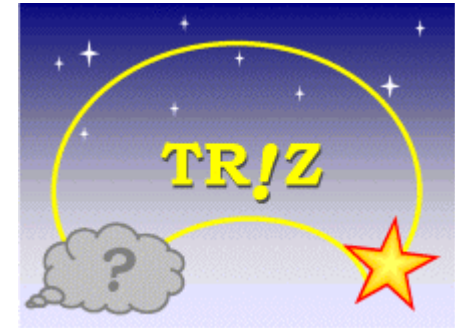


*Malaysia TRIZ Conference 2012*  
*Held by Malaysia TRIZ Innovation Association*  
*On Nov. 6-9, 2012 at Penang, Malaysia*  
*A Keynote Lecture*



**Creative Problem-Solving Methodologies**  
**TRIZ/USIT:**  
**Overview of My 15 Years**  
**in Research, Education, and Promotion**

**Nov. 8, 2012**

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**Emeritus Professor**  
**Osaka Gakuin University, Japan**

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# 1. Introduction: Personal History and Today's Talk

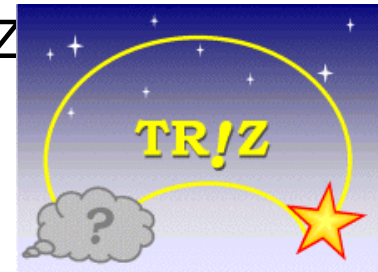
1963-1980 Univ. of Tokyo: Physical Chemistry, Research on molecular structure  
1980-1998 Fujitsu Co.: Research in Software QC, (later) research supporting staff  
1998-2012 Osaka Gakuin Univ.: Research, education, and social promotion of TRIZ



**Encountered TRIZ** in May 1997 in a seminar by a MIT researcher.  
Introduced TRIZ & TechOptimizer in Fujitsu Labs (till Mar. 1998)

Moved to Osaka Gakuin Univ. and worked to promote TRIZ

Started "**TRIZ Home Page in Japan**"  
(in Japanese & in English) (Nov. 1998)



Attended international conferences. Nov. 1998 USA, TRIZCONs (USA 1999 - )

Met **USIT** (Ed Sickafus, USA) (Mar. 1999) and  
started USIT training in Japan



Trip to TRIZ Mother Countries  
(Russia and Belarus) (Aug. 1999)



Japanese Edition of Classical TRIZ and Modern TRIZ textbooks:

Yuri Salamatov (ed. Valeri Souchkov, 1999) ==> (Sept. 2000)

Darrell Mann "Hands On Systematic Innovation" (2000) ==> (Jun. 2002)

**Slow-but-Steady Strategy for Promoting TRIZ** (Nakagawa, TRIZCON2000)

European TRIZ Conferences (ETRIA TFC, 2001 -)

**Developing USIT Further in Japan**

"**USIT Operators**" for solution generation (reorganizing TRIZ) (2002)

"**Six-Box Scheme**" -- a new paradigm for creative problem solving (2004)

Teaching classes in OGU: Case studies of solving familiar problems

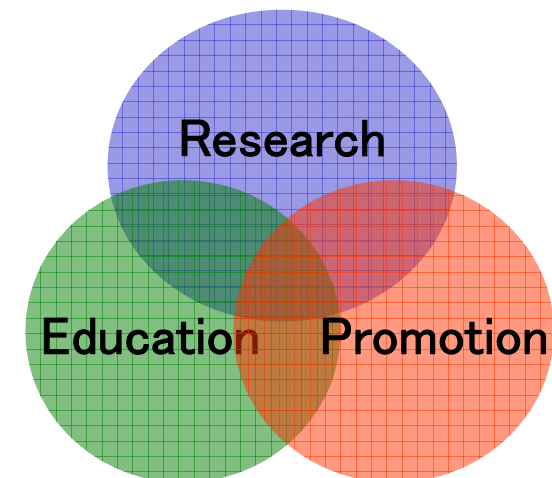
**Japan TRIZ Society**

(informally 2005, formally as an NPO 2007)

**TRIZ Symposium in Japan**

(annual, partly international, 2005- )

Proposal of "Global network of public websites  
in TRIZ" (2008)

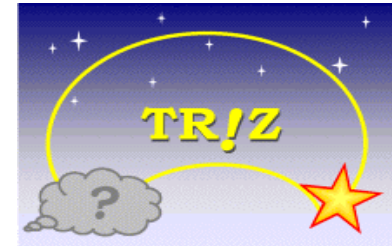


# 2. Research: TRIZ → USIT → New Paradigm

## 2.1 Understanding TRIZ (Theory of Inventive Problem Solving)

### 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

Patents DB

Set ups → Effects

Problem → Solution

World Extracted by TRIZ

Inverse retrieval of technology

solving contradictions

Trends of Systems

Target → Method, Method, ...

