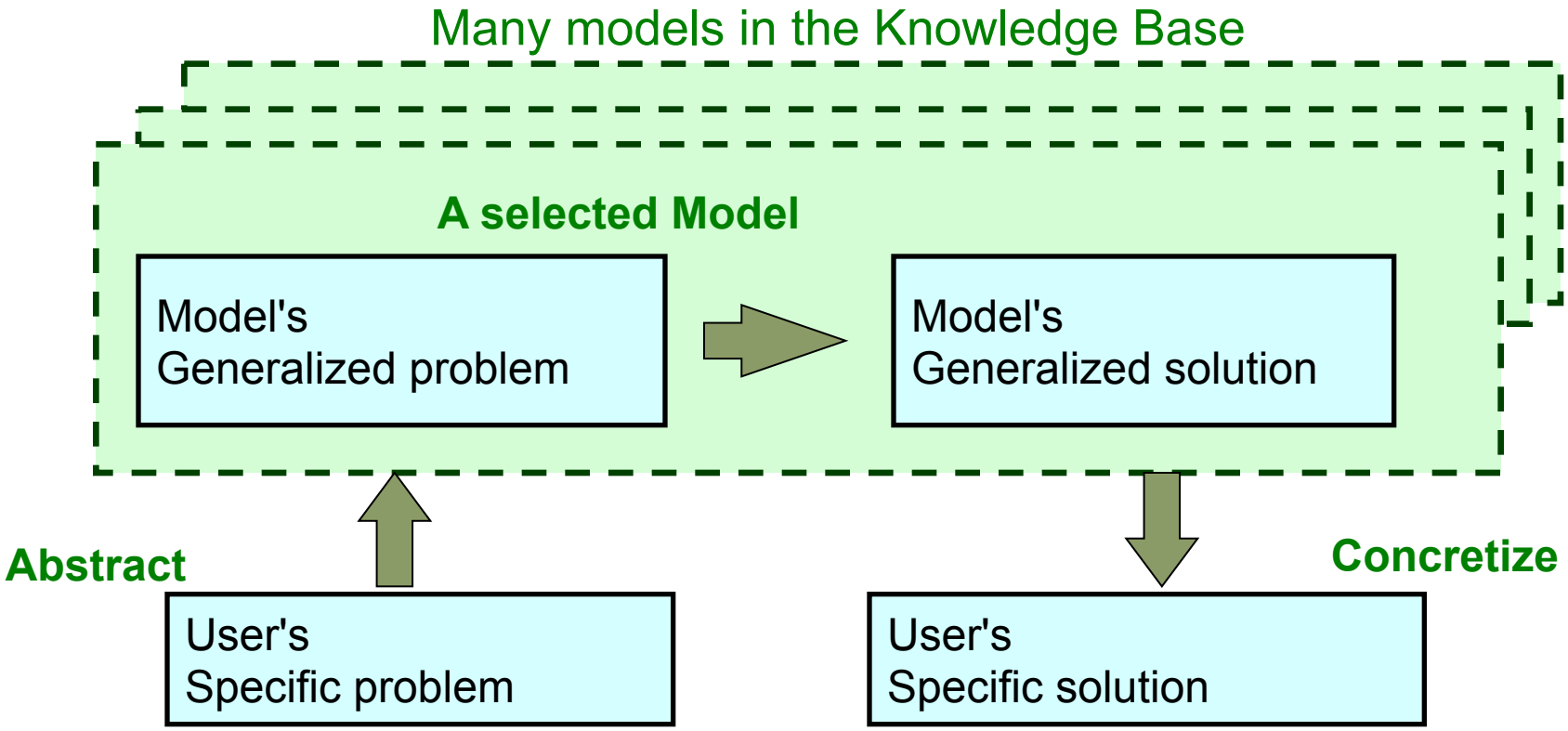
Description of Your Own Problem

Solution for Your Own Problem

Basic scheme for Problem Solving (Conventional: "Four-Box Scheme)

Science & Technologies (Many models, specialized in areas)

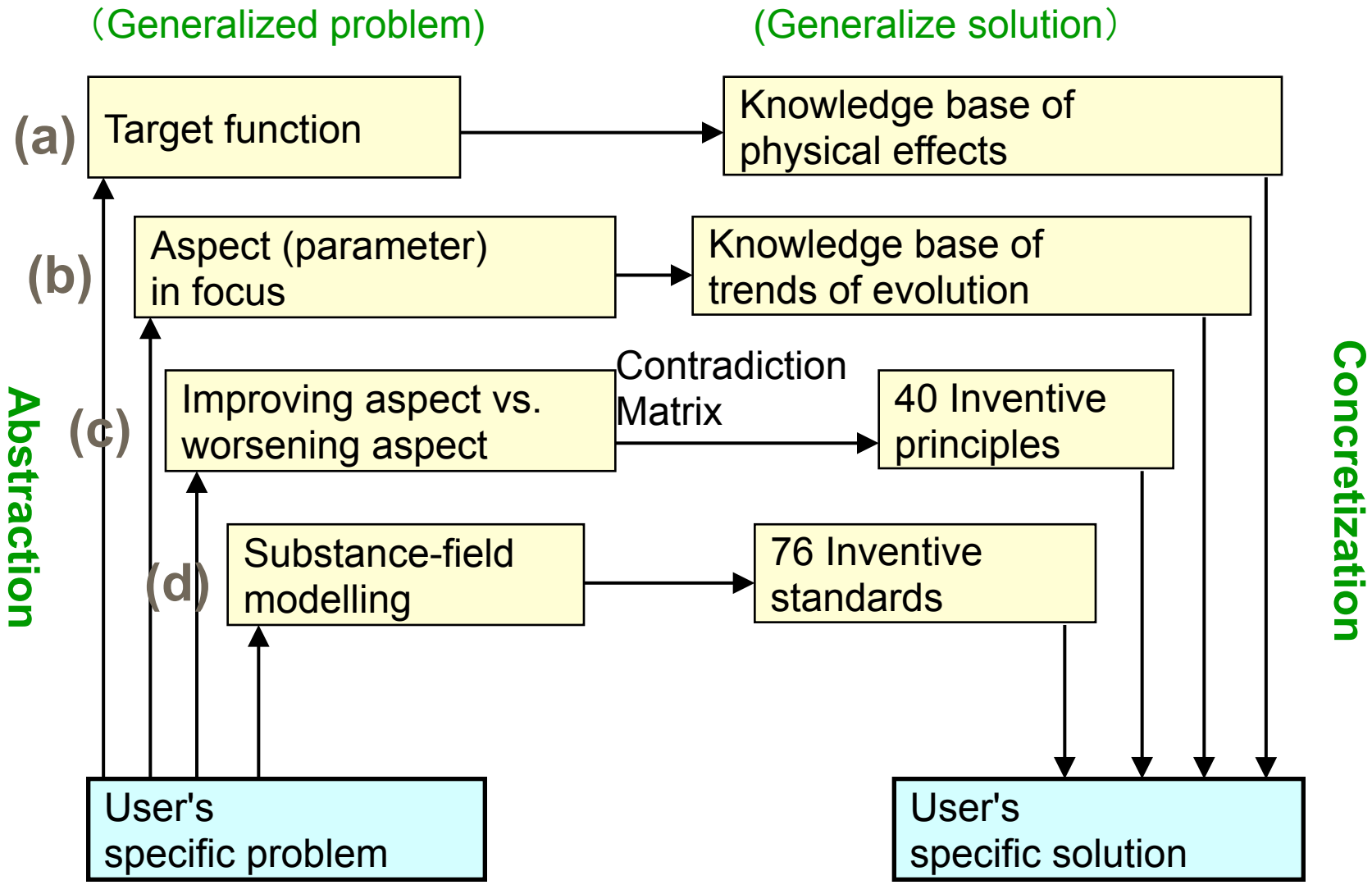
==> (Traditional) TRIZ (**Across areas**, but many separate tools)



