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Six-Box Scheme: New Paradigm for Creative Problem Solving

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The Society of Systematic Innovation
Institute of Systematic Innovation, HK
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IELM Making Smart Decisions

Introduction:

Solving problems (or undesirables) creatively and
Achieving tasks (or desirables) creatively

have been tried, practiced, and carried out successfully

for the humans to establish the culture for millions of years
in every area (e.g., society, business, technology, science, etc.)
in every era and in every region of the world.

However, the processes and methods which produced successful results

were widely diverse and not well recognized and recorded.

We should collect and integrate such successful methods
and form a general and yet effective methodology, named

'the General Methodology for Creative Problem-Solving/ Task-Achieving'. (CrePS)

For this purpose, we need some basic framework (i.e., paradigm)

-- We can use **'Six-Box Scheme'**.

Outline: 4 Stages of Recent Development of Methodologies of Creative Problem Solving

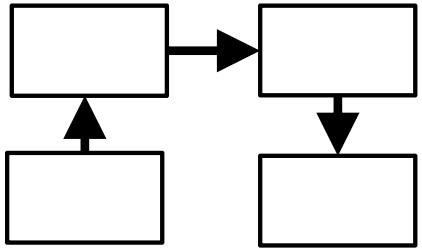
Stage 1: Current conventional understanding

Paradigm of Science & Technology

- 'Four-Box Scheme of Abstraction'
- Theories and models in specific disciplines

+ Various 'Creativity methods'

- Seeking for 'Hints' and 'Shortcuts'



Stage 2: TRIZ (Theory of Inventive Problem Solving) [Genrikh Altshuller]

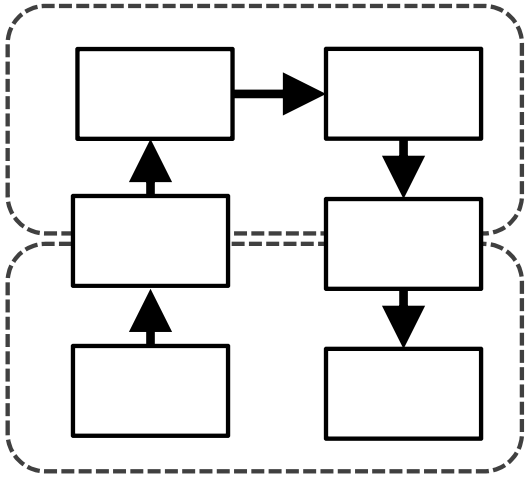
- Knowledge bases of science & technology applicable across various fields
- Thinking methods, especially for solving contradictions.
- 'Four-Box Scheme' of multiple tools
- Complex overall process.

Outline: 4 Stages of Recent Development of Methodologies of Creative Problem Solving

Stage 3: USIT (Unified Structured Inventive Thinking) [Ed Sickafus => TN]

- A concise whole process of creative problem solving
- 'Easy-to-learn TRIZ' （Reorganizing TRIZ solution generation methods)
- Finding 'Six-Box Scheme' as the new paradigm

Stage 4: CrePS (General Methodology of Creative Problem Solving) [Toru Nakagawa]



- **'Six-Box Scheme'** as the paradigm
- Different roles of 'Real World' and 'Thinking World'
- Clear definition of stages:

  Defining the problem; analyzing the problem (understanding the present system and the ideal system); generating ideas; constructing conceptual solutions; and implementing into real solutions
- Framework for integrating different methods around TRIZ/USIT
- USIT is a concise process executing the CrePS methodology

Current status of research on CrePS/TRIZ/USIT:

'General Methodology for Creative Problem-Solving/Task-Achieving' (CrePS)

CrePS is feasible with the Paradigm of the 'Six-Box Scheme'.

Different methods (including TRIZ) can be **reorganized into CrePS**.

USIT is a concise process for applying the Six-Box Scheme of CrePS.

On-going research activities for developing CrePS:

(1) To make **course materials of CrePS case studies**.
We should just use case studies already published.

(2) To understand **different methods (including TRIZ)**
and to describe them in the framework of CrePS.

(3) To relate CrePS to **various activities in the 'Real world'.**

(4) To categorize various purposes of CrePS application,
and to **recommend concise CrePS processes** for each category.

(5) To **proliferate the vision of CrePS**.

Methodologies of Creative Problem Solving

Stage 1:

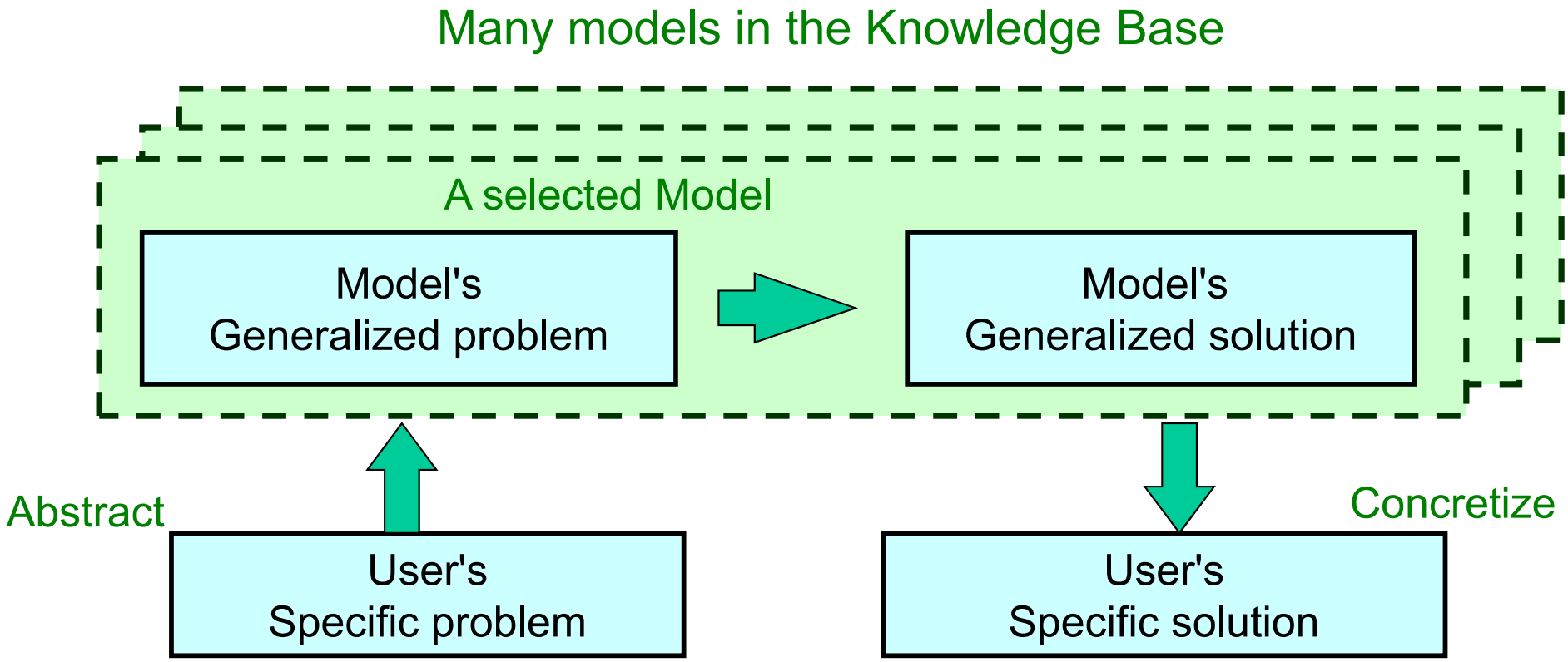
Current conventional understanding:

Paradigm in science and technology

+

Various 'Creativity methods'

Conventional Paradigm in Science & Technology for Creative Problem Solving = Four-Box Scheme of abstraction



Many models in different fields (theories and knowledge bases)
Work well for typical problems in established specialized fields.

However, for many real problems it is not obvious
which model can be applicable, and often there are no suitable models exist.

For (discoveries and) inventions, (it is often assumed that) idea generation and enlightenments are important.

Thus many surveys were carried out to record the experiences of enlightenments by scientists and engineers.

Findings in common:

(a) Continuing study and research, having sound background knowledge,

(b) Having the problem in mind, thinking to solve it for a long time, generating ideas in various directions and examining them,

(c) At an occasion of some relaxed mental state, with a trigger of some minor event or in the dream, happened to encounter the 'enlightenment'.

(d) Applying the enlightened idea to the problem, one could solve the problem quickly.

Obviously, we have to make efforts for a long time, BUT

It is uncertain when and whether an enlightenment really comes out.

Many different approaches have been advocated :

1. Anyway we have to **work hard to learn,** research, try, and do experiments.
2. **Generate ideas freely** and abundantly, and try them.
3. Try to enhance our own capability of **imagination**; e.g., use animation methods.
4. Make your brain **flexible**, and train yourself to think from different aspects.
5. Think over using various examples as **hints;**
   search for hints and make a collection of them.
6. Survey relevant **references and patents**, and think over with them.
7. Describe and **analyze your problem** and your desire.
8. For making yourself **relaxed**, prepare for suitable time, space, environment, etc.
9. Communicate and **discuss with people** having different experiences,
   specialties, and opinions.

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Various methods for creative problem solving & task achieving

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Approaches	Examples in conventional methods	Examples in TRIZ/USIT
Basics in Science & Technology	Principles, theories & models in each discipline; knowledge bases	Knowledge bases of physical effects
Learning from cases	Analogical thinking, Collections of hints, Equivalent transformation thinking	Active use of patent databases
Analyzing problems/ tasks	Mind mapping, KJ method (Affinity method), Quality function deployment (QFD), QC tools, Root cause analysis, Value engineering (VE), Functional analysis	Problem definition, Root cause analysis, Function & attribute analysis, Formulating contradictions, Substance-field modeling
Supporting idea generation	Brain storming, Brain writing, SCAMPER	40 Inventive Principles, 76 Inventive standards, Contradiction matrix, USIT operators
Taking care of environment and mental aspects	Brain storming, Facilitation methods, Cynectics, NM method, 'The 3rd alternatives'	Size-Time-Cost (STC) operators, Smart little people (SLP) modeling, Particles method
Realizing the ideas	Design methods in each discipline, Pugh's method, CAD/CAE, Taguchi method	Technical knowledge bases
Foreseeing the future	Using various statistics, Delphi method, Scenario writing	9 Windows method, Trends of technical evolution, S-curve analysis, DE (Directed evolution)
Towards a general methodology	Four -box scheme of abstraction, analogical thinking, ET thinking	Four-box scheme, ARIZ, Six-box scheme of USIT

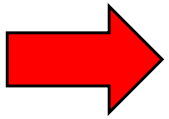
These different approaches have been advocated and practiced, separately.