Contra-diction → Principles of Invention

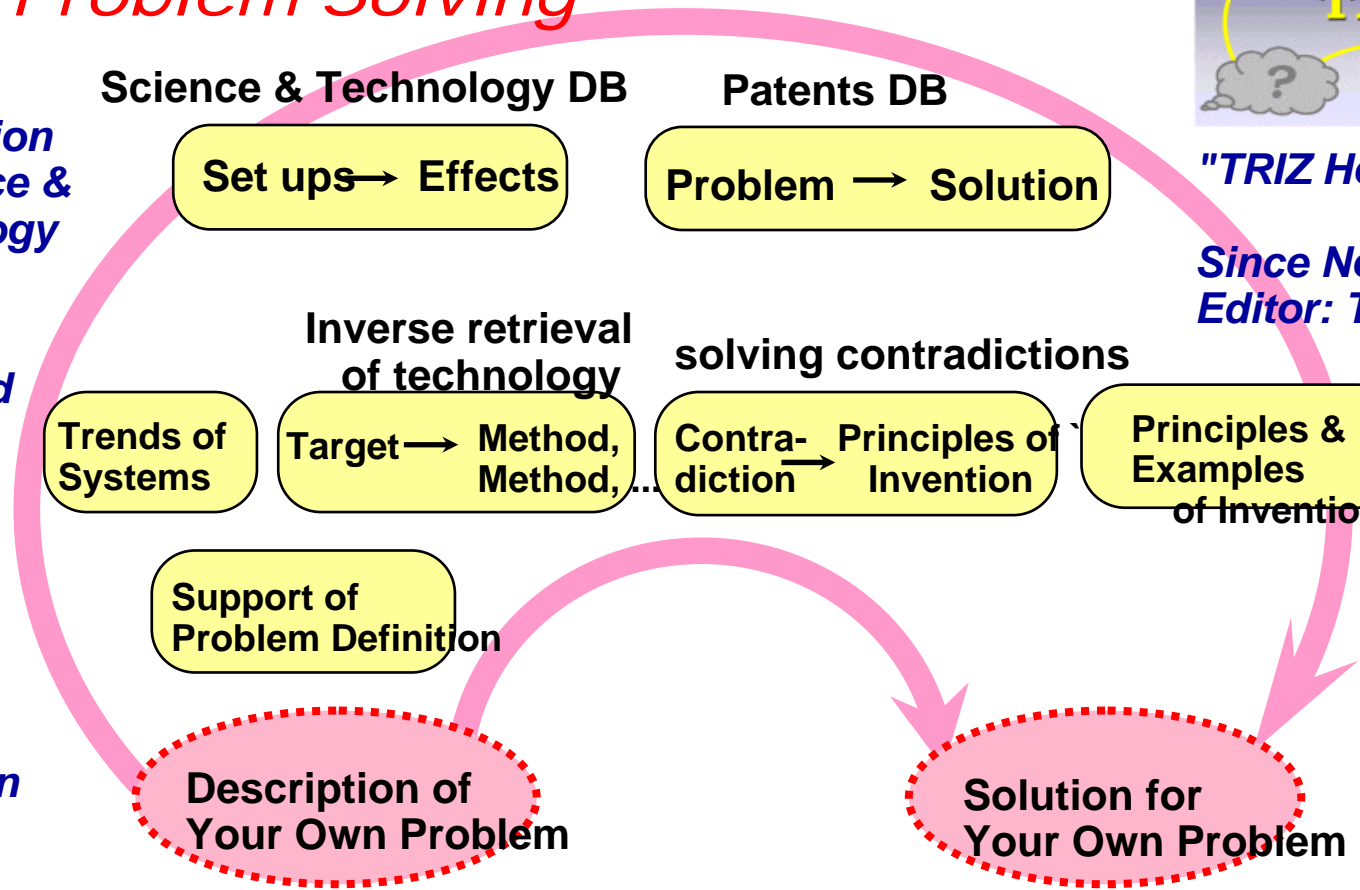
Principles & Examples of Invention

Support of Problem Definition

World of Your Own Problem

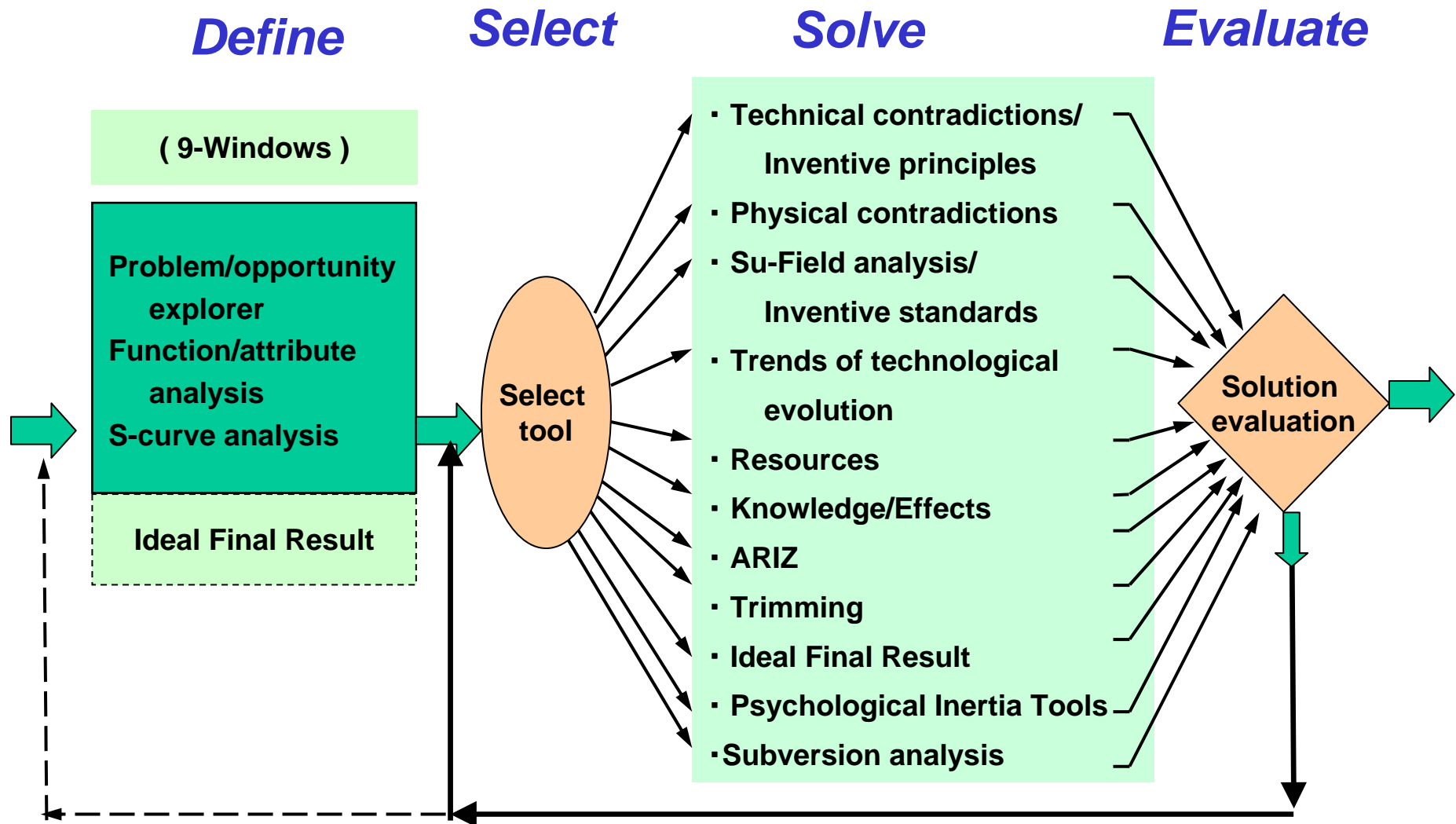
Description of Your Own Problem

Solution for Your Own Problem



# Overall Procedure in TRIZ

Darrell Mann's "HOSI" (2002)



