Japan Creativity Society Conference 2021
Oct. 2-3, 2021
At Kurume University, Kumamoto (Online)

From "Four-Box Scheme of Abstraction" in Science and Technology To "Six-Box Scheme of Creative Problem Solving"

Oct. 3, 2021

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Introduction: Problem ➡ Development ➡ New Understanding

Basic Paradigm in science and technology is "Four-Box Scheme of Abstraction".
However, it is NOT effective for "Creative Problem Solving".
It is often thought that getting an inspiration for coming up with ideas is crucial to invent". But reliable process (or basic paradigm) for it is not known.
Thus, various **"Creativity Methods" have been explored in** diverse directions.

TRIZ (Theory of Inventive Problem Solving) has built various methods to make inventions using reorganized knowledge bases of science & technology information on the basis of Four-Box Scheme. (G. Altshuller)
USIT (Unified Structured Inventive Thinking) simplified TRIZ and made a concise thinking process for invention. (E. Sickafus)

We generalized USIT to get **"Six-Box Scheme"** and recognized it as a new **"Basic Paradigm of Creative Problem Solving".** (Toru Nakagawa)

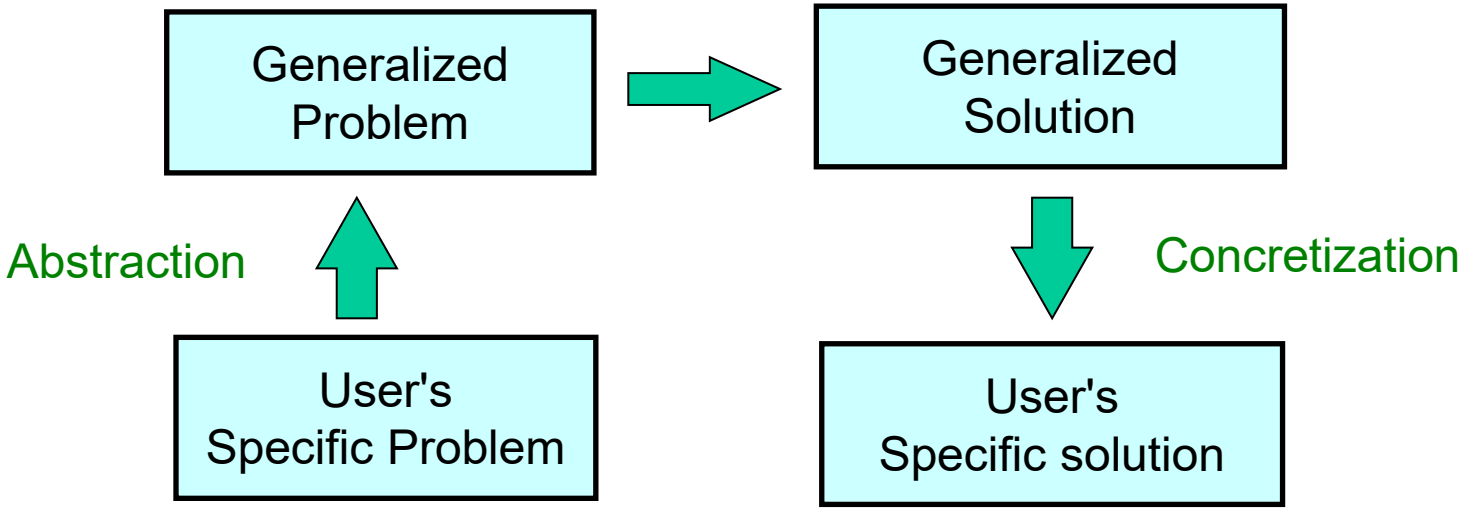
Various "Creativity Methods" may be integrated into the "Six-Box Scheme".
USIT is a concise and effective process of Creative Problem Solving in the "Six-Box Scheme".

[1] Basic Paradigm of Science and Technology and Various "Creativity Methods"