Problem is analyzed in an aspect and mapped onto a model.

⇨ Partial and insufficient analysis.

Tools of TRIZ (Based on the Four-Box Scheme)



Essence: Many tools and huge knowledge bases are applicable across technical fields.

But parallel structure of multiple tools = partialness in each method

Essence of TRIZ in 50 Words

Toru Nakagawa
TRIZCON2001, Mar. 25-27, 2001

Essence of TRIZ:

Recognition that

technical systems evolve

towards the increase of ideality

by overcoming contradictions

mostly with minimal introduction of resources.

Thus, for creative problem solving,

TRIZ provides with a dialectic way of thinking,

i.e.,

to understand the problem as a system,

to make an image of the ideal solution first, and

to solve contradictions.

TRIZ is huge and complex, people often say, but its essence is easy to learn and understand.

USIT (Unified Structured Inventive Thinking):

Developed by Ed Sickafus (USA) in 1995 under the influence of TRIZ.

It has a straightforward process with unified concepts and methods.

Problem Definition

Define the Problem
(in a Well-defined Form)

Problem Analysis

Analysis of the Present System
(Function and Attribute Analysis)
(Space and Time Characteristics Analysis)

Make Images of Ideal System
(Particles Method)
(Desirable Actions and Properties)

Solution Generation

Generate Ideas for solutions
(5 solution methods)

Build Up Conceptual Solutions

(After USIT)

(Implement into Real Solutions)

"USIT Oprators": A system of solution generaton methods

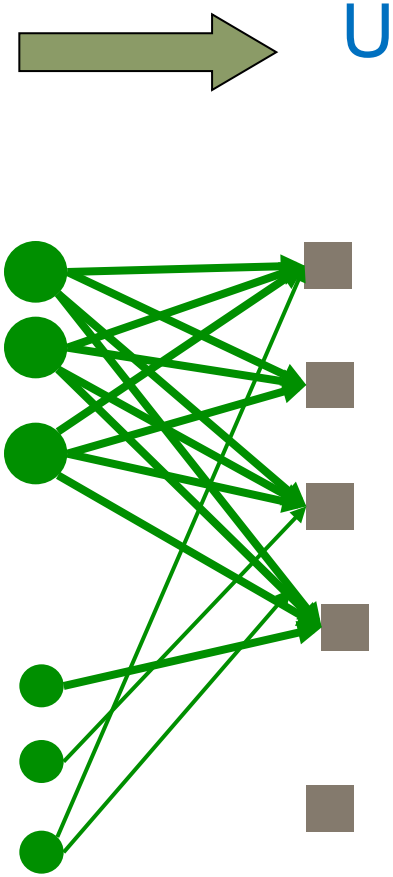
-- Obtained by re-organizing all the solution methods in TRIZ

T. Nakagawa, H. Kosha, and Y. Mihara (ETRIA 2002)

TRIZ methods for Solution Generation

40 Inventive Principles
76 Inventive Standards
35 Trends of System Evolution

Separation Principle
Self-X Principle
Trimming



USIT Operators

(5 Main-, 32 sub-methods)

Object Pluralization
Attribute Dimensionality
Function Distribution
Solution Combination
Solution Generalization

USIT Operators are further classified in a hierarchical way.

An example of USIT Operator sub-method

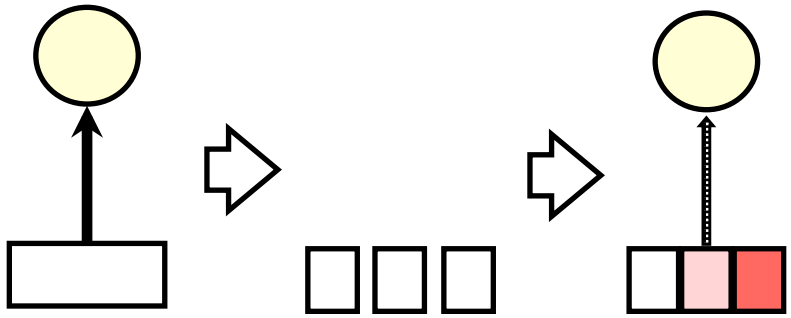
(1) Object Pluralization Method

(1c) Divide the Object (into 1/2, 1/3, ..., 1/∞).