Each tries to find some 'short cuts'.

Sometimes successful, sometimes not.

Effective in some aspects, but only partly for each.

Confusing with one another, without a clear overall view.



Isn't there any methodology more scientific and sure?

Instead of trying a big jump with enlightenment,
we should be able to proceed in many small but steady steps to finally solve problems creatively.

Methodologies of Creative Problem Solving

Stage 2:

TRIZ
(Theory of Inventive Problem Solving)

Genrikh S. Altshuller (ex-USSR)

Recently, 'Methodology for Creative Problem Solving' has been developed

on the basis of TRIZ and its extensions.

G.S. Altshuller
(1926-1998)
(ex-USSR)

Reorganizing knowledge in science & technology and in patents,
TRIZ has developed a number of methods for creative problem solving.

==> **Without depending on enlightenment, an occasional big jump, TRIZ intends to analyze and understand the problem, to build up a number of ideas (or smaller jumps), and to reach certainly at a higher level of creative solutions.**

Altshuller got the basic idea in 1946, and developed TRIZ in 40 years.

His group has developed a system of philosophy, knowledge bases, techniques, etc.
After the end of the Cold War, TRIZ has been introduced into the western world, e.g. into Japan in 1996, and has been used mostly in manufacturing industries.

Efforts for making TRIZ easier to understand and more effective to apply have been made for these years around the world.

TRIZ makes full use of knowledge in science and technology

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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

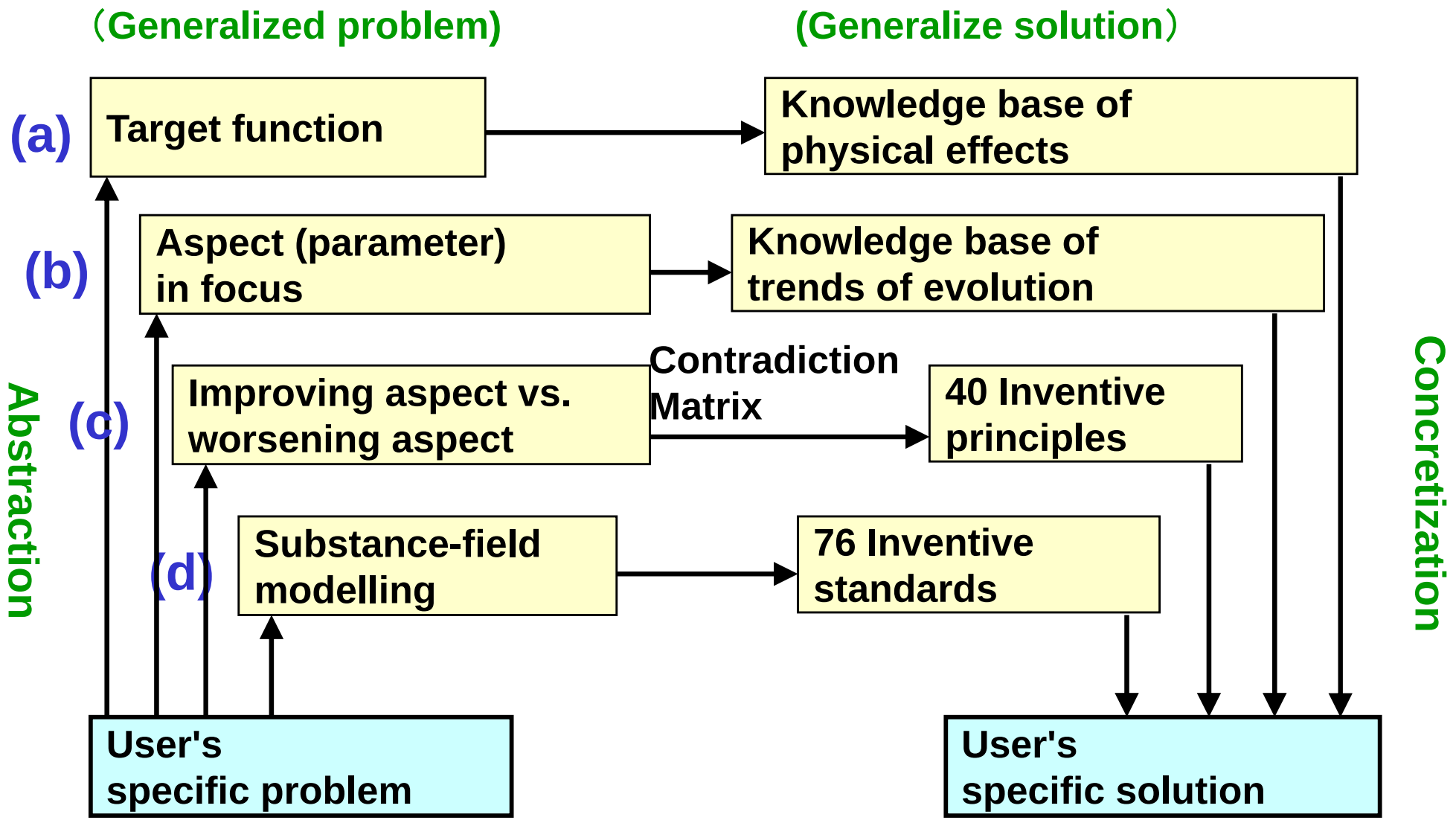
Support of Problem Definition

World of Your Own Problem

Description of Your Own Problem

Solution for Your Own Problem

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



Several big tools with huge knowledge bases are applicable across technical fields.
But parallel structure of multiple tools means partialness in each method.
Thus the overall process in TRIZ is complex (e.g., ARIZ).

Overall Procedure in TRIZ

Darrell Mann's "HOSI" (2002)

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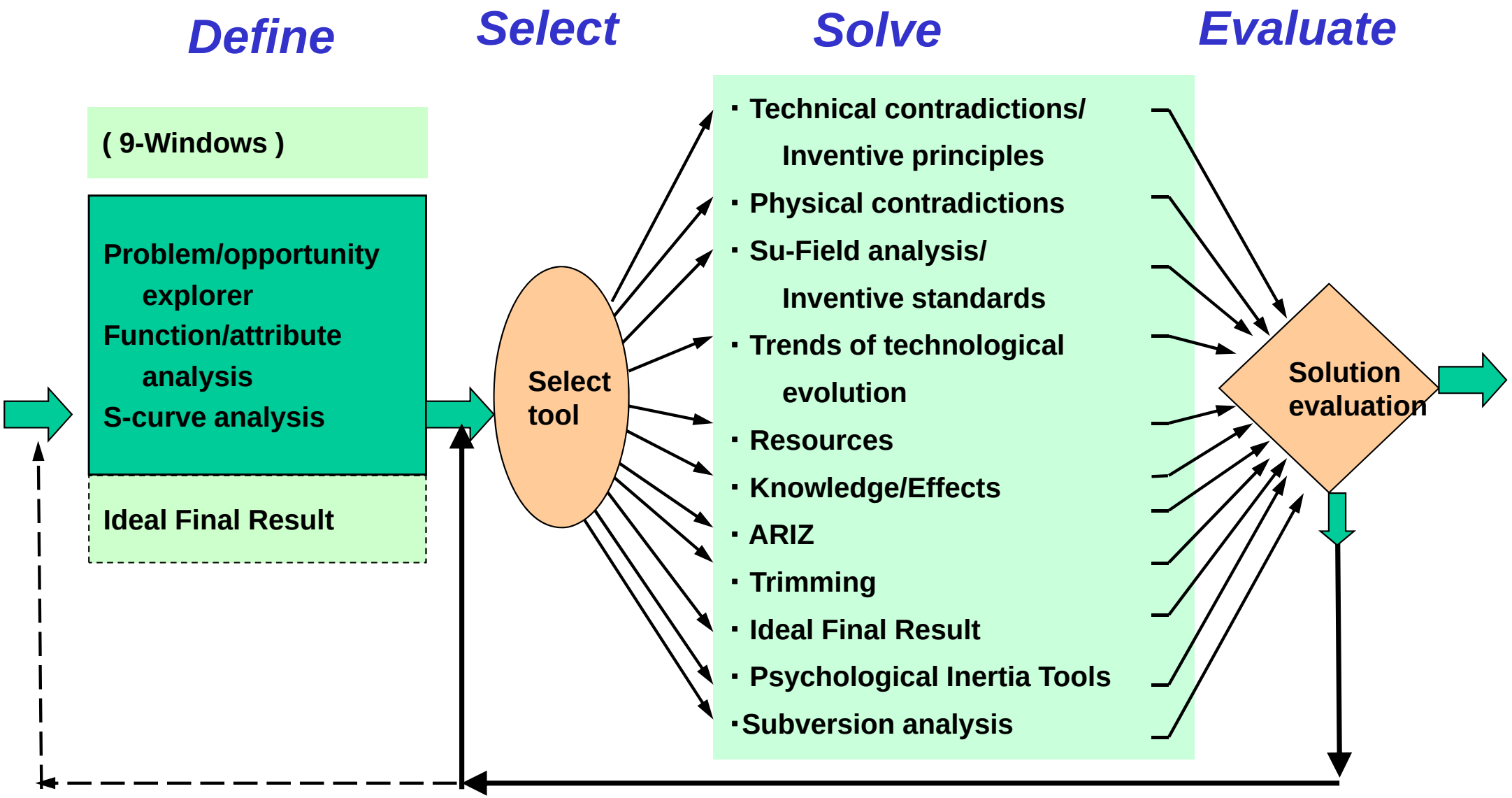


You may learn the tools one by one as you need. (Mann)

We need a simpler and straightforward method. (Nakagawa)

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,

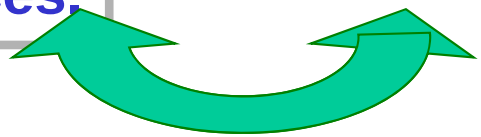
TRIZ provides with a dialectic way of thinking,

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.