[1A] Basic Paradigm of Science and Technology = "Four-Box Scheme" of Abstraction

Example: Quadratic equation $a x^2 + b x + c = 0$

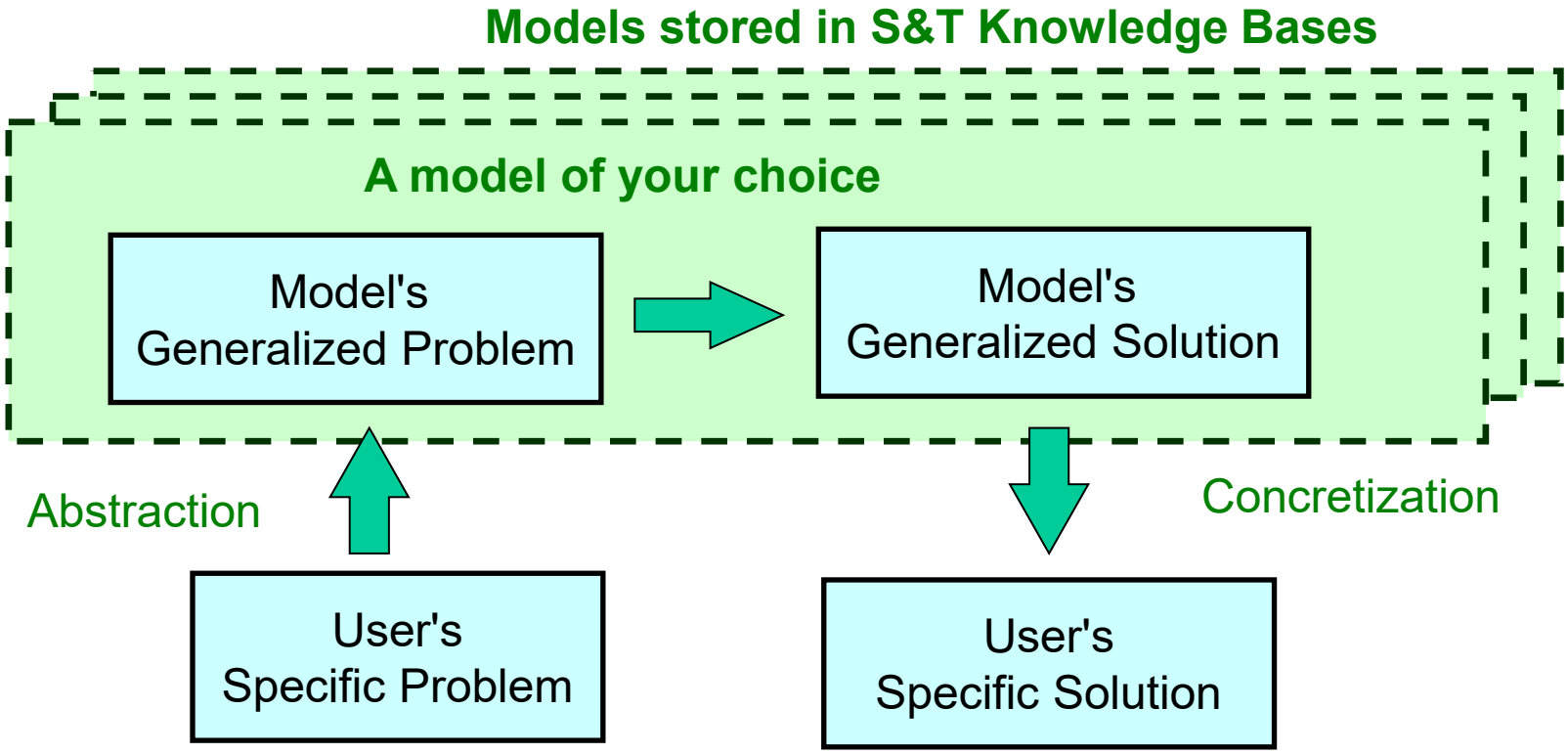
root formula $x = \frac{- b \pm \sqrt{b^2 - 4ac}}{2a}$



In math, we learned a lot of formula. It was hard to remember them.

The calculation problems are easy. Application problems are difficult.

[1B] Science & Technology:
Features and Limitations of the "Four-Box Scheme of Abstraction"



Many models in various specialized fields (theories and knowledge-bases).
They work well for typical problems in established fields.

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

[1C] Science and Technology : "Inspiration" for Invention?

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 to 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, (during this period various ideas are supposed to be prepared subliminally.)

(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.

Question: Using this finding as the guideline, what should we do now and in the future?

[1D] Science & Technology: Different Approaches to Inspiration

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 so far:

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; use animation methods, for example.
4. Make our brain flexible, and train ourselves 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 our problem and our desire.
8. For making ourselves relaxed, prepare for suitable time, space, environments, etc.
9. Communicate and discuss with people having different experiences, specialties, opinions, and backgrounds.

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[1E] Various methods for creative problem solving & task achieving

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

[1F] We don't have a Basic Paradigm of creative problem solving?

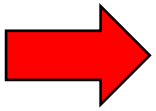
These different approaches have been advocated and practiced, separately.

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?

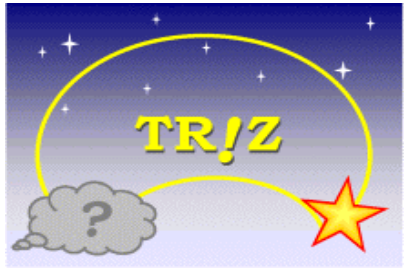
Instead of trying to make a big jump with enlightenment, we should be able to proceed in many small but steady steps to finally solve problems creatively.