Divide the Object into multiple parts (1/2, 1/3, ..., 1/∞),
modify the parts (slightly,
or differently for different parts),
and combine them for using together in the system.

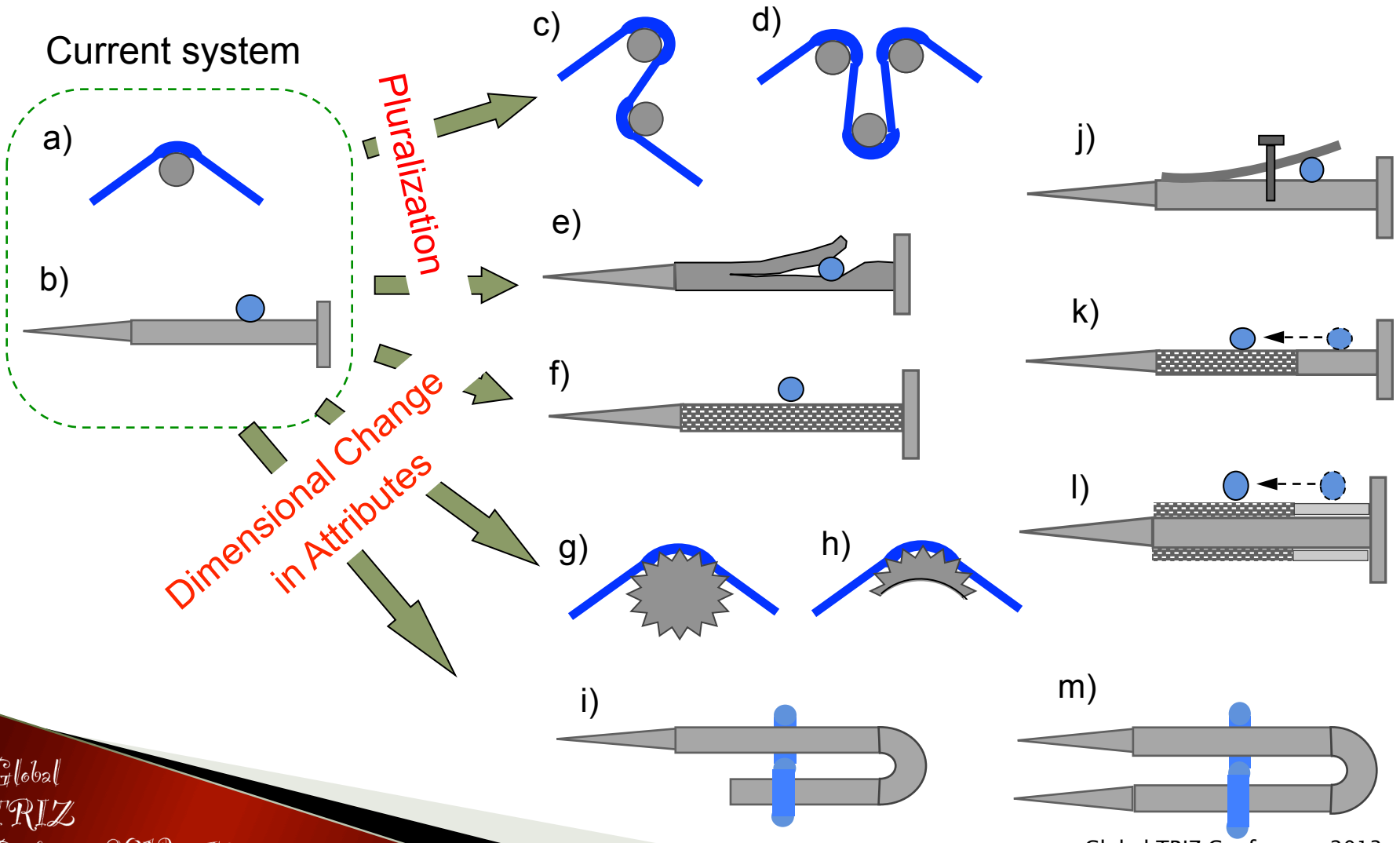
TRIZ Inventive Principles
which brought this sub-method:

- P1. Segmentation
- P2. Taking away
- P3. Local quality
- P15. Dynamicity



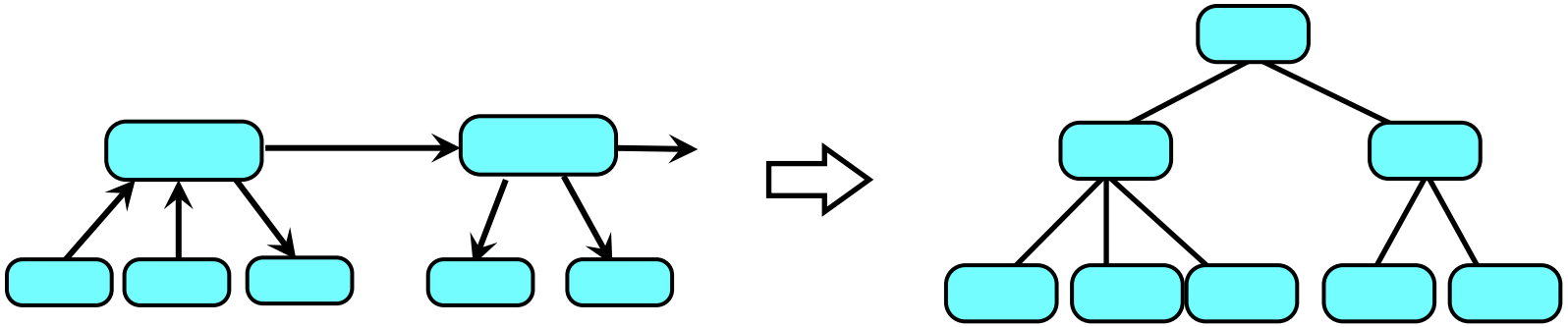
Examples of Application of USIT Operators: (Part)

Picture Hanging Kit Problem. USIT Operators are applied to the nail.