Methodologies of Creative Problem Solving

Stage 3:

USIT
(Unified Structured Inventive Thinking)

Ed Sickafus (USA)

==> Toru Nakagawa (Japan)

USIT (Unified Structured Inventive Thinking)

In 1995 Ed Sickafus developed USIT at Ford.

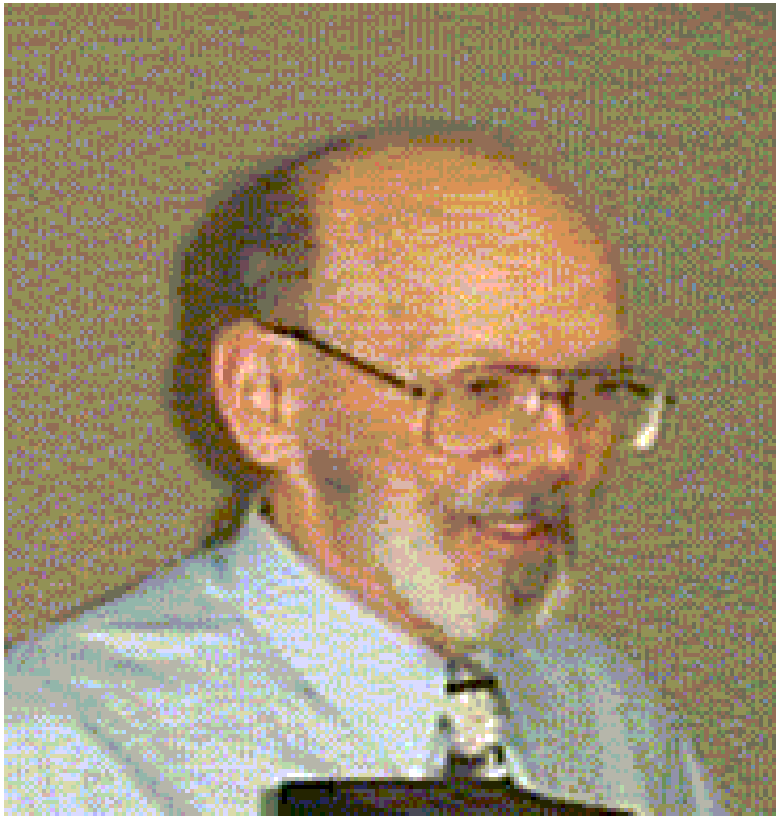
As its basis he introduced Israeli SIT,
i.e., a much simplified version of TRIZ.

On his basis as an experimental physicist,
he built up solid concepts and frameworks.

He created a well-defined thinking process for
problem solving.

He trained about 1000 engineers and
promoted its application projects in Ford.

Since 1999, Toru Nakagawa introduced USIT
into Japan, and extended it further as
a simplified, unified, new generation of TRIZ.



Ed Sickafus
(USA)

USIT Procedure [Flowchart]

[T. Nakagawa, Mar. 2005]

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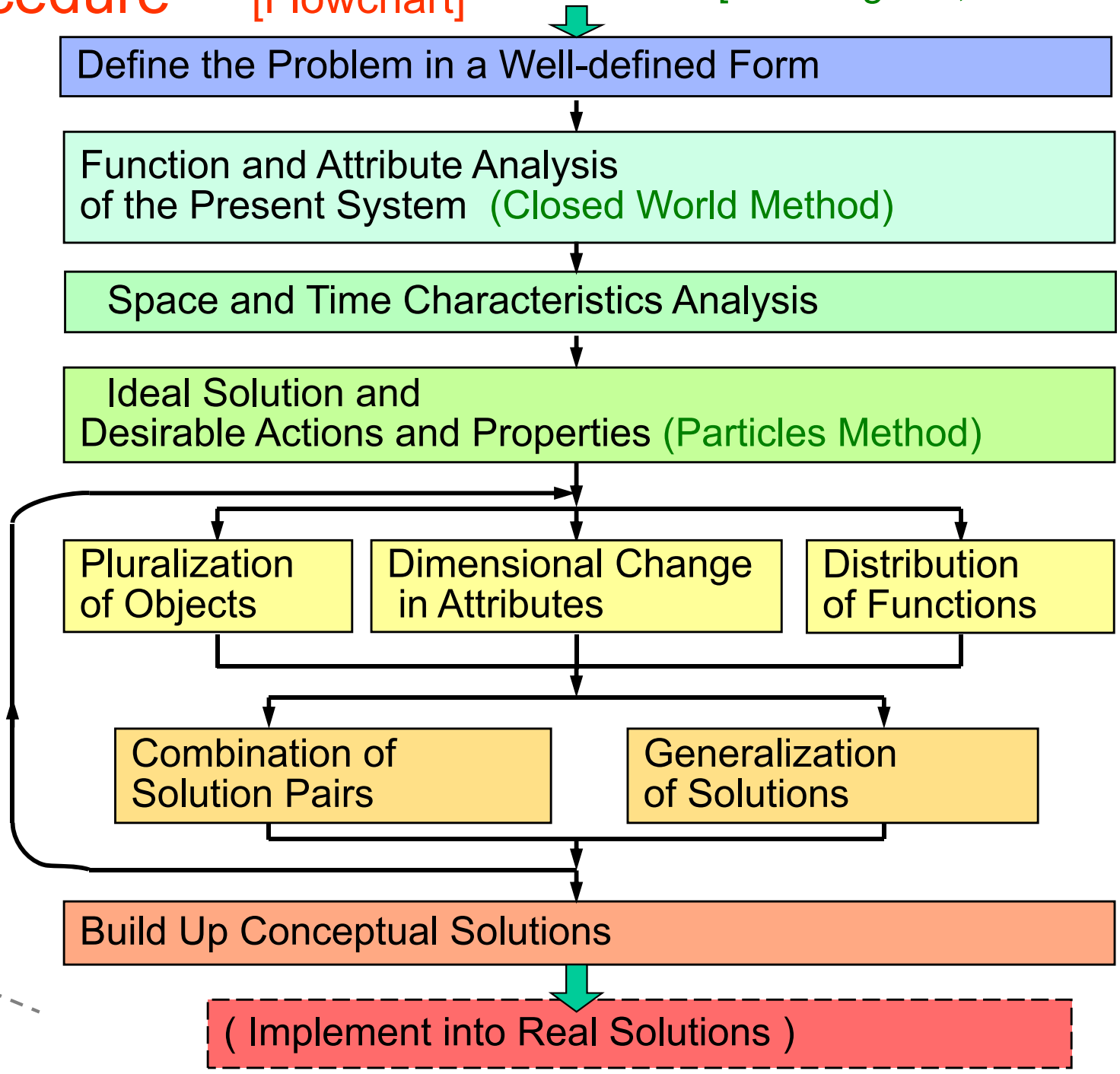
Problem Definition

Problem Analysis

Solution Generation

After USIT

(Implementation)



A Simple Case Study of USIT

T. Shimoda and T. Nakagawa (2006)

Everyday-life Case Study in USIT:

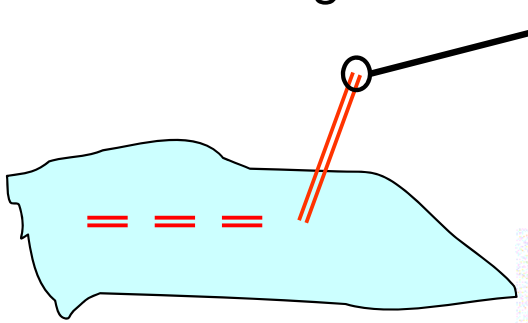
How to fix a string shorter than the needle at the end of sewing

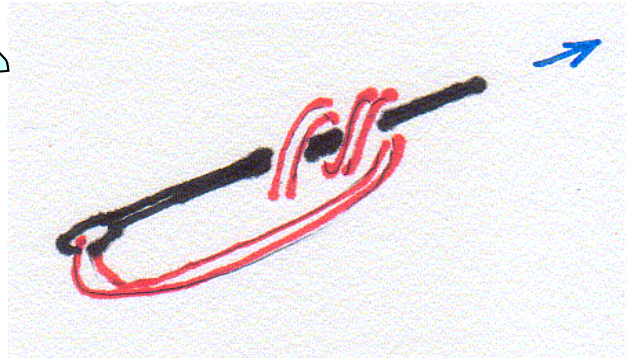
Define the Problem: [Box-1 ==> Box-2]

(a) An Unwanted 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

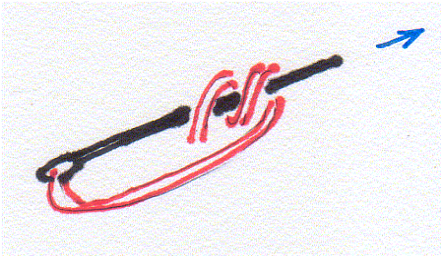
Problem Analysis (A): Understanding the present system

[Box-2 ==> Box-3]

(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

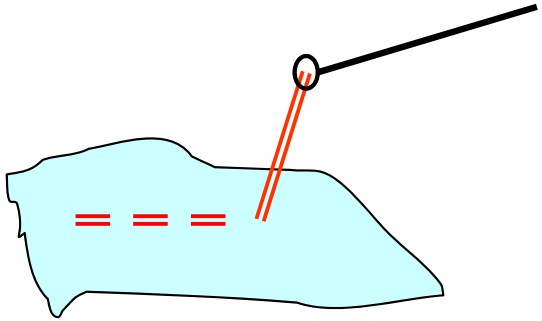


(2) Attribute analysis: Properties taken for granted form the Constraints:

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.