[2] Development: TRIZ and USIT: Towards Methodologies of Creative Problem Solving

[2A] TRIZ makes full use of knowledge in science & technology

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

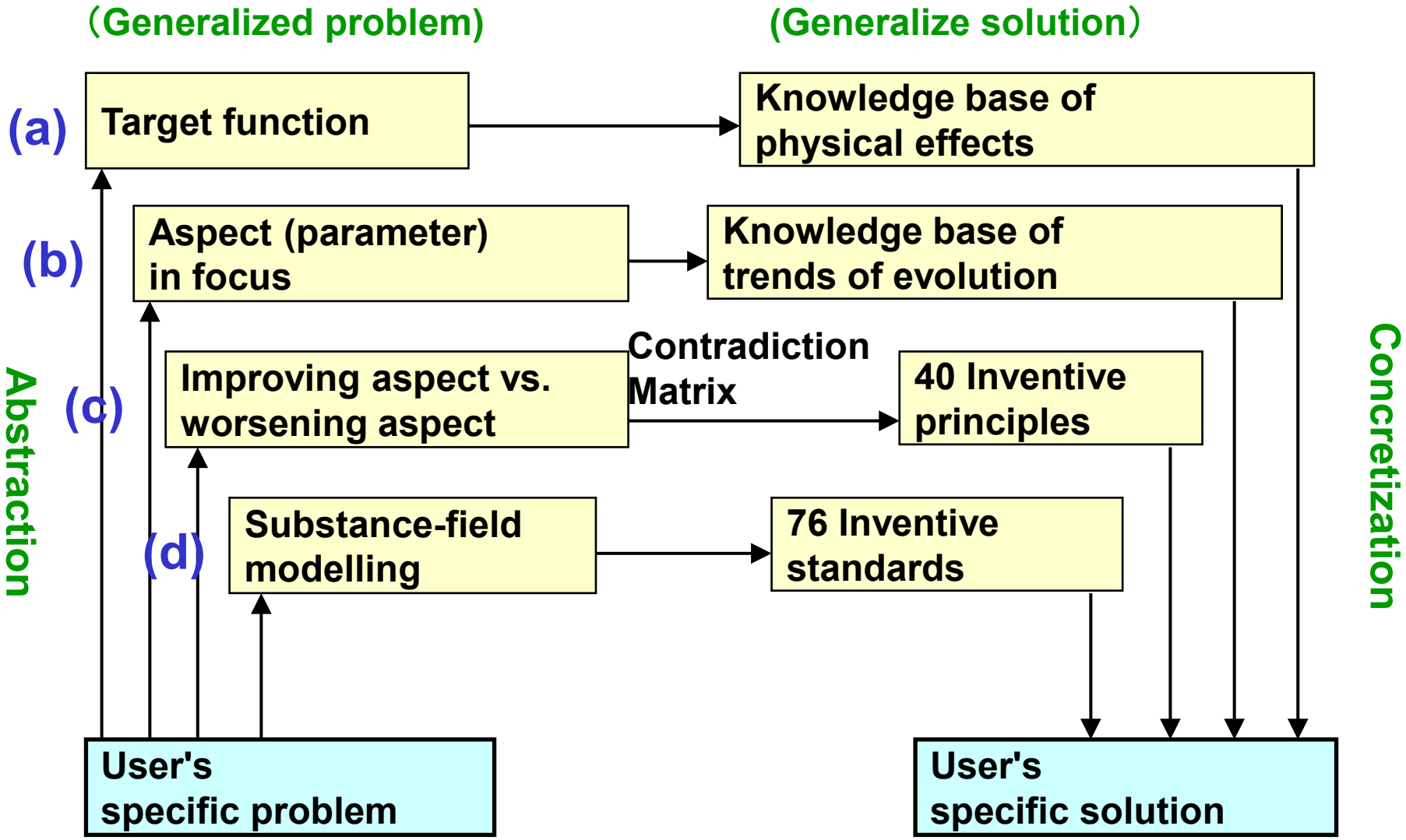
Support of Problem Definition

World of Your Own Problem

Description of Your Own Problem

Solution for Your Own Problem

[2B] Main 4 Methods of TRIZ (Based on the "Four-Box Scheme")



Many tools and huge knowledge bases are applicable across technical fields.
But parallel structure of multiple tools means partialness in each method.