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

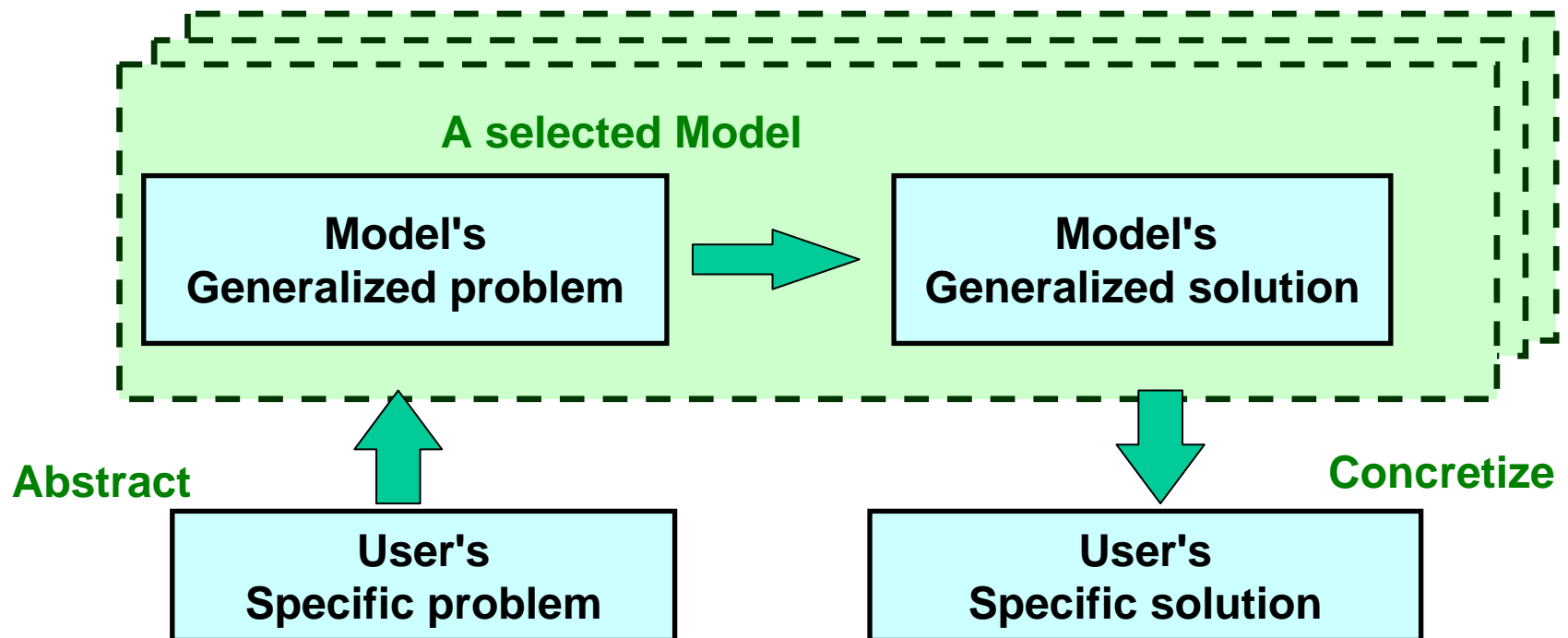
➡ We need a simpler and straightforward method. (Nakagawa)

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

**Science & Technologies** (Many models, specialized in areas)

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

Many models in the Knowledge Base



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

→ Partial and insufficient analysis.