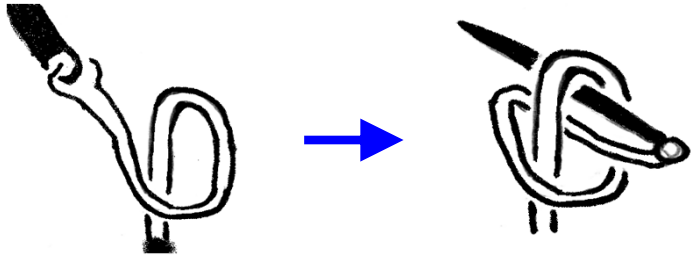
(3) Analysis of time characteristics: Processes of sewing:

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' .

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 (B) : Understanding the Ideal system

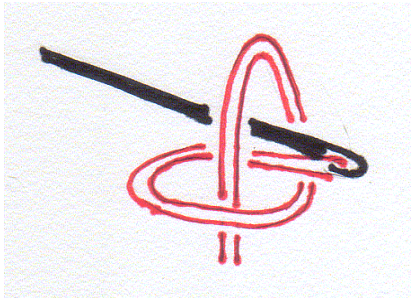
[Box-2 ==> Box-3]

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

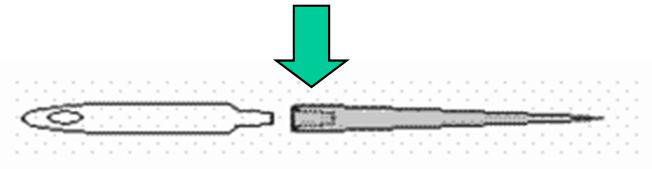
[Box-3 ==> Box-4] [Box-4 ==> Box-5]



Known technique

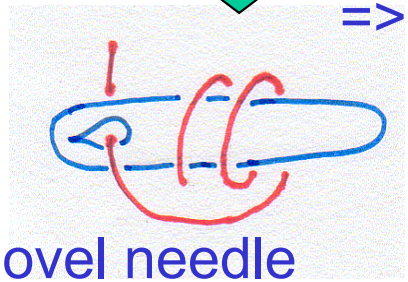
'Let's break the needle!'

A ridiculous idea !?



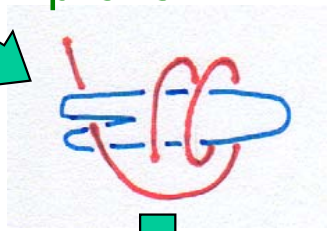
What does this mean?

=> No need to sew any further.

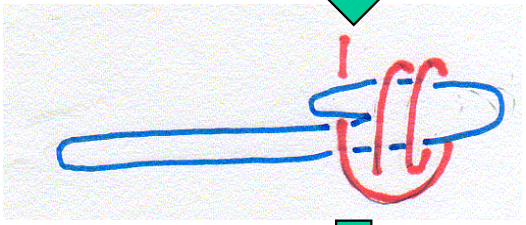


A novel needle specialized for making a knot

improve

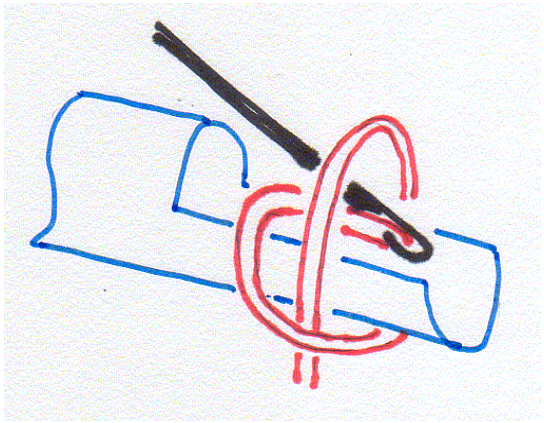


improve

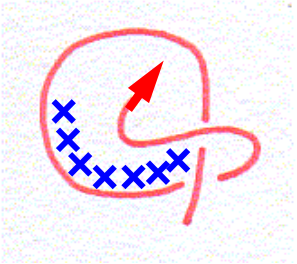


improve

Image of Ideal situation



A novel tool made of a straw



"USIT Oprators": A system of solution generation methods

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

T. Nakagawa, H. Kosha, and Y. Mihara (ETRIA TFC2002)

TRIZ methods for Solution Generation

40 Inventive Principles

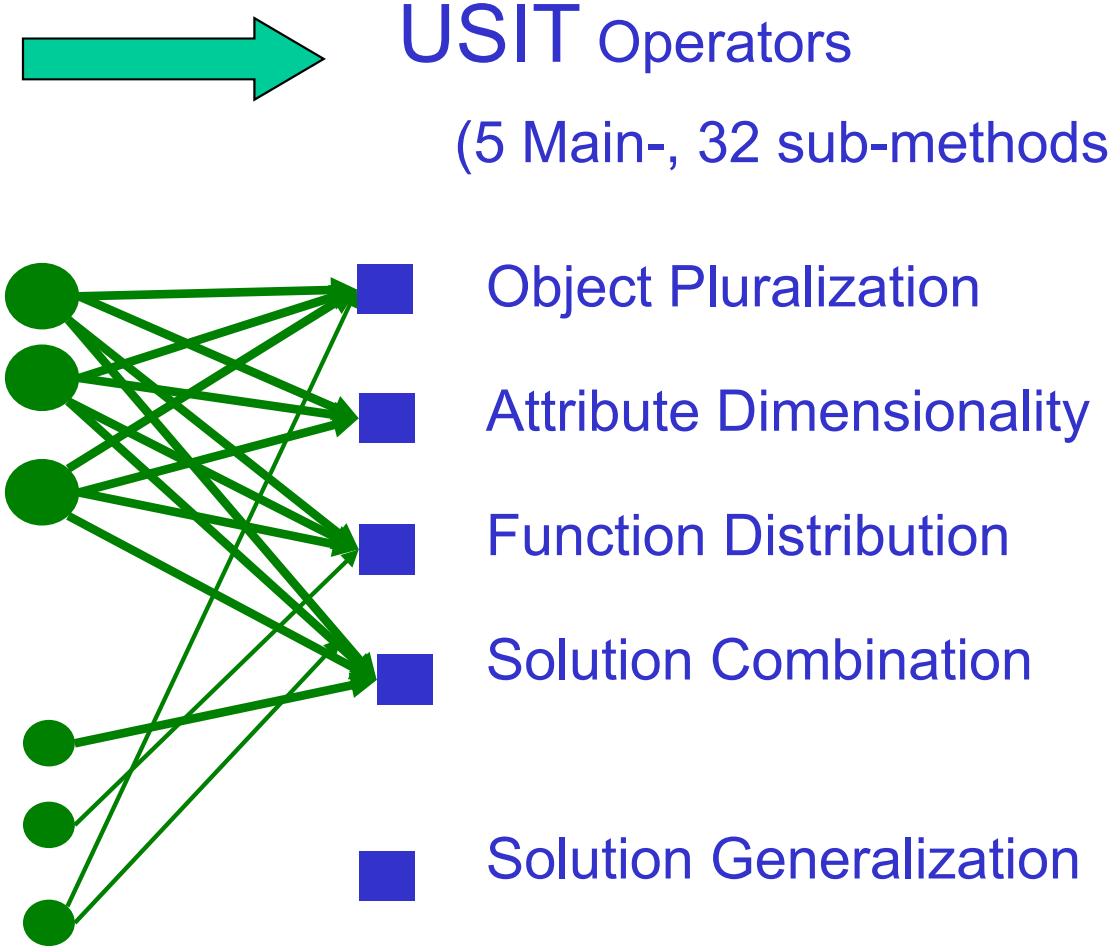
76 Inventive Standards

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.

USIT Operators

Nakagawa, Kosha, Mihara (2002)

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(1) Object Pluralization Method

a. Eliminate
b. Multiply into 2, 3, ..., ∞
c. Divide into 1/2, 1/3, ..., 1/∞
d. Unify
e. Introduce or modify ⟺ KB
f. Introduce from the Environment.
g. From solid to powder/liquid/gas

(2) Attribute Dimensionality Method

a. Deactivate a harmful attribute
b. Activate a useful attribute ⟺ KB
c. Enhance a useful or suppress a harmful attribute
d. Introduce a spatial attribute or vary in space
e. Introduce a temporal attribute or vary in time
f. Change the phase or the inner-structure
g. Attributes at the micro level
h. Properties of the system as a whole

(3) Function Distribution Method

a. Reassign to a different Object
b. Divide the compound Functions and assign them separately
c. Unify multiple Functions
d. Introduce a new Function ⟺ KB
e. Vary the Function in space, use space-related Functions.
f. Vary the Function in time.
g. Detection/measurement Function.
h. Enhance adapting/coordination/control
i. With a different physical principle

(4) Solution Combination Method

a. Combine functionally
b. Combine spatially
c. Combine temporally
d. Combine structurally
e. Combine at the principle level.
f. Combine at the super-system level

(5) Solution Generalization Method

a. Generalize/specify
b. Hierarchical system of solutions

An example of USIT Operator sub-method

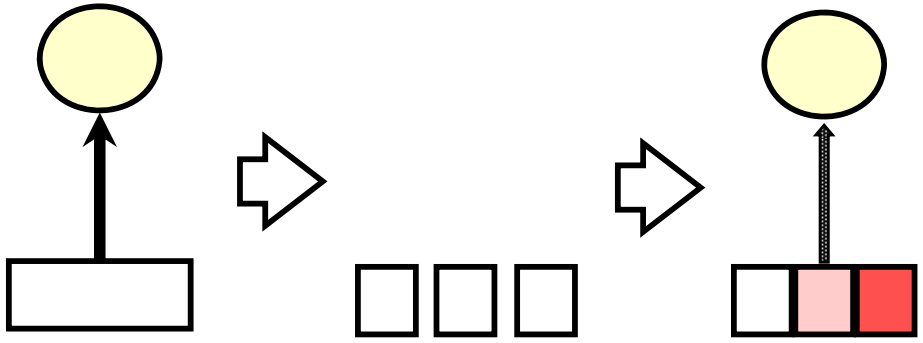
(1) Object Pluralization Method

(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)