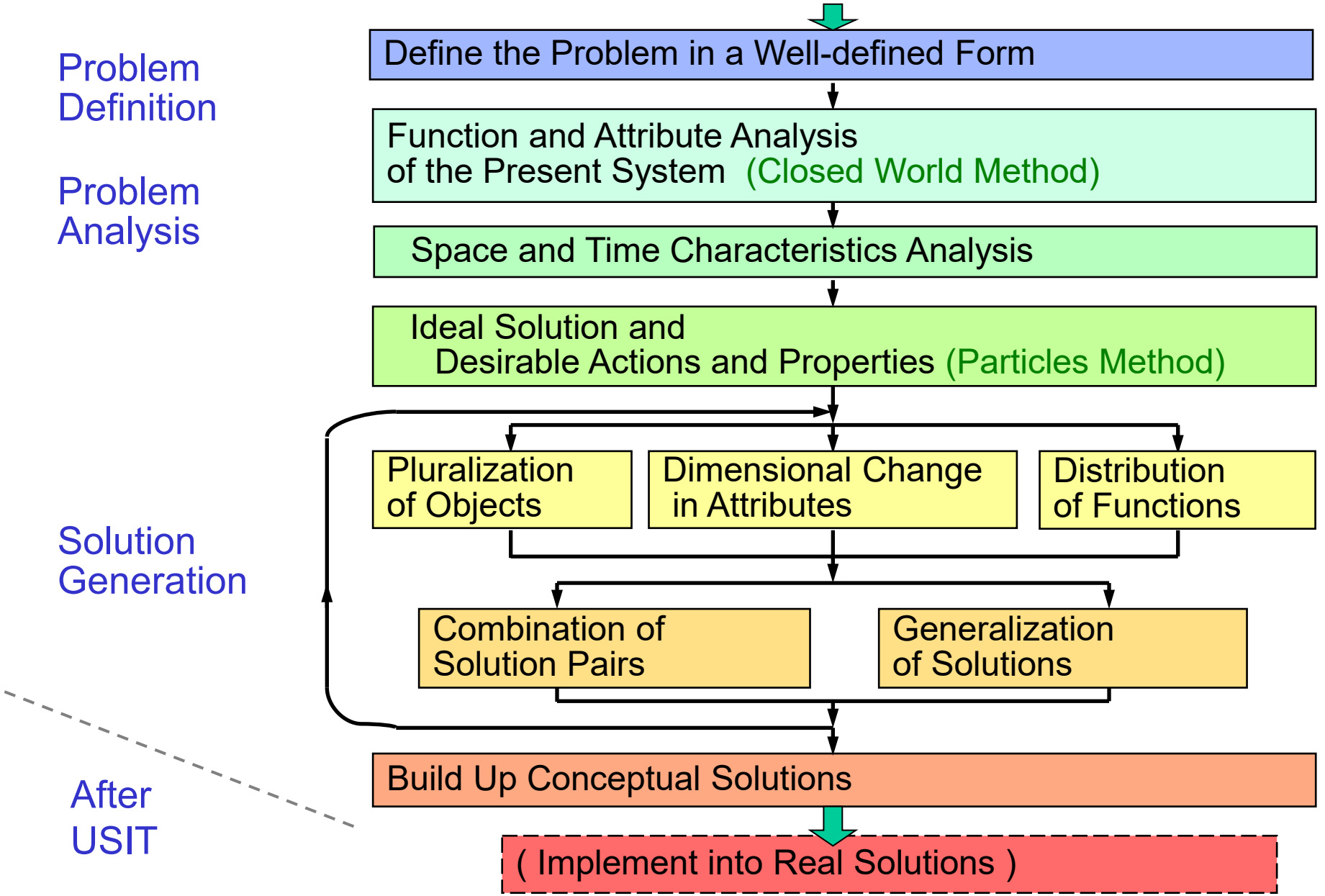
[2C] USIT Is a Concise, Consistent, Effective Process for Inventive Thinking

A simplified version of TRIZ for problem solving. having a concise, consistent, and effective thinking process.
(E. Sickafus)

USIT is smoothly applicable to concept generation in real problems in industries.
It does not depend on tables, handbooks, or software tools.

[2D] Overall Process of USIT (Flowchart Representation)

[T. Nakagawa, Mar. 2005]