(5) Solution Generalization Method in USIT

Represent a solution in a more general way,
form a solution template, and
obtain concepts of solutions
in the associative manner.
Also generate a hierarchical system of solutions.



USIT (i.e., a simple and unified TRIZ)
analyzes any problem in a standard process and
generates solutions systematically and comprehensively.

USIT Example: Solving Familiar Problems:

Skip

T. Shimoda and T. Nakagawa (2006)

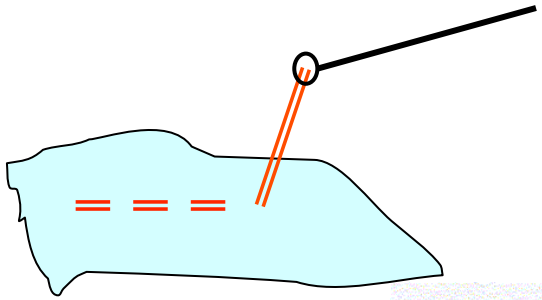
How to fix a string shorter than the needle at the end of sewing

Problem Definition:

(a) Undesirable effect: The string is shorter than the needle and prohibit applying the standard way of making a knot.

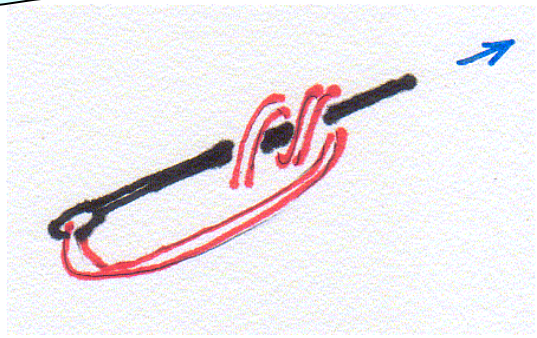
(b) Task statement: Devise methods for fixing the string left shorter than the needle.

(c) Sketch:



(d) Plausible root causes:

The standard way of making a knot is applicable only when the string left is longer than the needle.



(e) Minimum set of relevant objects:

Cloths, string (already sewn), string (left), the needle

Problem Analysis (1): Understanding the present system

Skip

(1) Functional analysis: What is the function of the Needle?

A base for making a loop of the string;

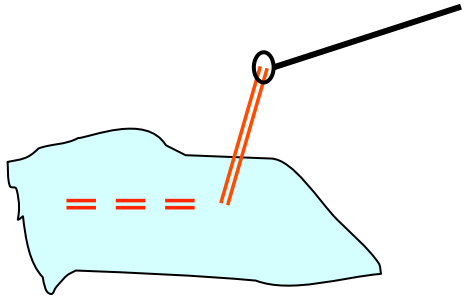
A guide for passing the end of the string through the loop

(2) Attribute analysis: Properties taken for granted form the Constraints:

The string does not expand = Its length does not change.

The needle is hard = No change in shape and length.

When any of these constraints is lifted,
there appears a novel solution.



(3) Analysis of time characteristics: Processes of sewing:

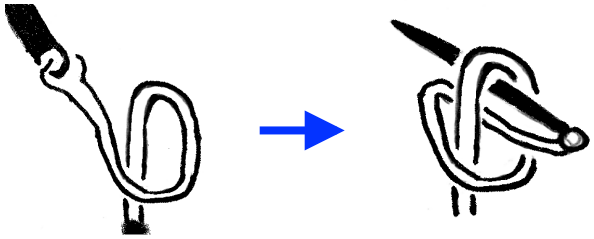
Solutions at the final stage and solutions at any earlier stage.

(4) Analysis of space characteristics: A knot makes the string thick at the end.

Watch out about the topology in making a knot and in the 'hole and string'.

Skip

Several known solutions:



A well-known technique.
Difficult to make the loop of string in the space; need some practices

The hole of the needle has a slit, thus the string can be passed and removed without cutting the loop of the string. (a commercial product)

Problem Analysis (2) : Understanding the Ideal system

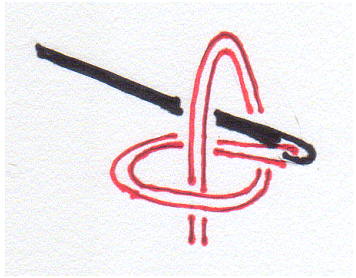
Ideal arrangement of a sting in space for making a knot

It should be nice if we could hold the string in this arrangement in the space.

Solution Generation:
Generate Ideas and Construct Solutions

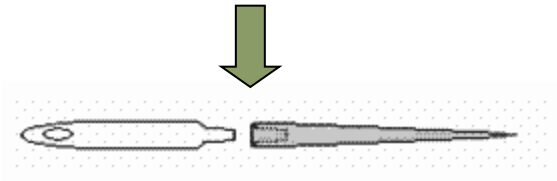
Skip

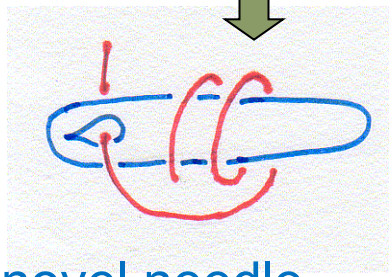
A ridiculous idea : 'Break the needle!!'