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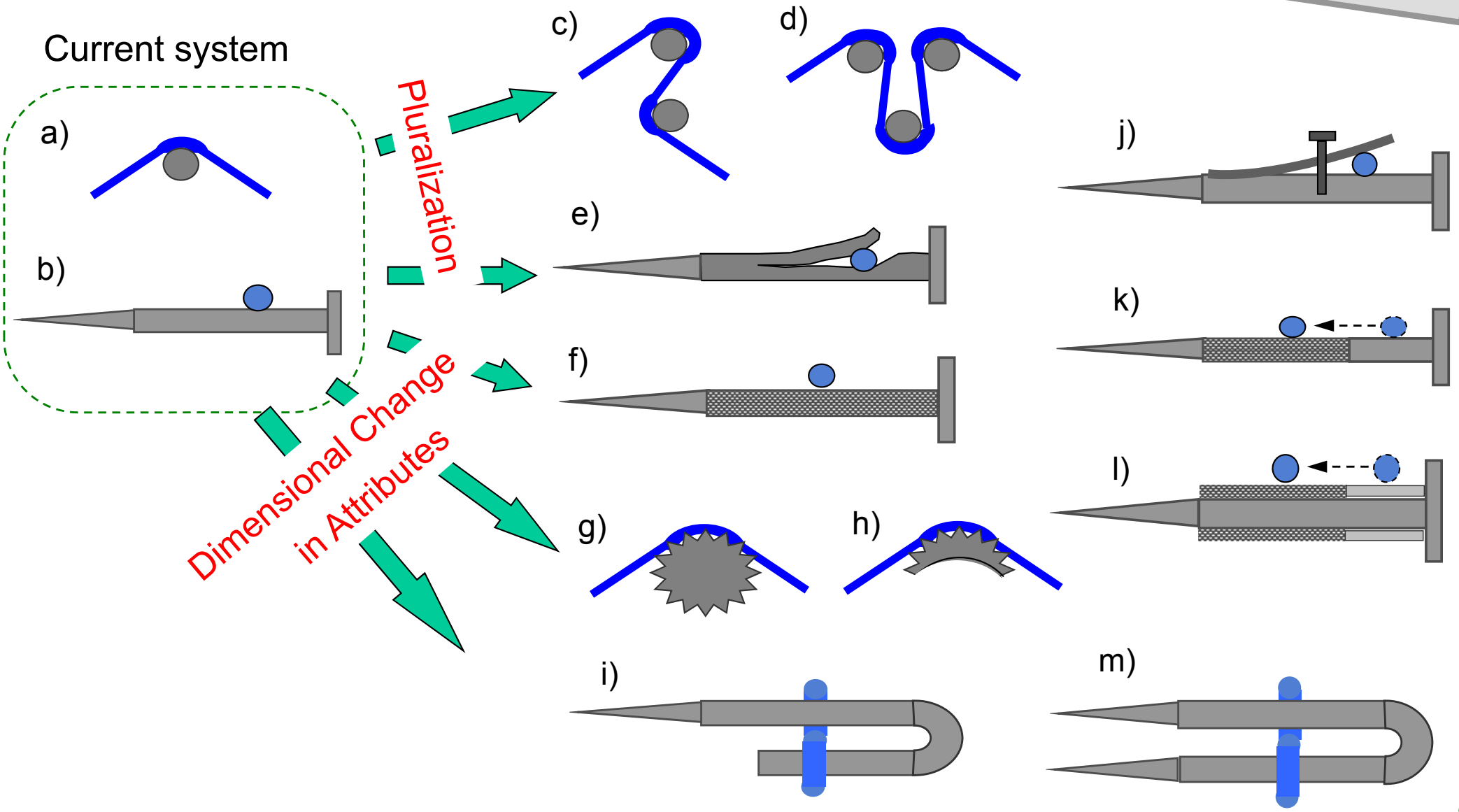
Picture Hanging Kit Problem. USIT Operators are applied to the nail.



(4) Solution Combination Method

Combine solutions

(4a) Functionally.

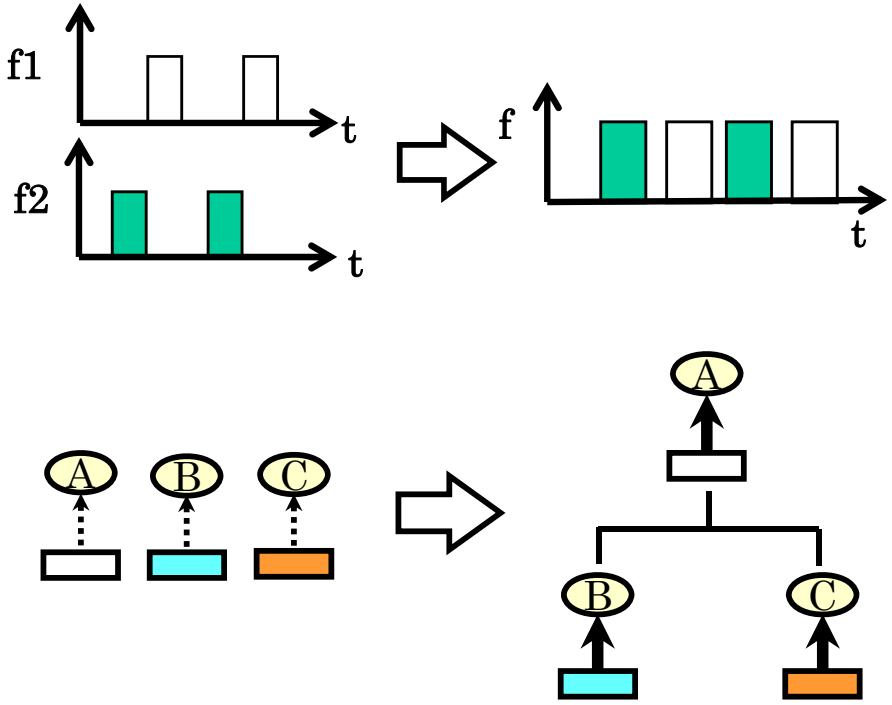
(4b) Spatially.

(4c) Temporally.

(4d) Structurally.

(4e) At the principle level.

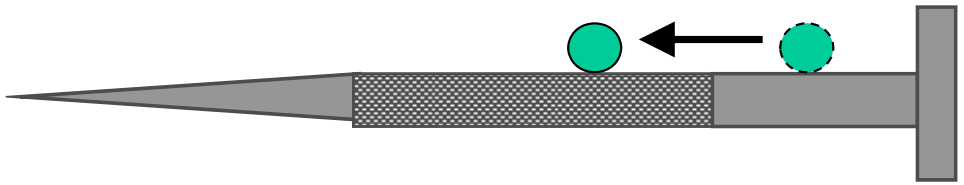
(4f) At the super-system level.



USIT
Solution Combination Methods ⟺ **TRIZ Separation Principles**
for solving Physical Contradictions

A solution can be interpreted (or derived) in multiple ways:

A case of solution



Picture Hanging Kit Problem

(a) Object Pluralization Method

Divide the Nail Object into halves, change the smoothness of the two parts, and use them in combination.

(b) Attribute Dimensionality Method

Change the values of the Smoothness Attribute in parts of the Nail.

(c) Function Distribution Method

The Adjusting and Holding Functions of the Nail are re-assigned to different parts of the Nail.

(d) Solution Combination Method

The solution of making the Nail smooth for easier adjustment and
the solution of making the Nail rough for better holding

are combined in space by dividing the Nail.

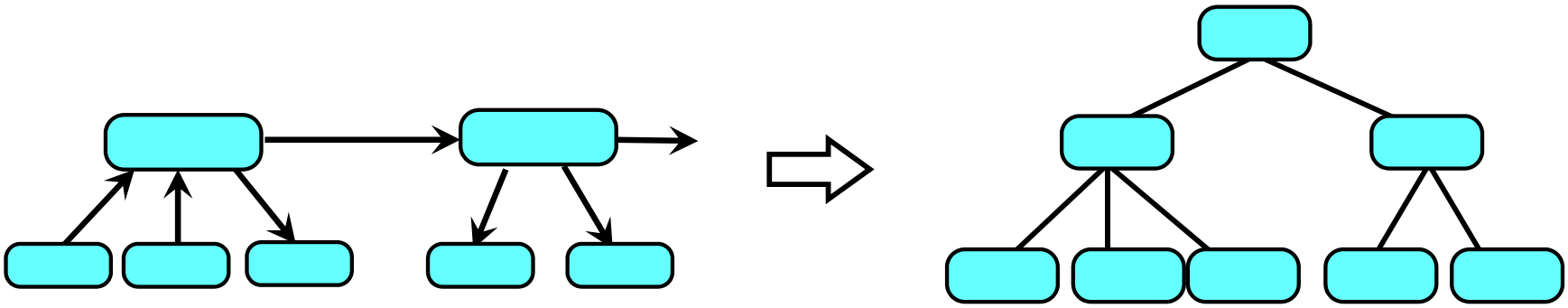
⟹ are combined in time. [This interpretation of the idea is most important.]

Multiple ways of intrpretation = Redundancy in USIT Operators
for making the solution generation easier.