[2E] Extension of USIT in Japan

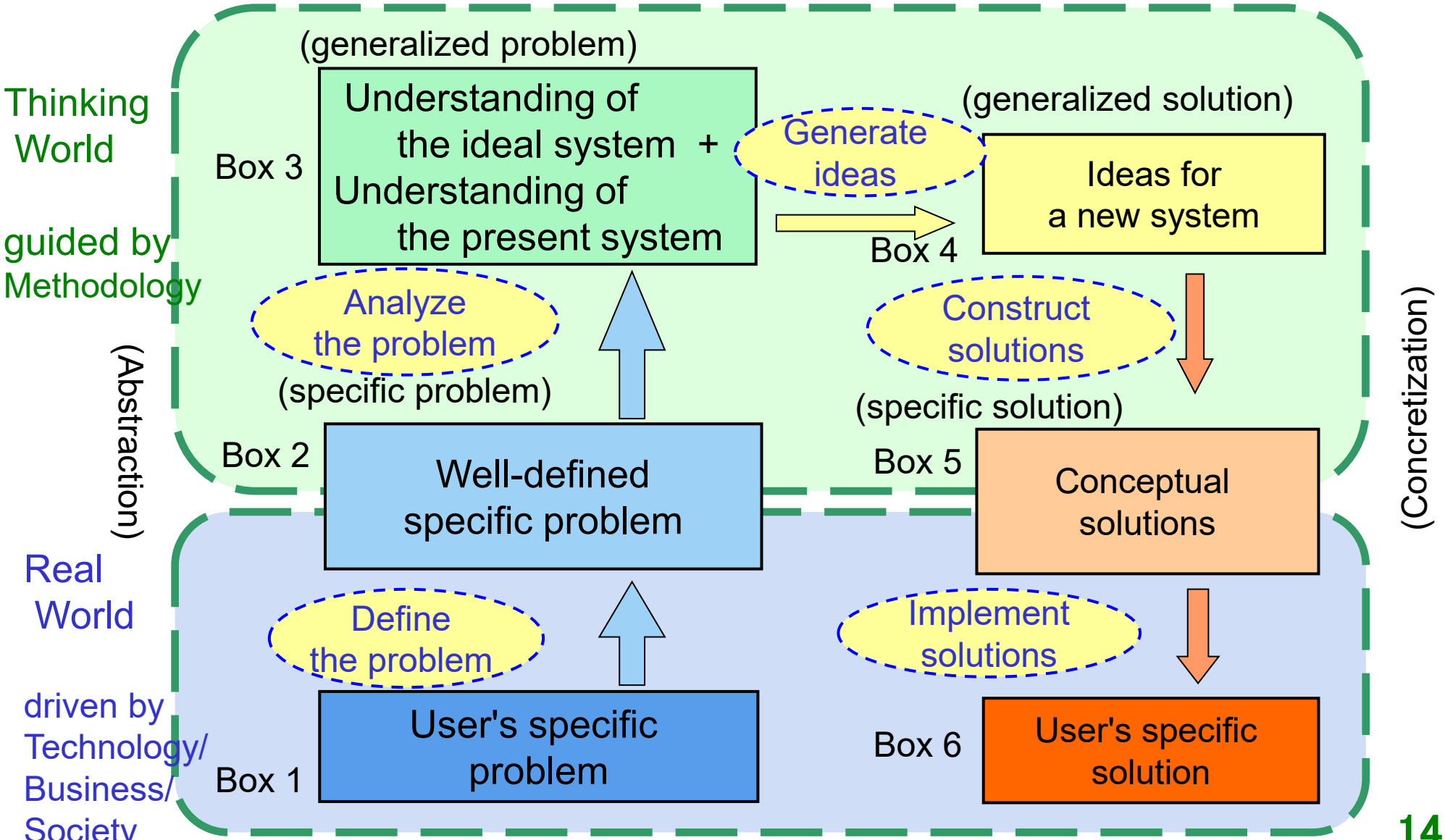
All TRIZ solution generation methods were disassembled
into their sub-methods
and reorganized them into the USIT framework
to integrate into the USIT Operator system
(5 methods, 32 sub-methods)
(T. Nakagawa, H. Kosha, Y. Mihara (2003))

From the data-flow representation of the USIT process
the concept of "Six-Box Scheme" was obtained.
==> It was recognized as
a new Basic Paradigm of Creative Problem Solving".
(Toru Nakagawa (2005))

[3] Six-Box Scheme: A New Paradigm of Creative Problem Solving

[3A] "Six-Box Scheme" Obtained from "Data-Flow Representation" of USIT

Toru Nakagawa (2005)

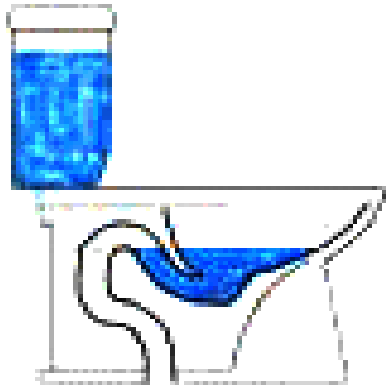


[3B] Example of Description in "Six-Box Scheme" (Case: WC (1))

TRIZ Case Study of Solving a Physical Contradiction: 'Water-Saving Toilet'

by Hong Suk Lee and Kyeong Won Lee (Korea), TRIZ Journal, Nov. 2003.

Task: Reduce the amount of flushing water necessary for the toilets.
-- Needs over the world.



Current problem: For flushing the waste, water of 6 to 13 liters is used.

Analysis: S-pipe is necessary to block the bad smell from coming up, and is effective for flushing all with the siphon effect.
S-pipe is not desirable for reducing the amount of flushing water.

Physical Contradiction: S-pipe is required to exist and not to exist.

Separation Principle: Separable in Time:
Required to exist -- during most of the time except flushing
Required Not to exist -- during the time of flushing

[3C] Example of Description in "Six-Box Scheme" (Case: WC (2))

Altshuller's Method
(Solving a Physical Contradiction by the Separation Principle)

State the requirements clearly:

Require the S-pipe to Exist .

Require the S-pipe Not to Exist.

This is a contradiction !
We cannot satisfy these two requirements together!