Known technique

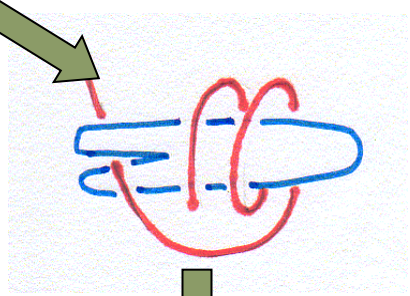
Image of
Ideal situation



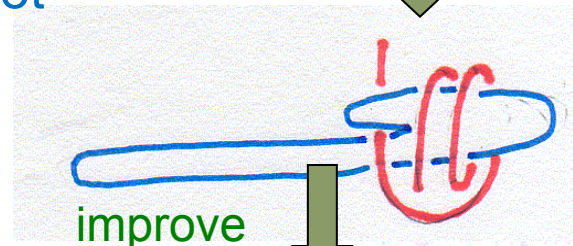


A novel needle
specialized for
making a knot

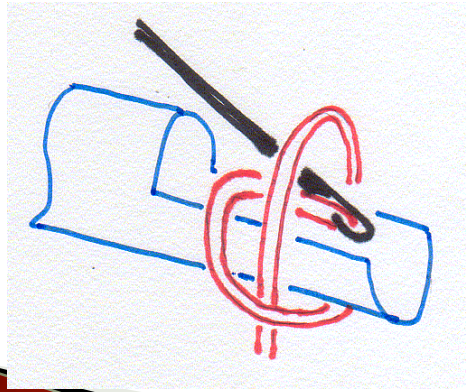
improve



improve



improve



A novel tool
made of a straw

USIT Training: In-company and open trainings

- USIT is much easier to learn than (conventional) TRIZ.
- USIT fits well for group work.
- USIT is applicable to real problems for conceptual solutions.
- Use TRIZ knowledge base tools in a complementary way.