# *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.

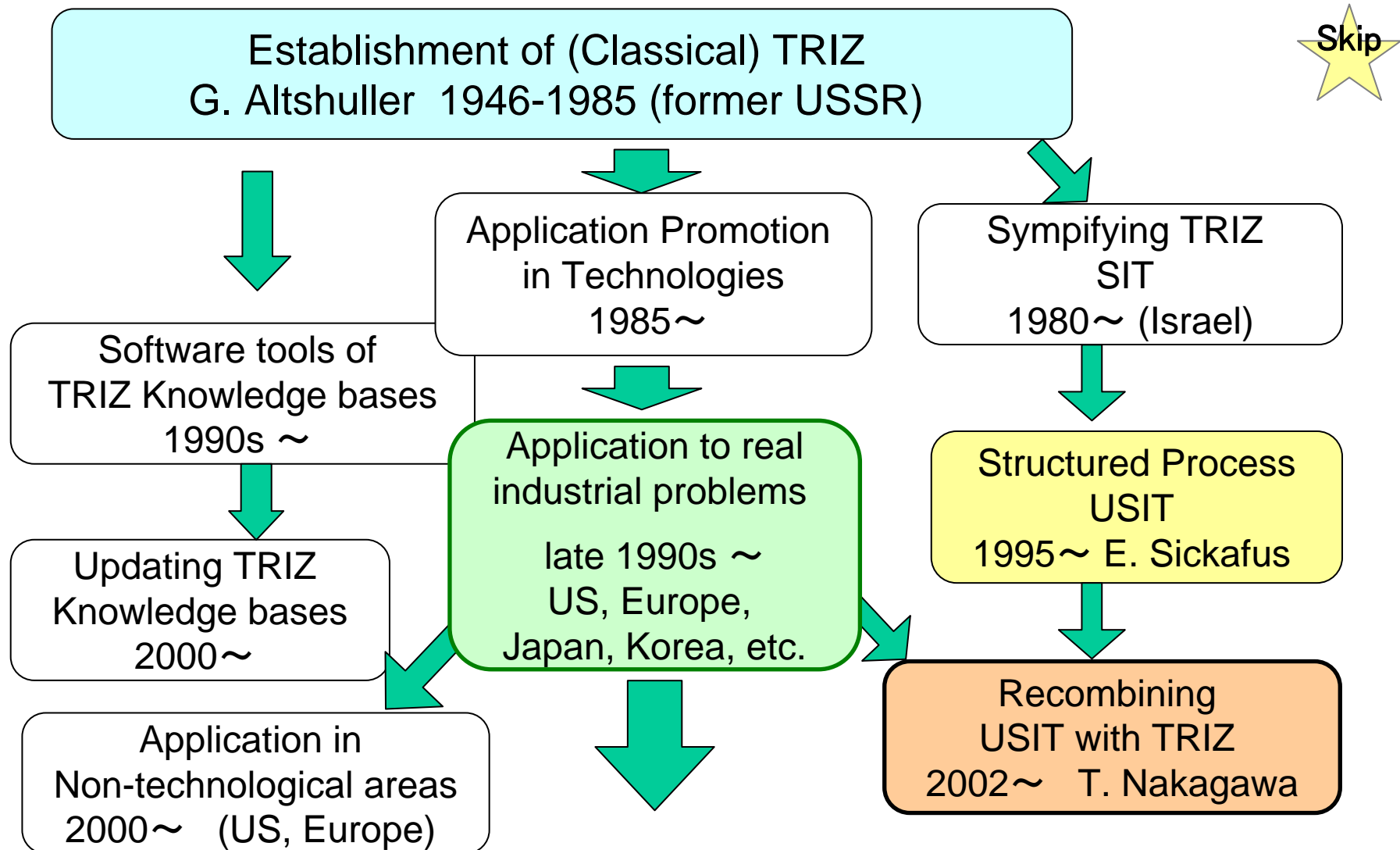


**TRIZ is huge and complex, people often say, but  
its essence is easy to learn and understand.**



## 2.2 From TRIZ to USIT (Unified Structured Inventive Thinking)

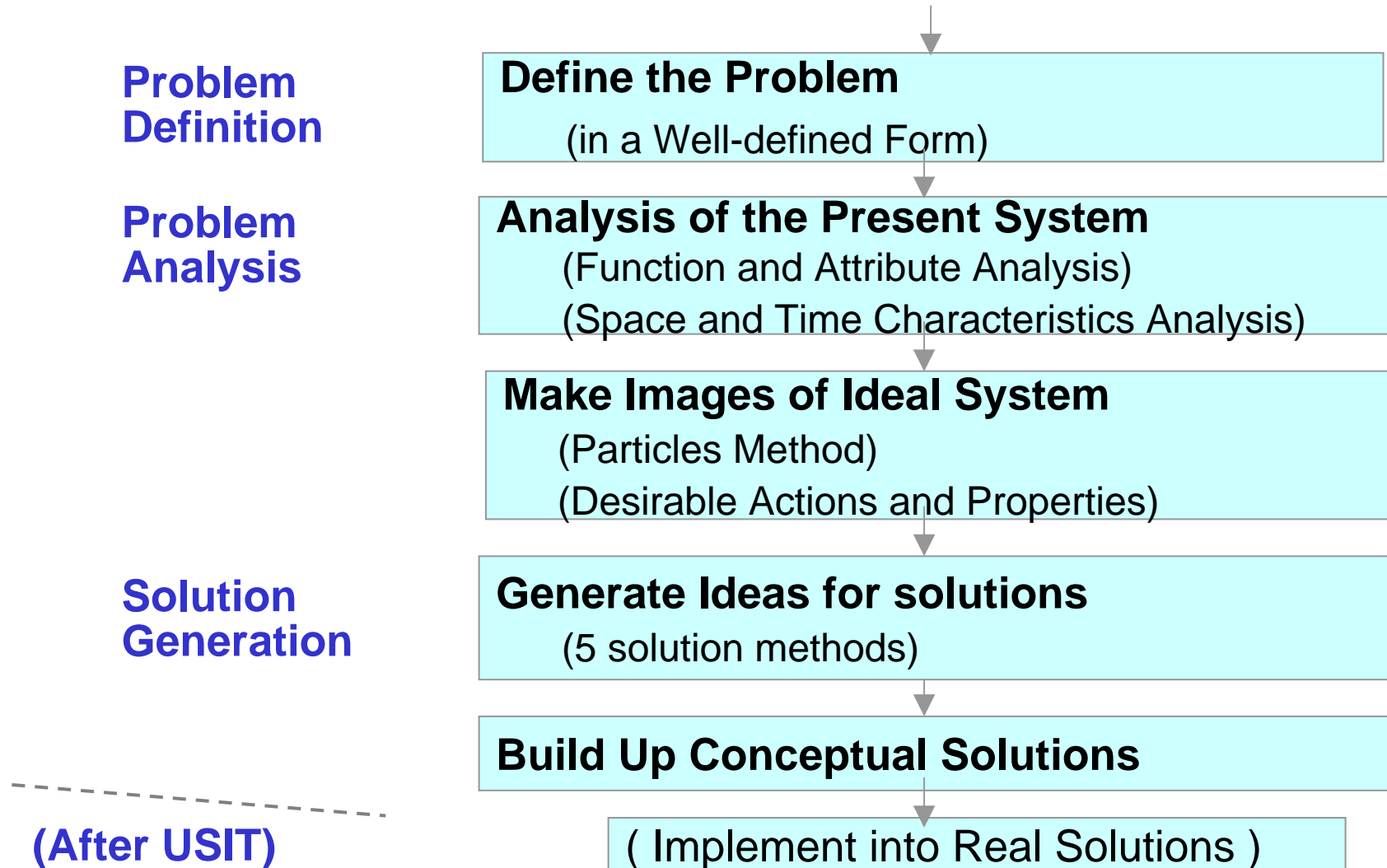
### Overview of TRIZ (and USIT) World History





# 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.



# Slow-but-Steady Strategy of Promoting TRIZ

(Nakagawa, 2000)



## Hurry and Forcing

**In a complete form  
of the whole TRIZ,  
Using the full ARIZ algorithm,  
Teaching system analysis,  
from the beginning,  
With top-down leadership  
organization,  
Ordering to all/many employees,  
Changing current R&D style  
drastically,  
Believing in its effectiveness,  
Rapidly, extensively, and widely**

## Slow but Steady (Nakagawa)

**Starting with the understandable  
parts of TRIZ,  
Using USIT process (a simplified TRIZ),  
Using TRIZ data base and USIT,  
at the beginning,  
With bottom-up grass-root  
organization,  
By groups of volunteer employees,  
Introducing into the current R&D  
activities,  
Proving its effectiveness by ourselves,  
Without hurrying; steadily, and deeply**

## Extension of USIT in Japan



## Significance of USIT



(1) Sickafus developed USIT, and we **introduced USIT** into Japan.  
(1999 Nakagawa)

Easy-to-learn TRIZ

Slow-but-Steady Strategy  
for promoting TRIZ in Japan.

(2) We reorganized TRIZ solution generation methods and constructed **USIT Operators**.  
(2002, Nakagawa, Kosha, Mihara)

USIT has unified the whole body of TRIZ.

USIT is a new generation of TRIZ.

(3) We represented the USIT procedure in the **Six-Box Scheme** and realized it as a new paradigm.  
(2004, Nakagawa)

No need to depend on the analogical thinking.

A New Paradigm of Creative Problem Solving.

(4) We have established the methods for education in university, training industrial engineers, and practical application to industrial problems