(1) Separate the two requirements in terms of time, space, conditions, etc.

Requirements can be separated in terms of time.

Require to Exist, all the time except while flushing

Require Not to Exist, only while flushing.

(2) Find solutions which fulfil the requirements separately while the time ranges.

Ordinary time range: The S-pipe Exists.

While the flushing time range: The S-pipe does Not Exist.

(3) Then, use the two solutions together in combination.

(First, tell the combined solutions literally.
and then think how to achieve them.)

The S-pipe exists while ordinary time, AND the S-pipe does NOT exist while flushing the water.

How can we achieve this ??

[3D] Example of Description in "Six-Box Scheme" (Case: WC (3))

How can we think?

S-pipe Exists / Disappeas

→ **The pipe is of S-shape / Not S-shape**

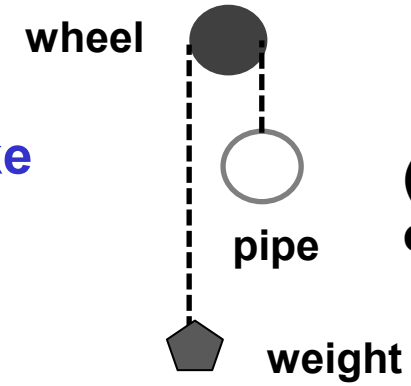
→ **The pipe is high in the middle / Not high in the middle**

Solution:

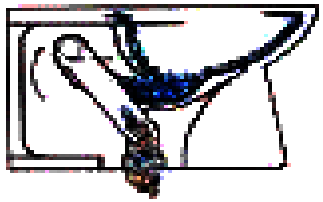
The basic idea:

Instead of a solid S-shape pipe, we should use some flexible pipe (say, of plastic) which can be lifted usually and lowered while flushing

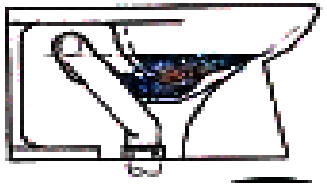
Can we make this work by itself?



The pipe goes up and down by itself.



(3) at the end of flushing



(1) while ordinary time

(2) while flushing

Results: Only 3 liters of water is necessary for a flushing.

[3E] Example of Description in "Six-Box Scheme" (Case: WC (4))

Saving Water in a Toilet System: Contradiction is solved with Altshuller's Method

Thinking World

3

Understanding of the ideal system

The S-shape pipe exists for most of the time, but does not exist when we flush the water.

Understanding of the present system

The S-shape pipe is useful and necessary, but need to be eliminated for less water. [Physical contradiction]

Generate ideas

Ideas for a new system

4

To make the S-shape pipe flexible and being lowered when we flush the water.
To lower and lift the S-shape pipe by itself.

Construct solutions

Analyze the problem

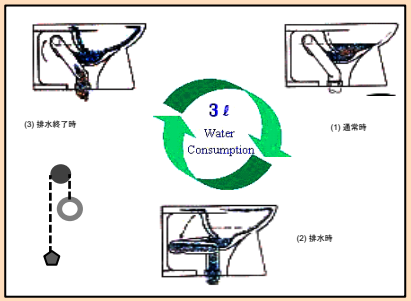
2

Well-defined problem

Want to reduce the amount of water necessary for flushing the toilet.
The much water is needed due to the S-shape pipe