USIT Operators

Operator (5): Solution Generalization Method

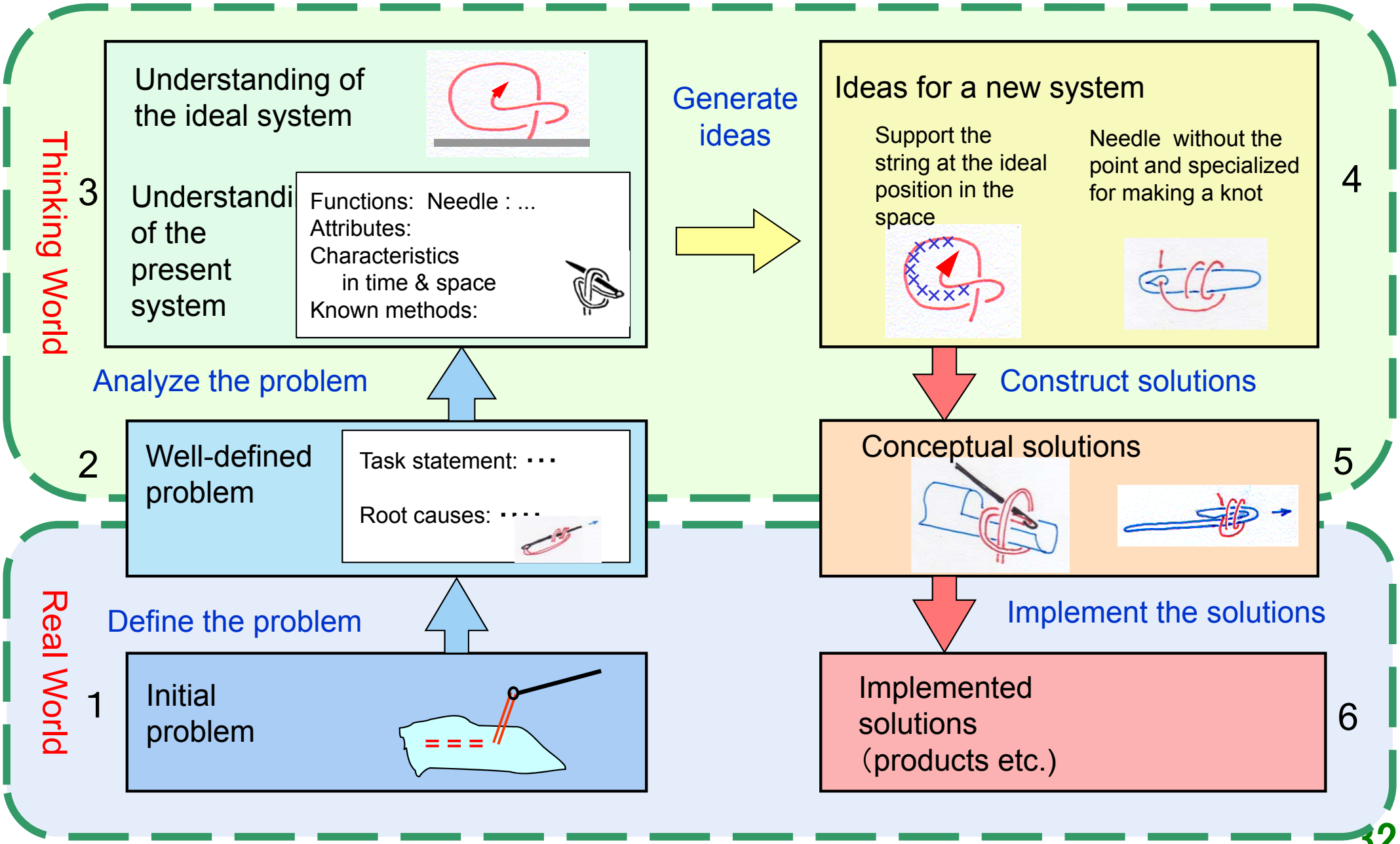
Represent a solution in a more general way,
form a solution template, and
obtain concepts of solutions
in the associative manner.
Also generate a hierarchical system of solutions.



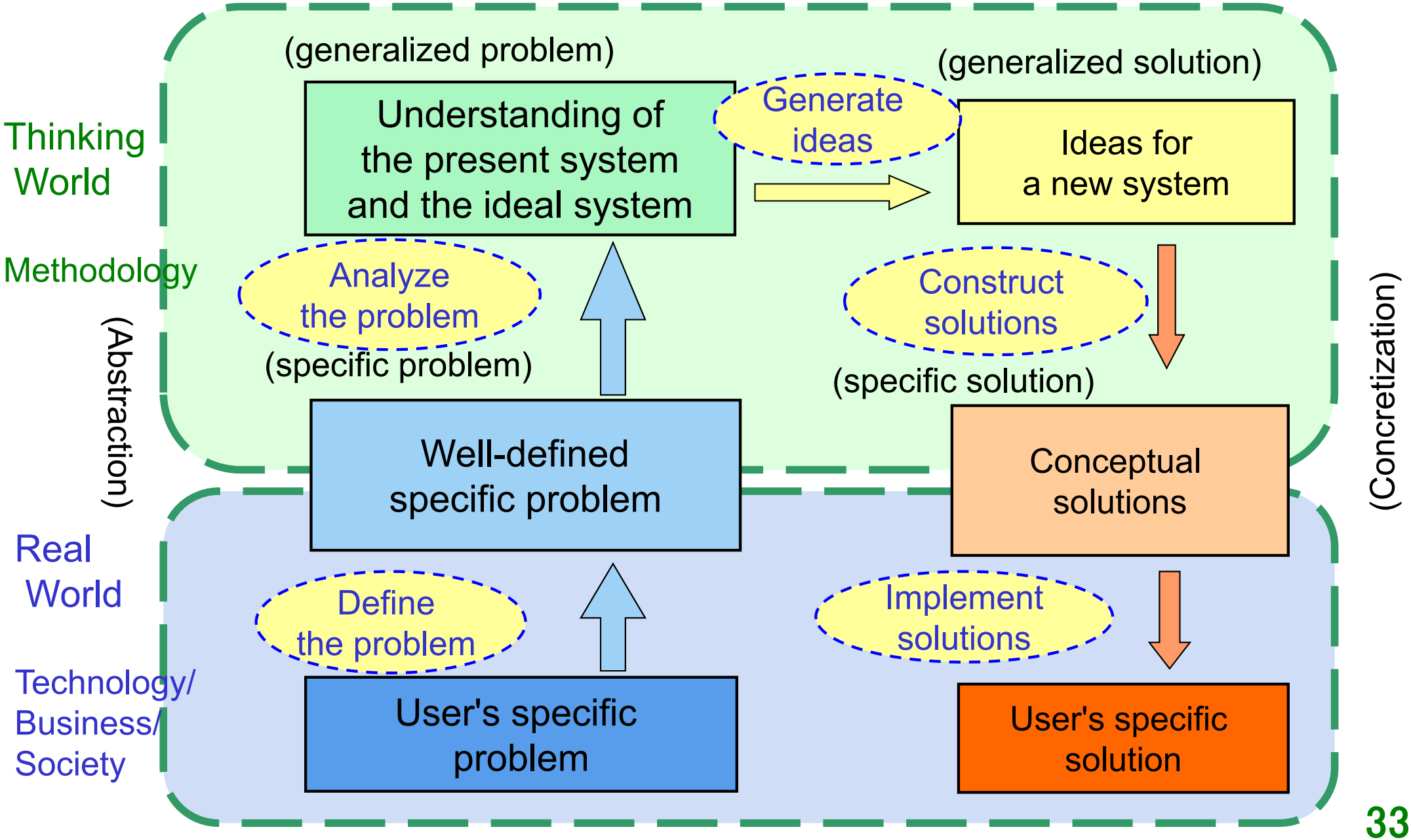
USIT (i.e., a simple and unified TRIZ)
analyzes any problem in a standard process and
generates solutions systematically and comprehensively.

Case study represented in the Six-Box Scheme: How to fix the string shorter than the needle

T. Shimoda and T. Nakagawa (2006)



New Paradigm of Creative Problem Solving
(Six-Box Scheme of USIT) ==> (Six-Box Scheme of CrePS)



'Six-Box Scheme' (the Paradigm of CrePS)

Skip

(a) 'Real World' and 'Thinking World' are separated, for clarifying their roles.

(b) Recognition of the problem situations (Box 1)
must be done in the 'real World' (or in the business activities)

(c) Problems and tasks to be addressed (Box 2)
is defined in the Real World and is handed to the Thinking World.

(d) (In Box 3) The present system is understood with standard analysis methods
in the aspects of space, time, components, attributes, and functions, and
the ideal system is also understood in its image.

(e) Ideas for a new system (Box 4), exceeding the stage of hints,
are often obtained quite smoothly from the understandings in Box 3,
and can be enhanced by use of the USIT Operators (or various similar methods).

(f) Conceptual solutions (Box 5)
need to be constructed around the core ideas,
by using basic capability in the relevant fields of subject matters.

(f) Actual solutions (Box 6)
need to be implemented by the business activities in the Real World.

Methodologies of Creative Problem Solving

Stage 4:

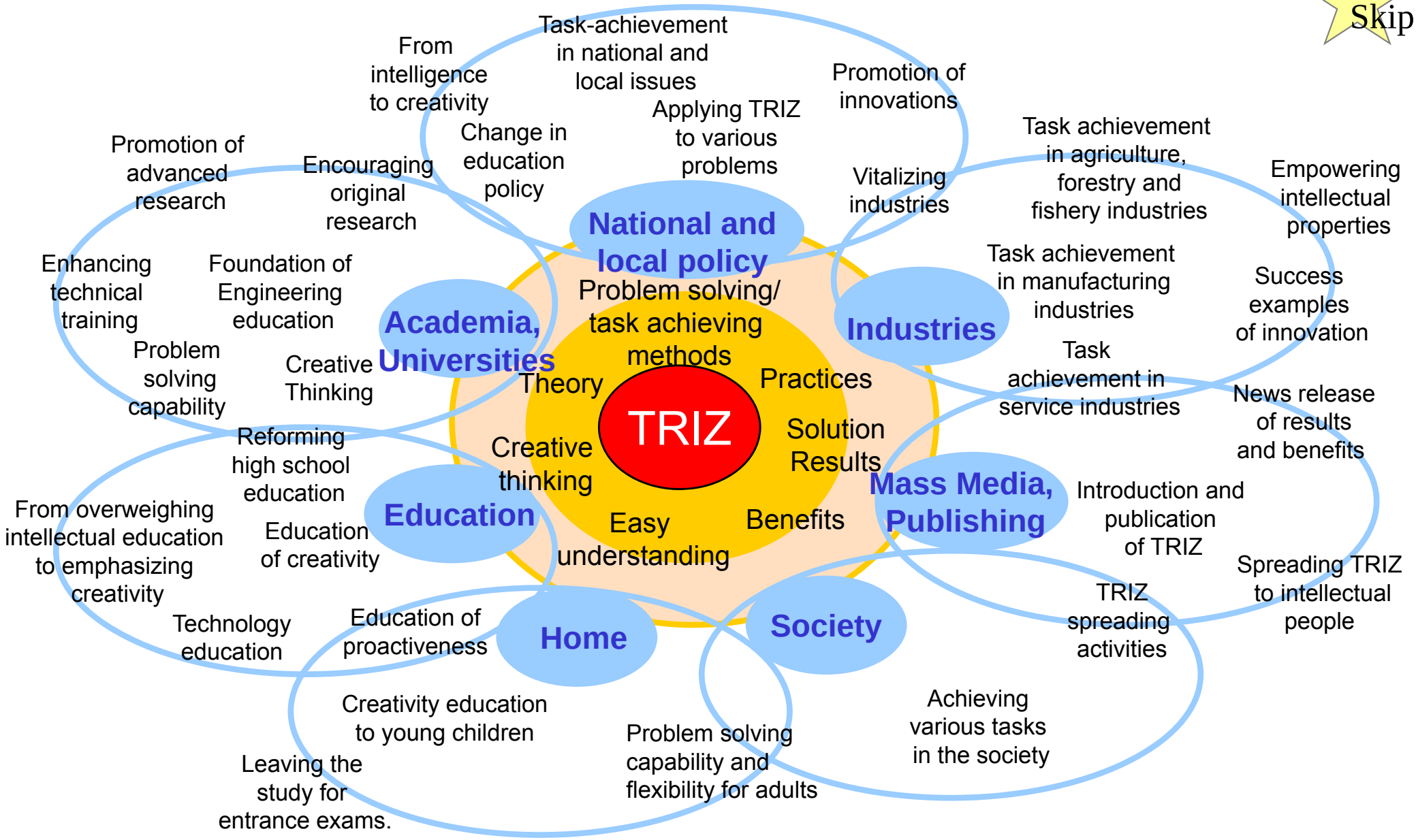
CrePS
(General Methodology of Creative Problem Solving)

Toru Nakagawa

Expected Areas of Applying TRIZ

Toru Nakagawa (May, 2012)

Skip



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

Reflection of the present situations around us and TRIZ

(1) Problem solving & task achieving is a job people want to do everywhere.

(2) A huge variety of studies and methods exist for helping the jobs,
but they are short in filling the demands. Why?
Because: Being fragmental without a good general framework.

(3) TRIZ has contributed good thoughts and many tools applicable widely,
but it is not easy to learn and use by people. Why?
Because: Being specific and complex without a good framework.

(4) We have two directions:

- Customize TRIZ well for the (narrow range of) target persons.
- Generalize TRIZ well for the (wider range of) target persons
  ==> General methodology of creative problem solving. (CrePS)

(5) General methodology CrePS should be a super-system of TRIZ
integrating various existing methods. How possible?
==> With the Six-Box Scheme as the new framework/paradigm.

Reflection of the present situations on TRIZ has guided us

to a new target at a higher level **Beyond TRIZ**

(May 2012, Toru Nakagawa)

a new target at a higher level.

To establish a general 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).

The methodology is named as **'CrePS'** (April 2013, Toru Nakagawa)

Target of Our New Methodology CrePS

Skip

"A General Methodology for Creative Problem Solving & Task Achieving"

- Help to solve problems (i.e., undesirables) and
  to achieve tasks (i.e., desirables).
- Capable to guide to new creative solutions and measures even for
  the problems/tasks conventionally thought difficult/impossible.
- Applicable generally and universally to different fields/areas
- Having integrated different preceding methods and different studies
- Delivering a methodology (a system of methods) which integrates
  various thinking methods, techniques, tools, etc.
- **Easy to learn, easy to apply, and effective in actual jobs of application.**

The current status of research on CrePS/TRIZ/USIT:

'General Methodology for Creative Problem-Solving/Task-Achieving' (CrePS)

CrePS is feasible by using the 'Six-Box Scheme' as the basic paradigm.

Different methods (including TRIZ) can be reorganized into CrePS.

USIT is a concise process for applying the Six-Box Scheme of CrePS.

On-going research activities for developing CrePS:

(1) To make course materials of CrePS case studies.
We should just use case studies already published.

(2) To understand different methods (including TRIZ)
and to describe them in the framework of CrePS.

(3) To relate CrePS to various activities in the 'Real world'.

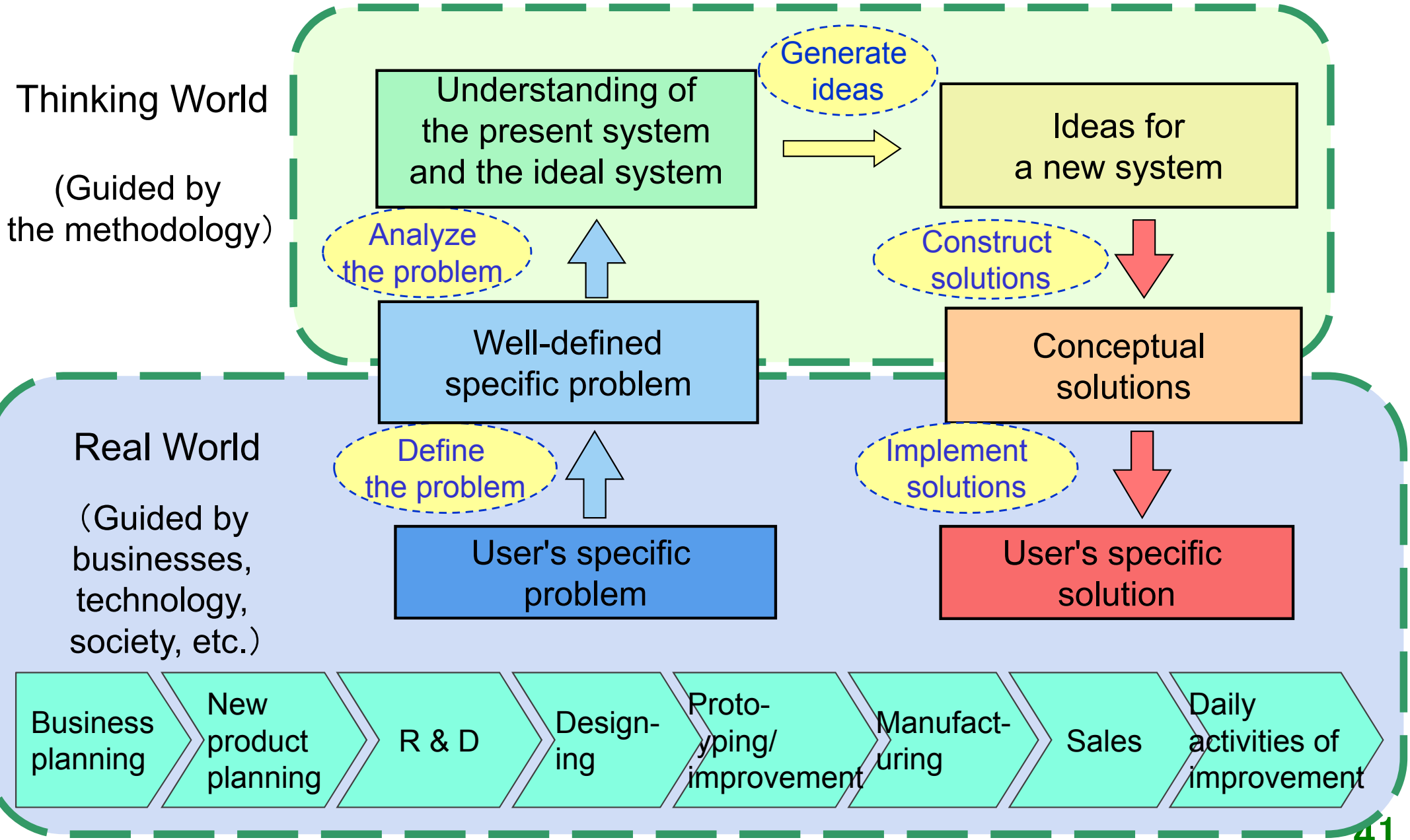
(4) To categorize various purposes of CrePS application,
and to recommend concise CrePS processes for each category.

(5) To proliferate the vision of CrePS.

(3) To relate CrePS to various activities in the 'Real world'.