Easy-to-learn Case Studies

Full training in 2 days

Steady Strategy of promoting TRIZ

## 2.3 Simple Case Study of USIT Application (Student's thesis)

T. Shimoda and T. Nakagawa (2006)

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

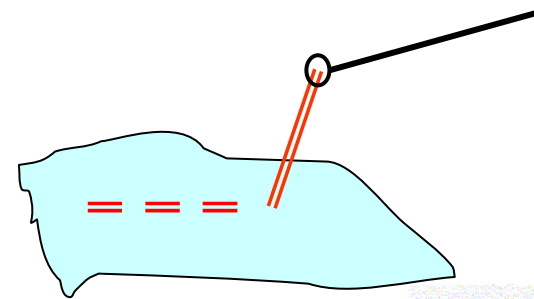


#### Problem Definition:

(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:**

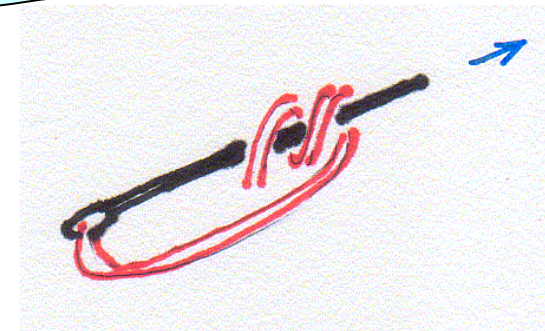


(d) **Plausible root causes:**

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

## (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

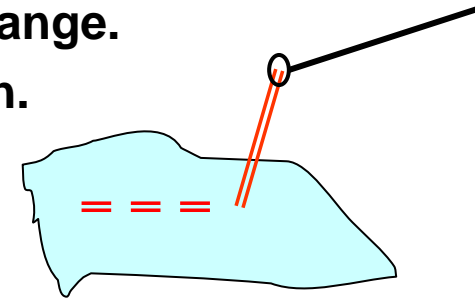


## (2) Attribute analysis: Properties taken for granted form the Constraints:

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:

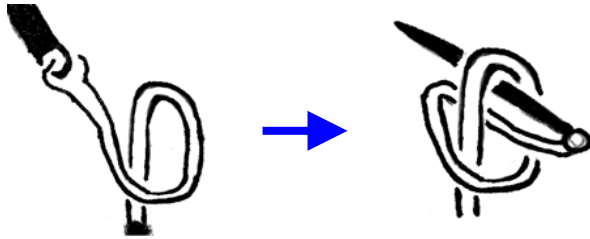
Solutions at the final stage and solutions at any earlier stage.

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

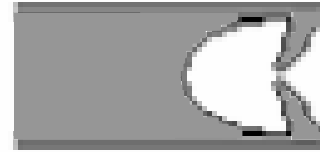
Watch out about the topology in making a knot and in the 'hole and string' .



## 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)

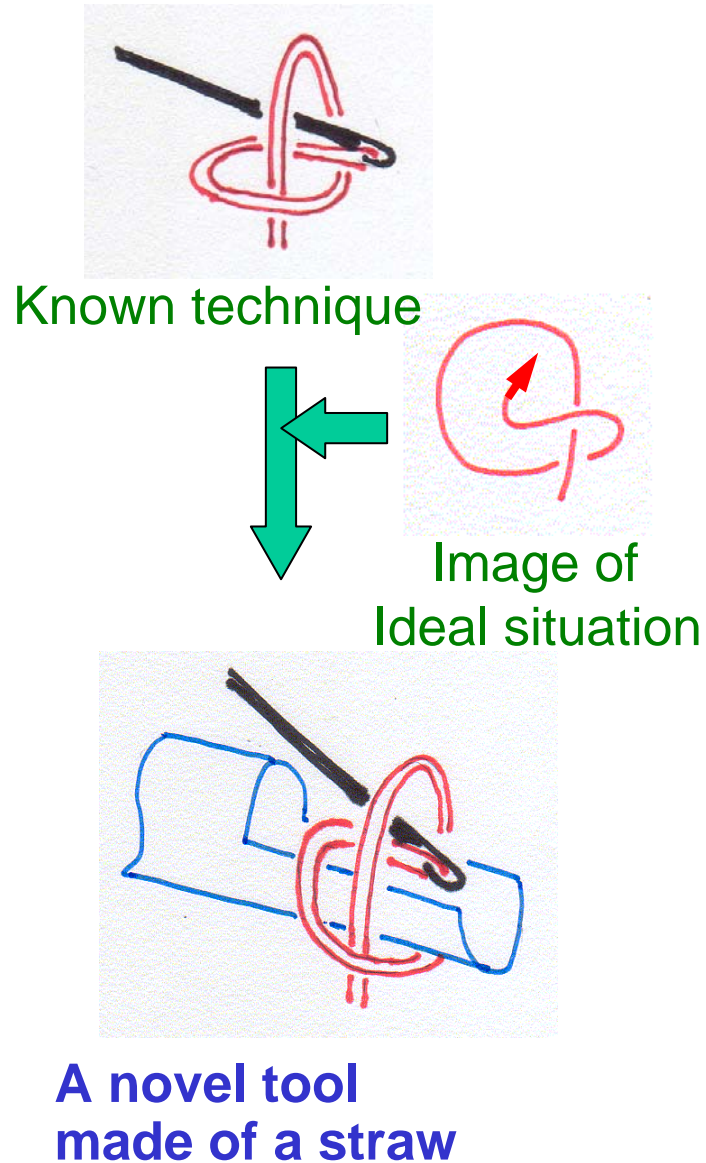
## Problem Analysis (2) : Understanding the Ideal system