Conceptual solutions

5



Implement the solutions

Define the problem

Real World

1

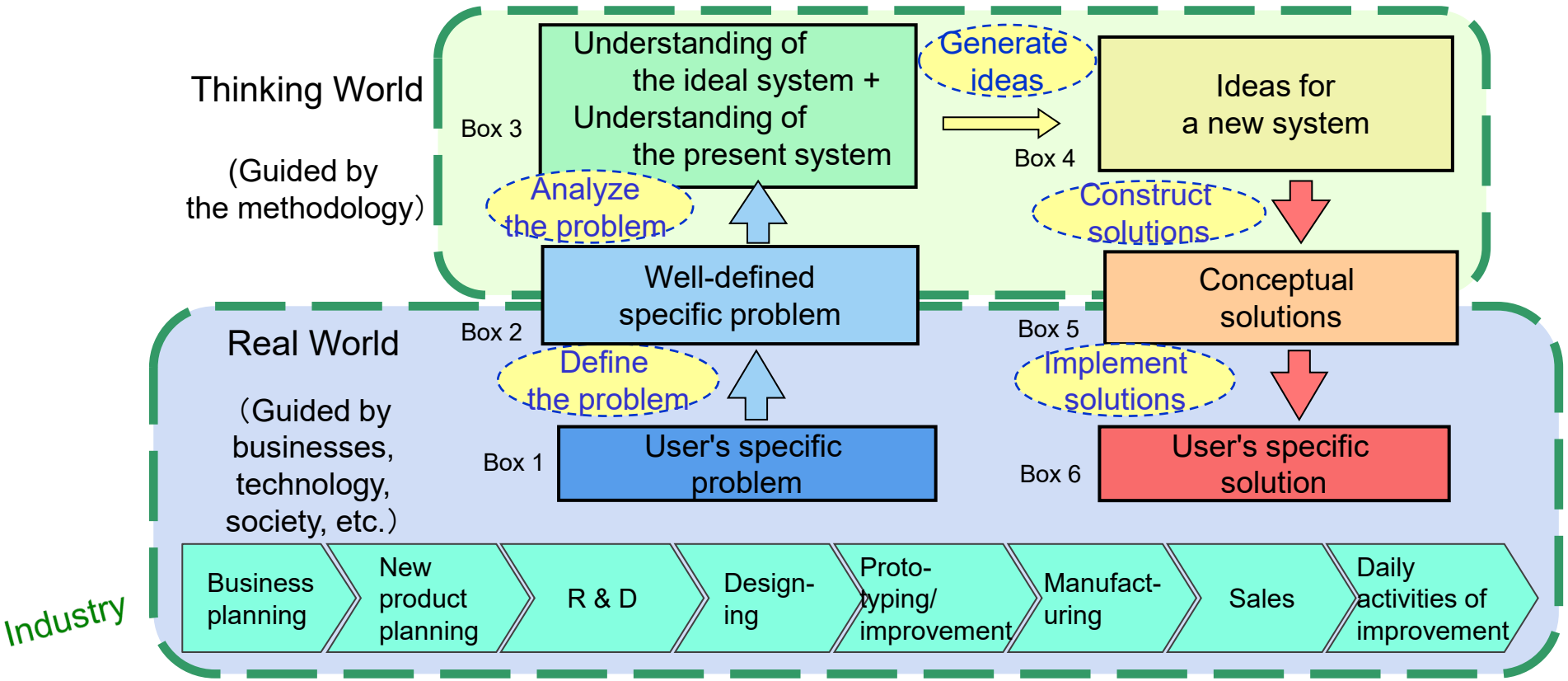
Initial problem

Too much water is necessary for flushing the toilet

Implemented solutions (products etc.)

6

[3F] Positioning "Six-Box Scheme": For Solving Real-World Problems



Which application field?
What type of Real World?
What stage of activity?
What purpose of problem solving?

How to analyze the problem, generate ideas, and construct solutions in the Thinking World?

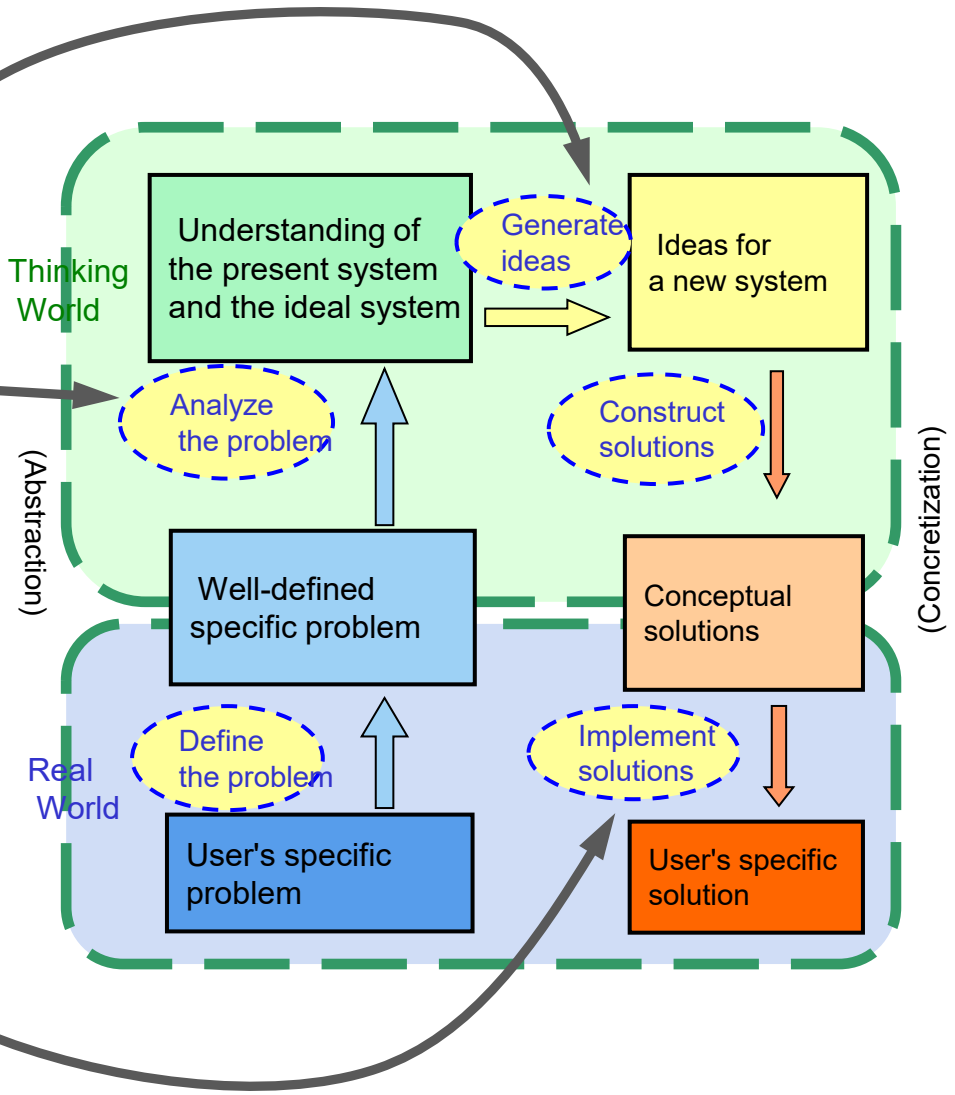
How to define the problem in the Real World?