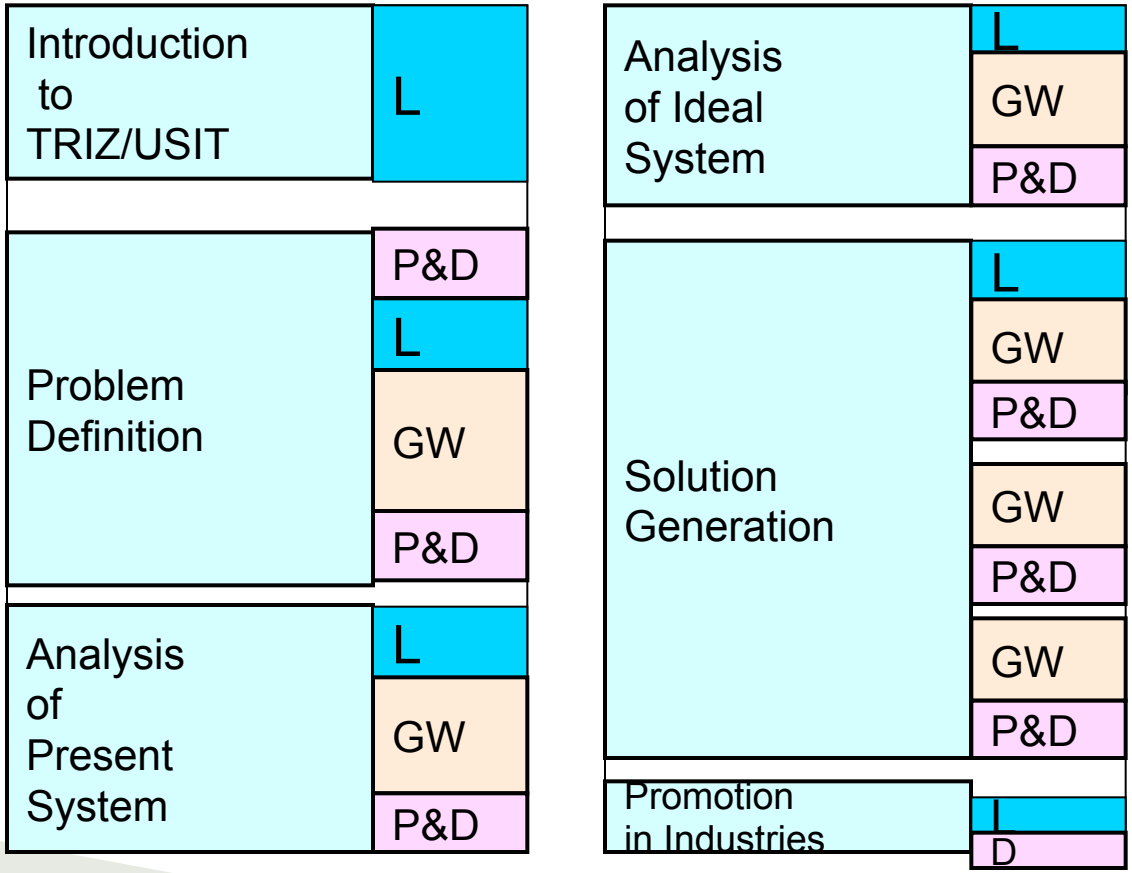
2-Day USIT
Training Seminar

3 real, brought-in problems
are solved in parallel
in the group work

L — Lecture

GW — Group work

P&D — Presentation & Discussion

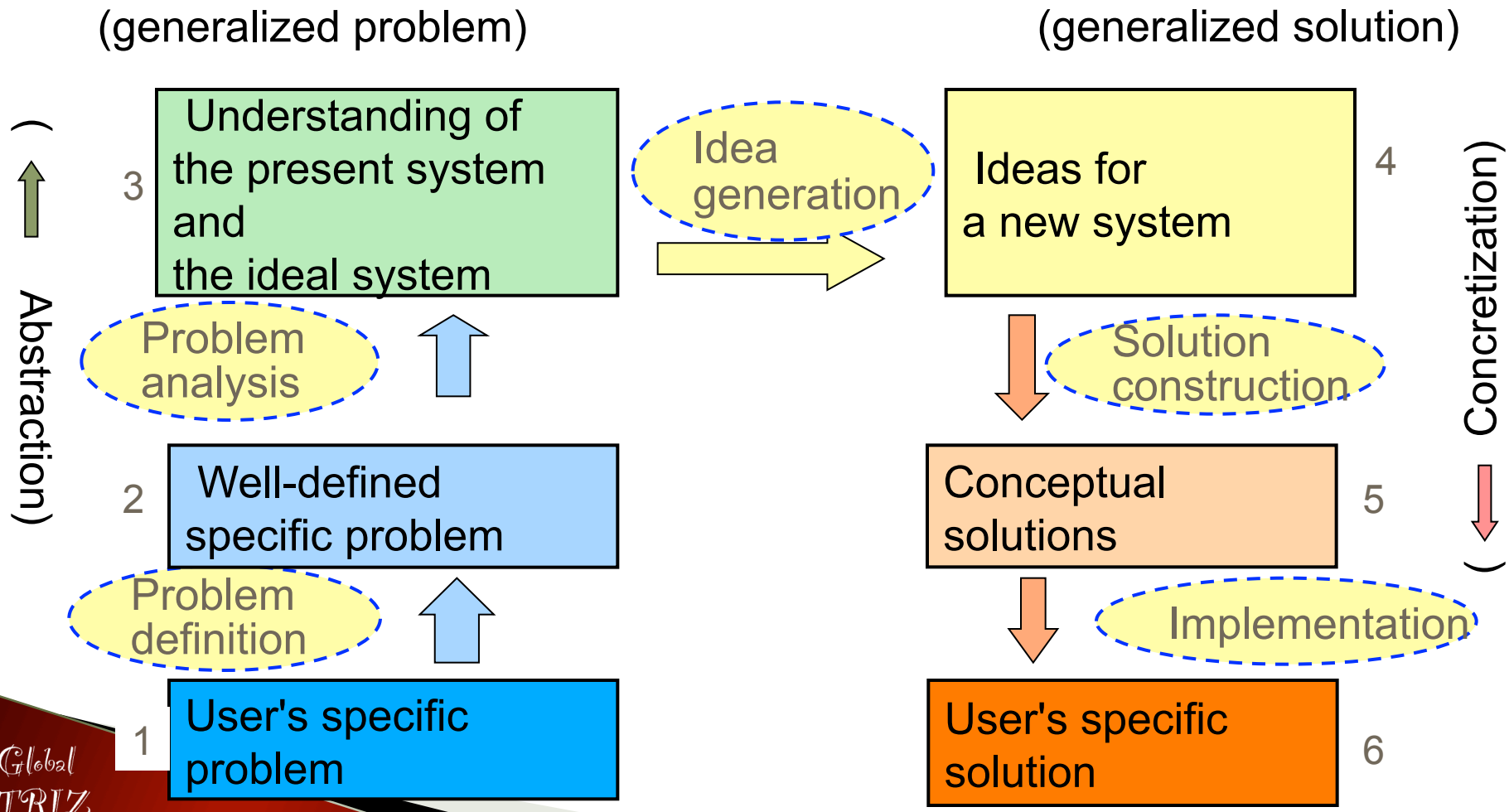


Six-Box Scheme of USIT:

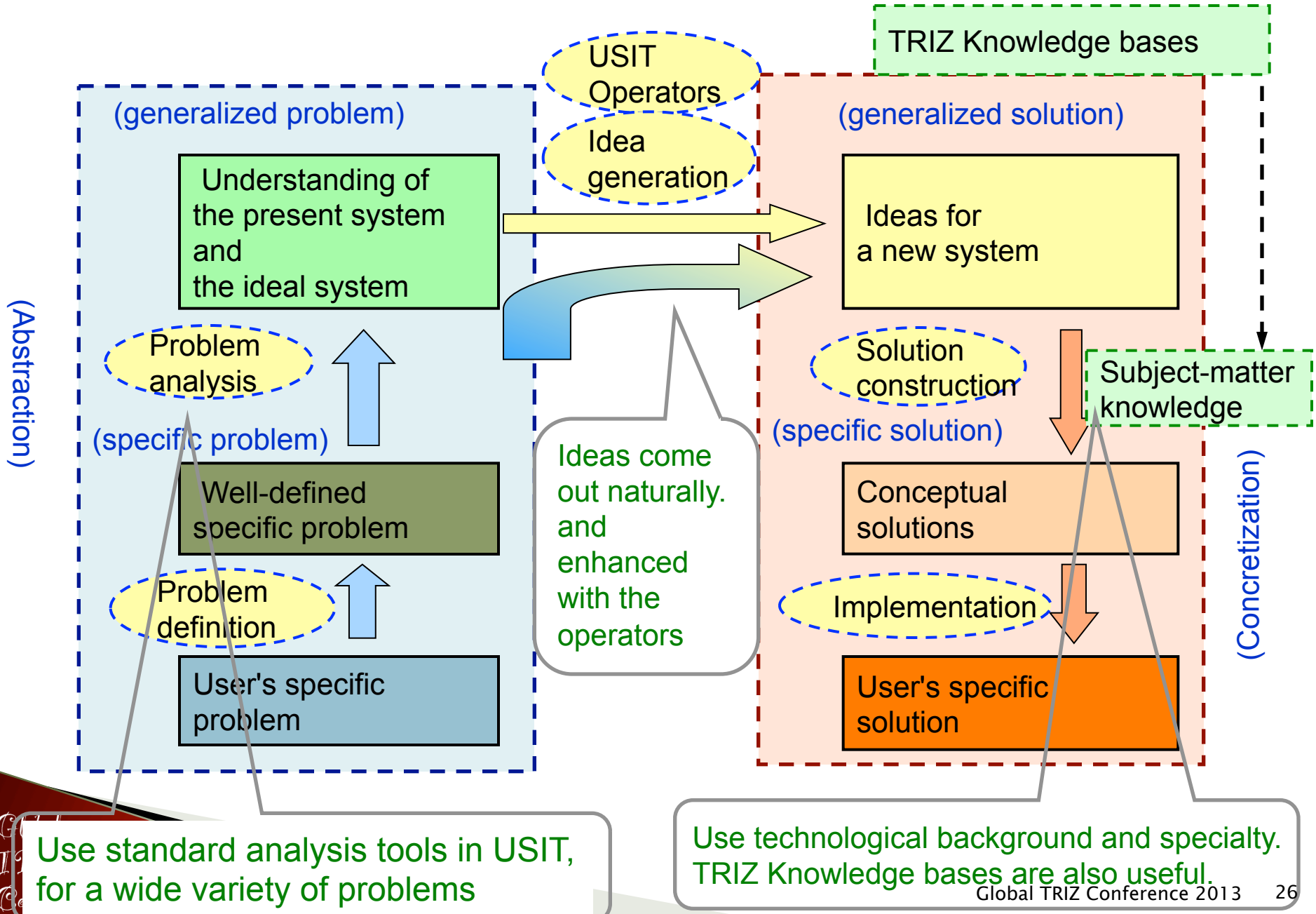
New Paradigm for Creative Problem Solving