Ideal arrangement of a string in space  
for making a knot

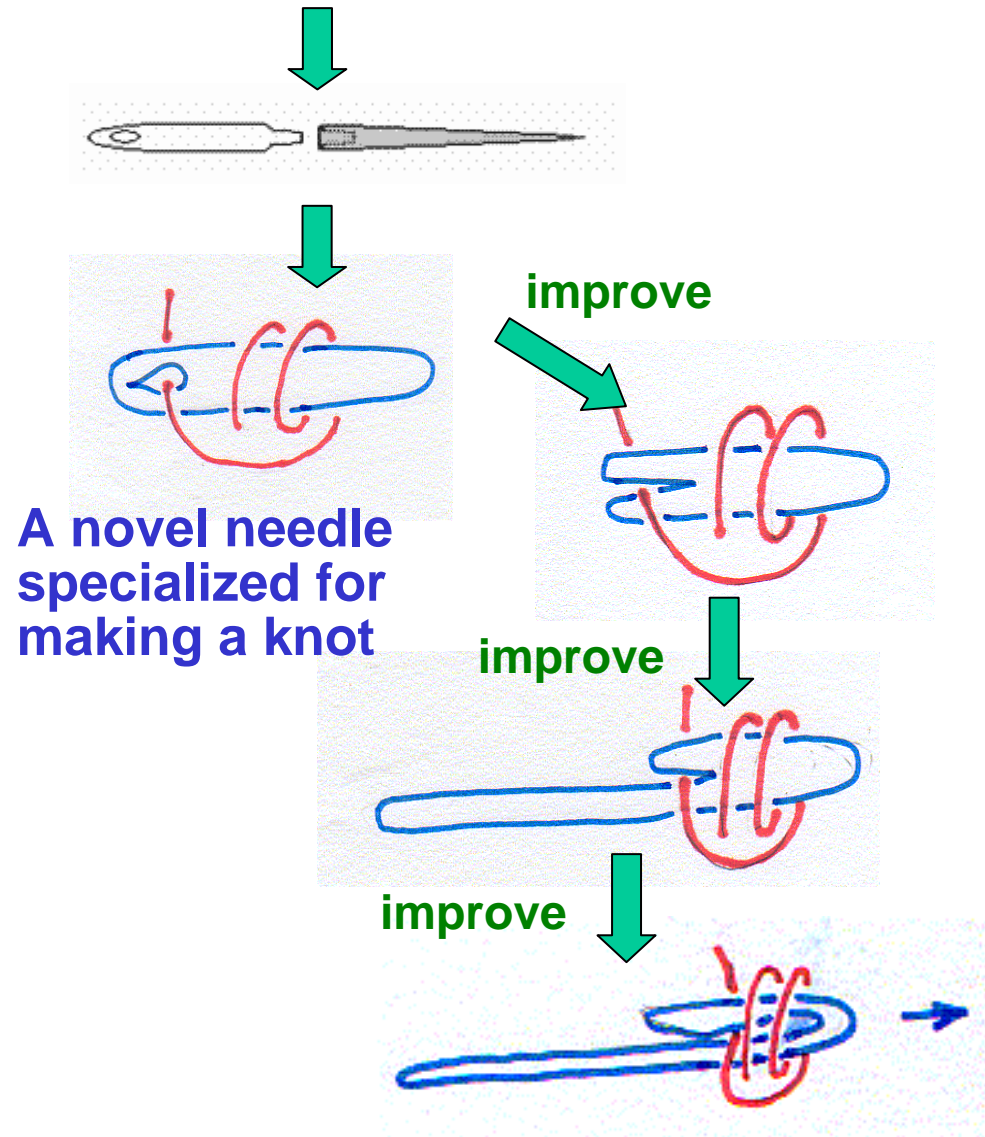


It should be nice if we could hold  
the string in this arrangement  
in the space.

# Solution Generation: Generate Ideas and Construct Solutions



A ridiculous idea : 'Break the needle!!'



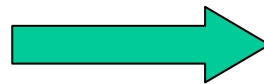


## 2.3 USIT Operators: A system of solution generation methods

Obtained by re-organizing all the solution methods in TRIZ

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

**TRIZ** methods for  
Solution Generation



**USIT** Operators

(5 Main-, 32 sub-methods)

40 Inventive Principles

76 Inventive Standards

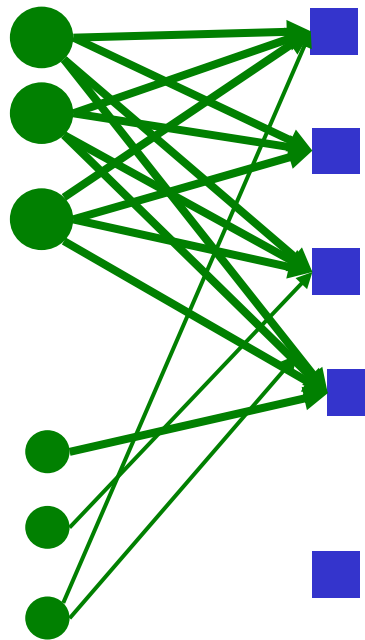
35 Trends of

System Evolution

Separation Principle

Self-X Principle

Trimming



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

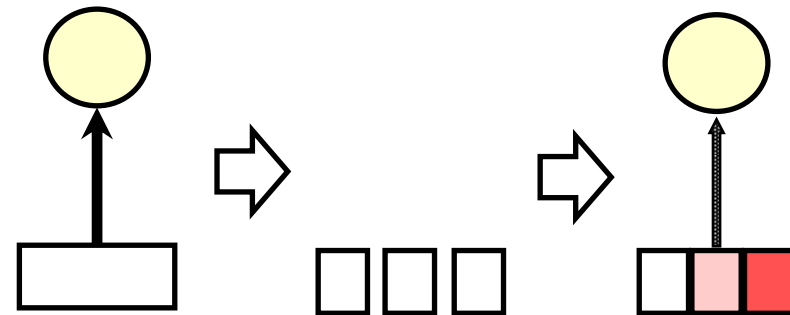
#### (1c) Divide the Object (into $1/2$ , $1/3$ , ..., $1/\infty$ ).

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

TRIZ Inventive Principles

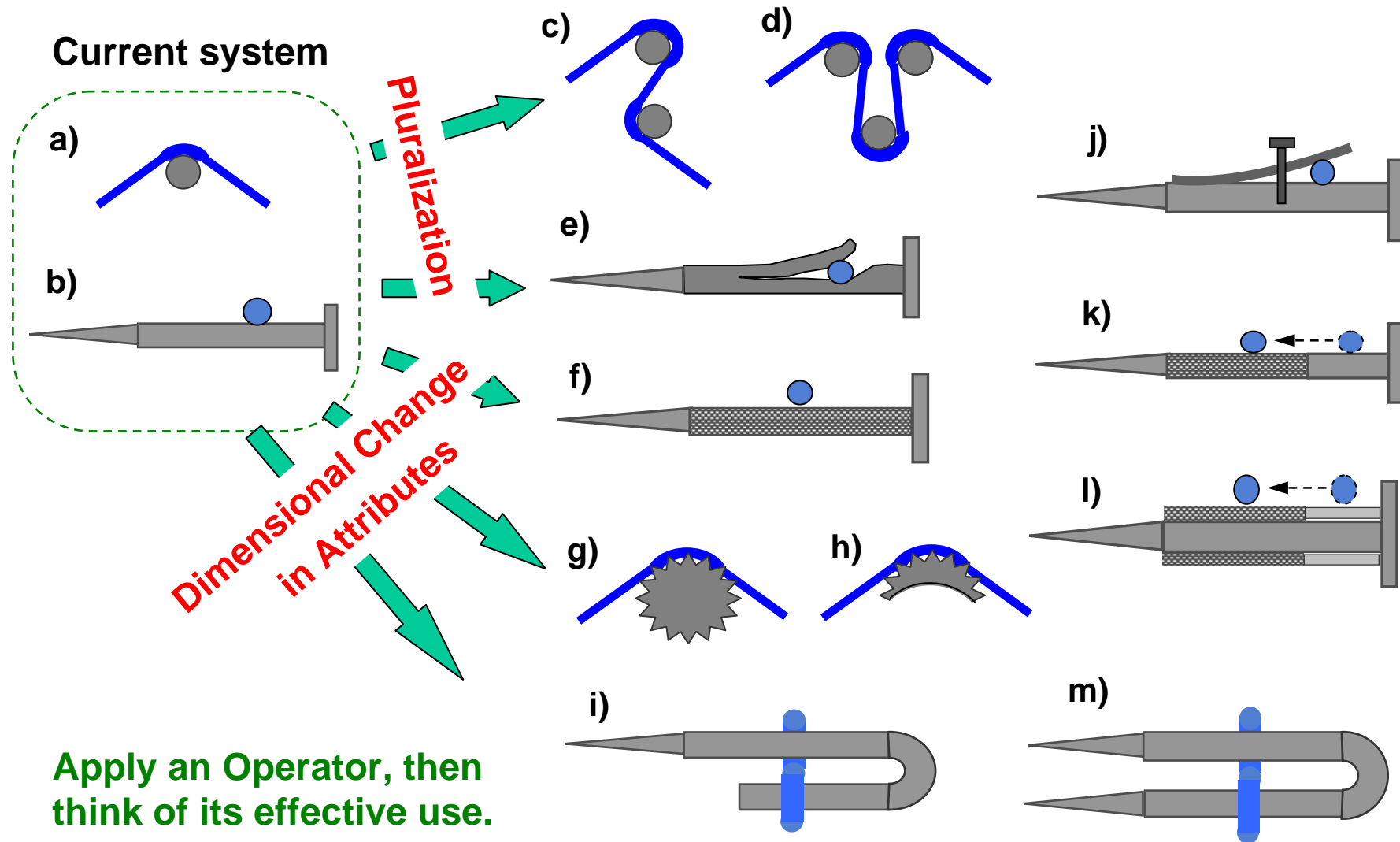
which brought this sub-method:

- 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.

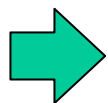
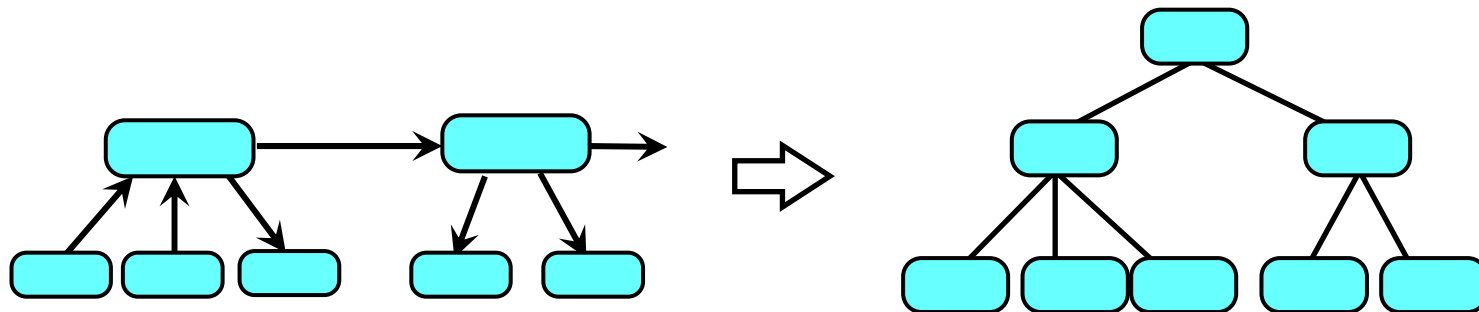


## USIT Operators

### 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.

# USIT Procedure [Flowchart]

[T. Nakagawa, Mar. 2005]

**Problem  
Definition**

Define the Problem (in a Well-defined Form)

Skip

**Problem  
Analysis**

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

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

**Solution  
Generation**

Pluralization  
of Objects

Dimensional Change  
in Attributes

Distribution  
of Functions

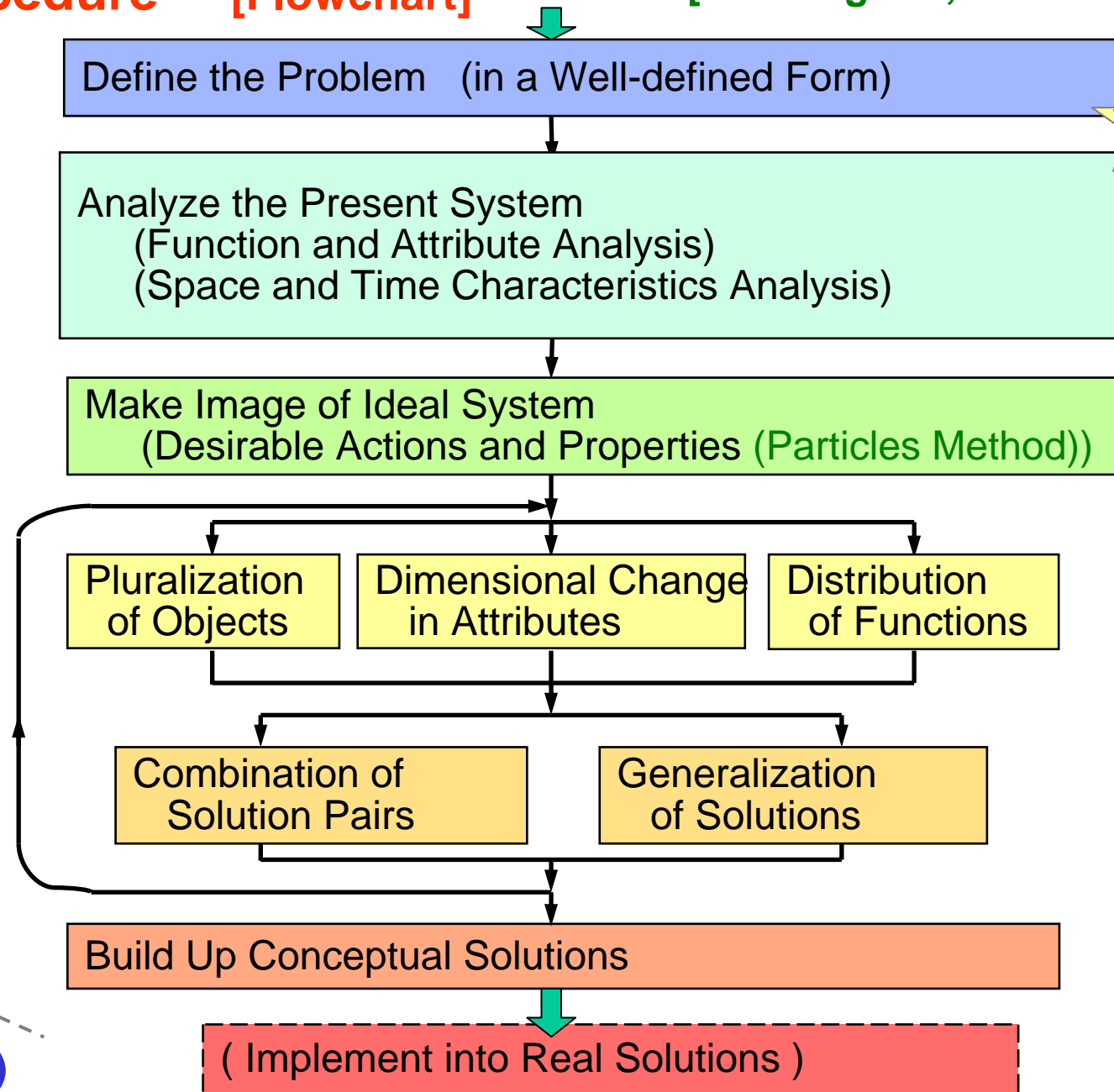
Combination of  
Solution Pairs

Generalization  
of Solutions

**After  
USIT  
( Implementation)**

Build Up Conceptual Solutions

( Implement into Real Solutions )