Skip

Position of CrePS and its Six-Box Scheme



Methodologies of Creative Problem Solving

For Study and Practice

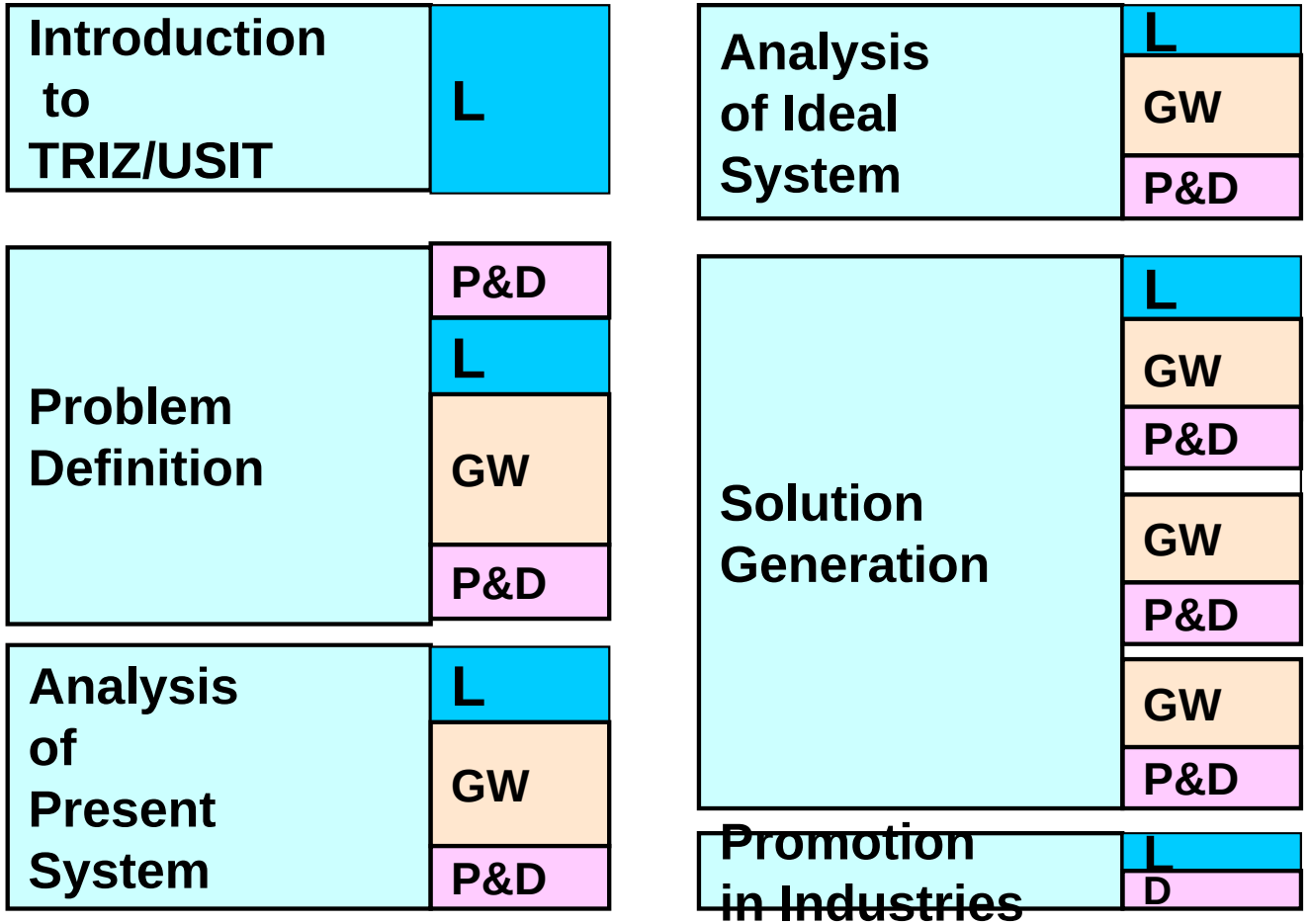
For Mastering TRIZ/USIT

- As a practical process for problem solving, I recommend USIT first.
  USIT is much easier to learn than (conventional) TRIZ.
- Use TRIZ knowledge base tools in a way complementary with USIT.
- TRIZ/USIT is applicable to real problems for conceptual solutions.
- TRIZ/USIT fits well for group work.

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



Practices of Introducing TRIZ/USIT

Key points

Skip

1. Around the pioneers, build a group for studying TRIZ/USIT.

2. Learn TRIZ/USIT by using invited lecturers, external seminars, conferences, etc.

3. Select an appropriate real job in the company and solve the problem by a group work.

4. Share information with intranet Web site etc. and in report meetings etc.

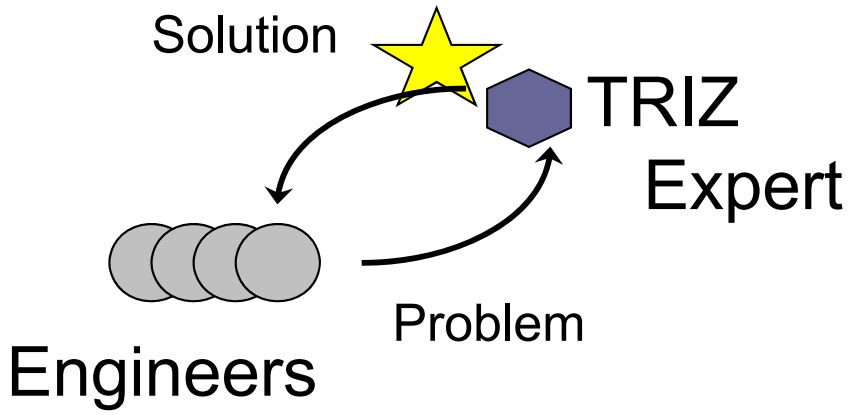
5. As a part of training of engineers, start the training programs of TRIZ/USIT.

6. Organize the TRIZ/USIT promotion activities officially in the company raising human resources and budgets, etc.

Implications of the New Scheme (3) Ideal expert

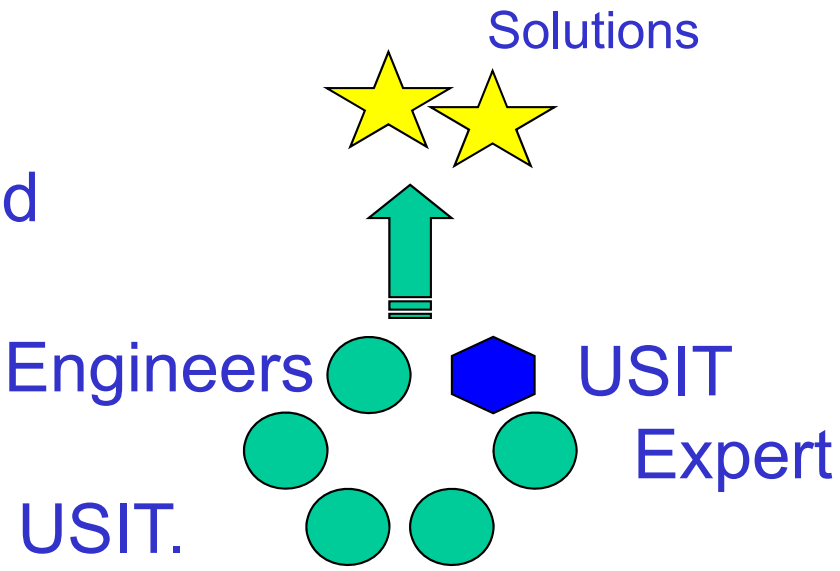
TRIZ Traditional:

an almighty inventor
an almighty contract researcher
in any technology field



New Paradigm with USIT:

a guiding assistant of engineers
to help engineers think and solve
work together with engineers in any field



can achieve much more
than he/she can do alone
and than the engineers can do without USIT.

==> practical and suitable for wider penetration

References:

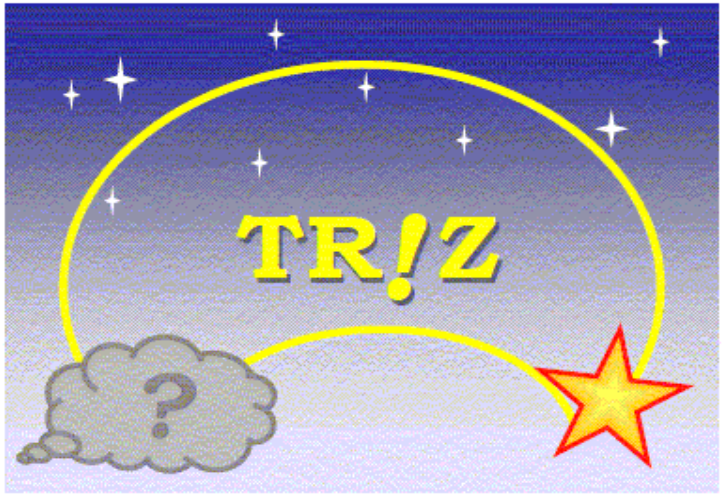
"TRIZ Home Page in Japan" --- Public Web site since Nov. 1998

Let's enjoy 'Think & Try' !
(for Children and Highschool students)
Editor: Toru Nakagawa
Last updated: Oct. 17, 2014

For solving problems creatively
(for Students and the General public)
Editor: Toru Nakagawa
Last updated: Oct. 17, 2014

Methods of creative problem solving
(for Engineers and Researchers novice to TRIZ)
Editor: Toru Nakagawa
Last updated: Oct. 17, 2014

Practices and methodologies of Creative problem solving
(for Practitioners and Experts)
Editor: Toru Nakagawa
Last updated: Oct. 17, 2014



This home page serves as an open forum of information exchange for better understanding and usage of Creative Problem Solving Methodologies, especially based in Japan. Readers' contributions are very welcome, including introductory articles, papers, case studies, news, questions, comments, etc

Pages under this directory are the English versions.
Click the hyper-linked keywords or the Engl. buttons.
The Jap. buttons guide you to the Japanese pages.
Most articles are posted in the two languages, but some are only in either of them.

TRIZホームページ

責任編集: 大阪学院大学 中川 徹
Last Updated: October 17, 2014 Jap.
http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/

TRIZ Home Page in Japan

Editor: Toru Nakagawa
(Professor Emeritus, Osaka Gakuin Univ.)
Last Updated: October 17, 2014 Engl.
http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/eTRIZ/

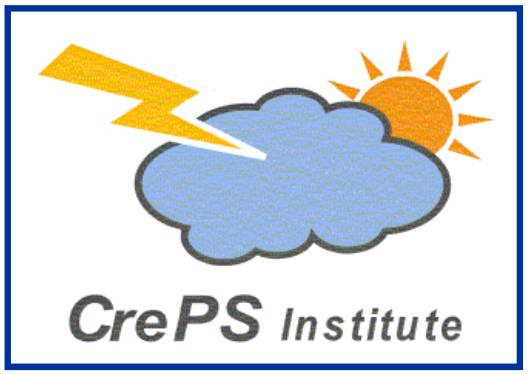
Established on Nov. 1, 1998

036609 visits since Nov. 1, 2005

4 'Entrance Pages'

Many important papers on TRIZ / SI / USIT / CrePS written by many authors

(Recently: CrePS Vision, USIT Manual, USIT Case Studies, USIT Operators, etc.)



Thank you for your attention

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http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/eTRIZ/ (English)