Toru Nakagawa (2005)

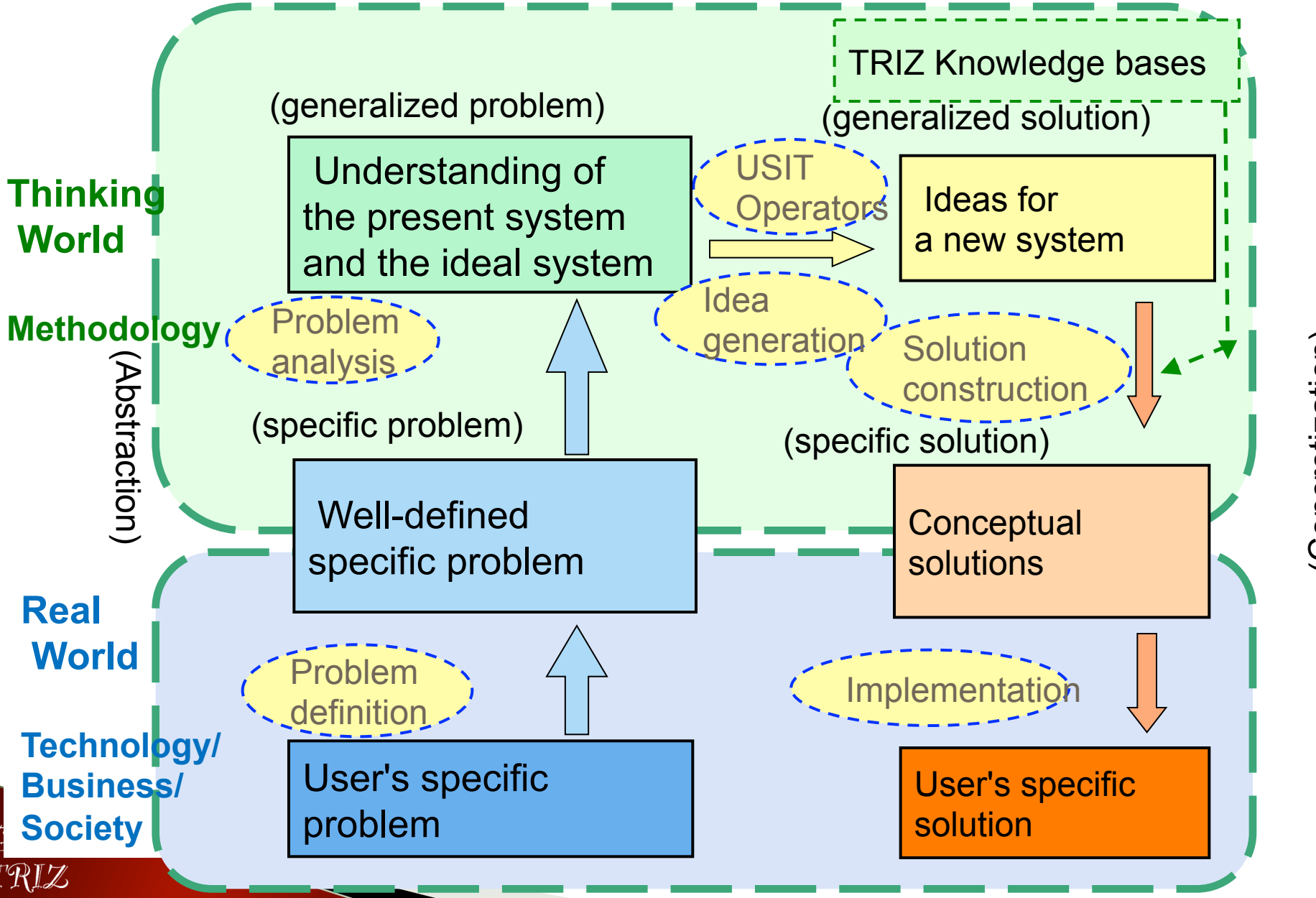
A unified method across the fields



6-Box Scheme of Creative Problem Solving (USIT)



6-Box Scheme of Creative Problem Solving (USIT)



General Methodology of Creative Problem-Solving (Outline)

For technological problems

(0) Whole procedure

(1) Finding the problem

(2) Understanding the present system

(3) Imaging the ideals

(4) Generating ideas

(5) Constructing solutions

For non-technological problems

(0) Whole procedure

(1) Finding the problem

(2) Understanding the present system

(3) Imaging the ideals & visions

(4) Generating ideas

(5) Constructing solutions

Further extension of TRIZ
guided by the new paradigm of the 6-Box Scheme of USIT

General method for creative problem-solving/task-achieving (for technology)

Whole procedure

- Consistent whole procedure
- Simple/specialized processes

Finding the problem

- Understanding the problem systematically
- Consider the goals and tasks
- Consider from broad perspectives
- Focusing the problem

Understanding the present system

- understanding difficulties and root causes
- Understanding the mechanism of the present system
- Functions & attributes
- space & time characteristics
- Clarifying contradictions
- Examine various present solutions
- Learn similar tasks in different fields

Imaging the ideals

- Thinking the images of the ideals
- Desirable behaviors & properties
- Consider the direction of evolution

Generating ideas

- Techniques of idea generation
- Collection of possible hints
- Resolve contradictions
- Generate ideas as widely as possible
- Identifying excellent ideas

Constructing solutions

- Extending the ideas
- Improving solutions with the ideas
- Designing new solutions
- Introducing good ideas used in different fields
- Solving secondary problems
- Identifying and evaluating excellent solutions

General method for creative problem-solving/task-achieving (for technology)

Requirements at the preceding stage

- Applicable widely to science & technology
  - Mechanical, electrical/electronic, chemical, etc.
  - biological, medical, etc.
- Using effectively the whole information in science & technology
  - Implementing the S & T information in the method.
- Effectively using patent information
- Possible to use concepts, theories, and methods in the subject-matter fields.
- Use the method of system analysis in the subject-matter field.