How to implement the solutions in the Real World?

[3G] "Six-Box Scheme": A New Basic Paradigm for Creative Problem Solving

Integrating various Creativity Methods into the framework of Six-Box Scheme

Approaches	Examples
(a) Basics in Science &Technology	Principles, th knowledge b
(b) Learning from cases	Analogical th Equivalent tr
(c) Analyzing problems/ tasks	Mind mappin Quality funct Root cause a Functional ar
(d) Supporting idea generation	Brain stormir
(e) Taking care of environment and mental aspects	Brain stormir NM method,
(f) Realizing the ideas	Design meth method, CAI
(g) Foreseeing the future	Using variou writing
(h) Towards a general methodology	Four -box sc thinking, ET



Concluding Remarks

The Basic Paradigm of science & technology is the "Four-Box Scheme of Abstraction".

However, Basic Paradigm of "Creative Problem Solving" is not known yet and diverse "Creativity Methods" have been explored and advocated desparately.

Clues to the general methodology of creative problem solving have been prepared by TRIZ and USIT.

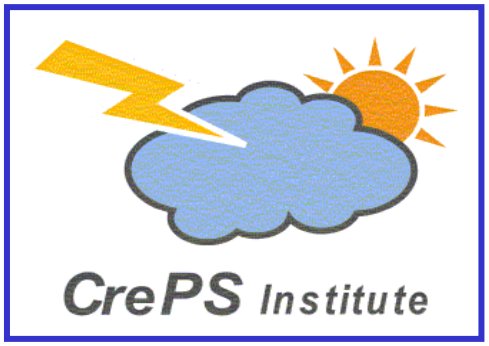
The "Six-Box Scheme" has been found to be "Basic Paradigm of Creative Problem Solving."

For creatively solving various problems in the real world, a basic scheme of how to think (or the Basic Paradigm) has been revealed.

A diversity of "Creativity Methods" may be understood and integrated into the framework of "Six-Box Scheme"(especially in its "Thinking World").

USIT is a concise, consistent, and effective process of executing the "Six-Box Scheme" especially in its "Thinking World".

The challenge left is to find the ways of handling various types of real problems in the "Real World" of the "Six-Box Scheme".



Thank you for your attention.

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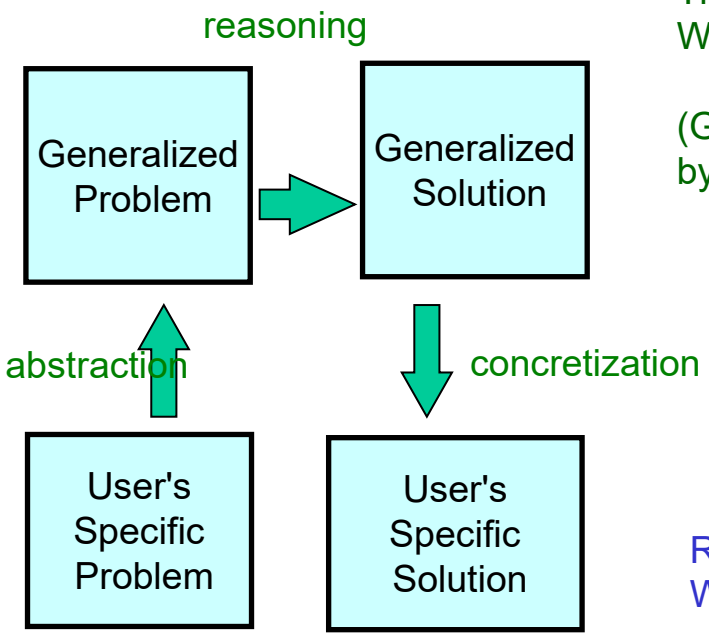
Basic Paradigm of Science and Technology

"Four-Box Scheme" of Abstraction



A New Paradigm for Creative Problem Solving

"Six-Box Scheme"