Whole procedure

- **Finding the problem**
  - Clear relationships with methods for technology development
- **Understanding the present system**
  - Able to find and understand the problem in the real world
- **Imaging the ideals**
  - Able to focus down the problem and clarify the task.
- **Generating ideas**
  - Able to refer to S & T information whenever necessary
- **Constructing solutions**

Introductory articles & materials	Easy-to-understand methods.
Textbooks of the methods	Practical application methods
Application examples	Chances to learn
Software tools & knowledge bases	Chances of training

Requirements at the succeeding stage

- Able to construct solutions
- Able to use designing techniques in the subject-matter field
- Able to implement the solutions
- Coordinated with methods for implementing solutions (CAD/CAE/CAM, Taguchi method, etc...
- Able to evaluate the solutions in the real world
- Coordinated with industrial and company infrastructure, e.g., designing, manufacturing, and sales

General method for creative problem-solving/task-achieving (for non-technology fields) (e.g., humans, society, business)

Whole procedure

- Consistent whole procedure
- Simple/specialized processes

Finding the problem

- Understanding the problem systematically
- Consider the goals, tasks, and visions
- From multiple perspectives
- Focus the problem
- Consider in steps

Understanding the present system

- understanding difficulties and root causes
- Understanding the mechanism of the present system
- Functions & properties of organizations & persons
- space & time character-istics
- Clarifying contra-dictions
- Examine preceding cases
- Learn similar tasks in different countries, companies, and fields

Imaging ideals & visions

- Thinking the images of ideals
- Stating the vision
- Consider the directions & steps of evolution

Generating ideas

- Techniques of idea generation
- Collection of possible hints
- Resolve conflicts & contradictions
- List up the ideas as widely as possible
- Identifying excellent ideas

Constructing solutions

- Extending the ideas
- Improving solutions with the ideas
- Designing new solutions
- Introducing good ideas in different countries and fields
- Solving secondary problems
- Identifying and evaluating excellent solutions

Areas where our 'Creative Problem Solving Methods' are wanted.

Stage 3 in our general target: To apply widely

Emphasis area → Development area

Creative PS / TA method

Things we need to provide

- Problem solving/ task achieving methods
- Theory
- Creative thinking
- Easy. understanding
- Practices
- Solution Results
- Benefits

(various areas of problems/tasks to apply)

Academia, Universities	**Creative Thinking**	**Problem solving capability**	**Foundation of Engineering education**	Enhancing technical training	Encouraging original research	Promotion of advanced research
Education	**Education of creativity**	Technology education	Reforming high school education	From overweighing intellectual education to emphasizing creativity		
Home	Education of proactiveness	Creativity education to young children	Leaving the study for entrance exams.			
Society	**Problem solving capability and flexibility for adults**	**Achieving various tasks in the society**				
Mass media, Publishing	**Introduction & publication of TRIZ**	**TRIZ spreading activities**	Spreading TRIZ to intellectual people	News release of results and benefits		
Industries	**Task achievement in manufacturing industries**	Empowering intellectual properties	**in agriculture, forestry and fishery industries**	**in service industries**	Success examples of innovation	
National & local policy	Change in education policy	From intelligence to creativity	**Applying TRIZ to various problems**	Task achievement in national and local issues	Vitalizing industries	Promotion of innovations

Note: Actually, we should find and get specific opportunities to try and apply the Creative PS/TA methods. Development of the method and extension of application area should be carried out in parallel. .

Concluding Remarks

(1) For understanding the difficulty in penetrating TRZ widely, the situations have been investigated by building **multiple models.**

(2) Recognizing **'TRIZ is just one of many items** for a person to study', the contents of TRIZ should be either
well customized for the (narrow range of) target persons
or **well generalized** for the (wider range of) target persons.

(3) Individual persons can learn TRIZ from outside information and promotion, but **mainly from his/her personal learning and experiences.**

(4) For an industry to accept TRIZ, personal growth of TRIZ practitioners/ leaders, application of TRIZ to real projects, and promotion by the management need to go together.

(5) TRIZ is applicable in the technological as well as non-technological areas. Thus TRIZ has a very wide range of application areas.
However, not TRIZ itself but a more general methodology is wanted there.
Thus we have been guided to a new target at a higher level.

(6) **'General methodology of creative problem solving'** is expected to be a further extension of TRIZ, especially guided by the Six-Box Scheme of USIT.

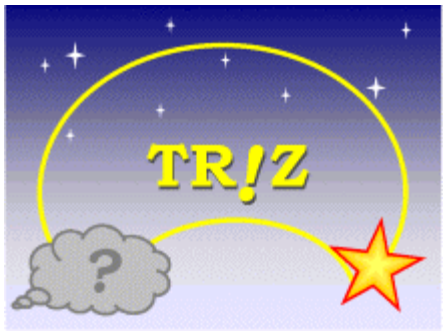
(7) In the technology fields, it is under construction with TRIZ/USIT in its framework and components. Various methods and processes need to be associated and integrated.

Significance of the vision need to be understood widely. Effective in technological innovation and creative research & education.

(8) In the non-technology fields, it is similar to the one in technology in its framework and basic tools.

However, problems are often bigger, more complex, and delicate. Mental aspects of stakeholders have bigger weight than tools. Various methods **need to be developed more clearly.**

(9) Realizing the higher level target, we will be able to **choose correct directions** in our application, development, and promotion activities.



Thank you for your attention

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