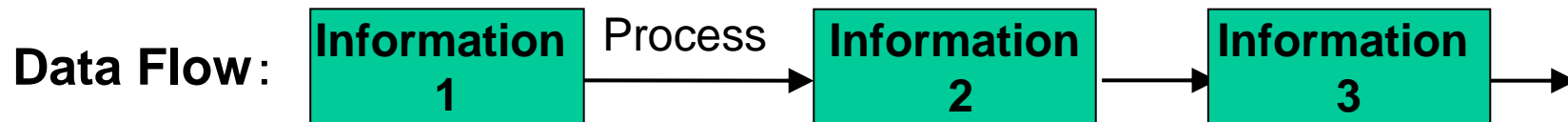
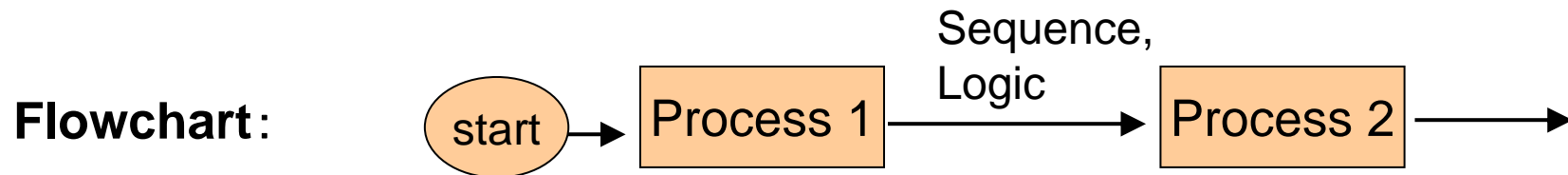


## 2.4 Six-Box Scheme of USIT: A New Paradigm for Creative Problem Solving



We represented the USIT procedure in Data Flow Diagram.

(T. Nakagawa, Sept. 2004)



Facts  
well known  
in computer  
science:

Data Flow describes the in/out and intermediary information as requirements.

There may be different methods (How) for achieving such requirements (What).

Flowcharts try to describe the means (How) to perform.

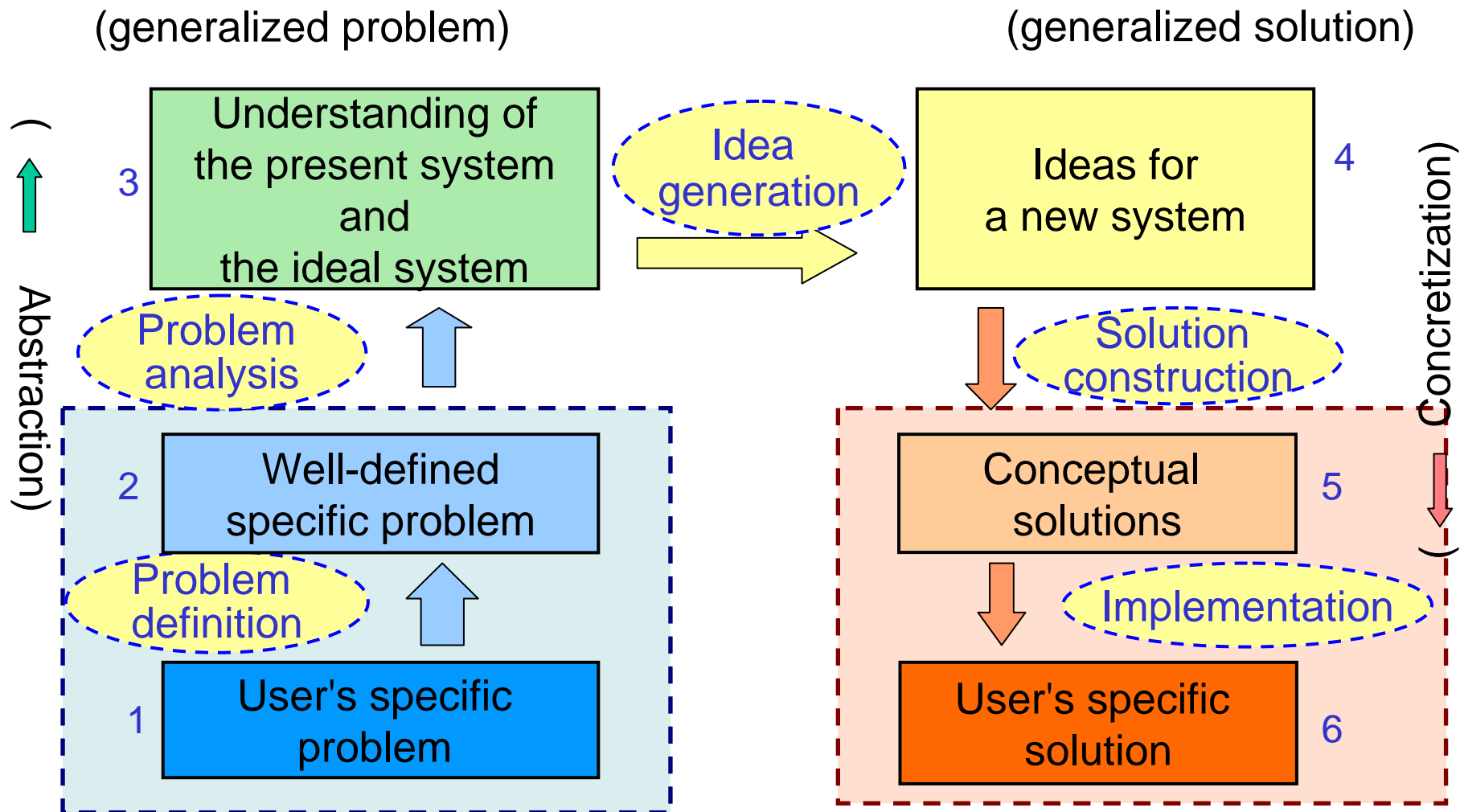
The information to be handled are implicit, not specified explicitly.

**Data Flow representations are more basic and stable  
than the Flowcharts.**

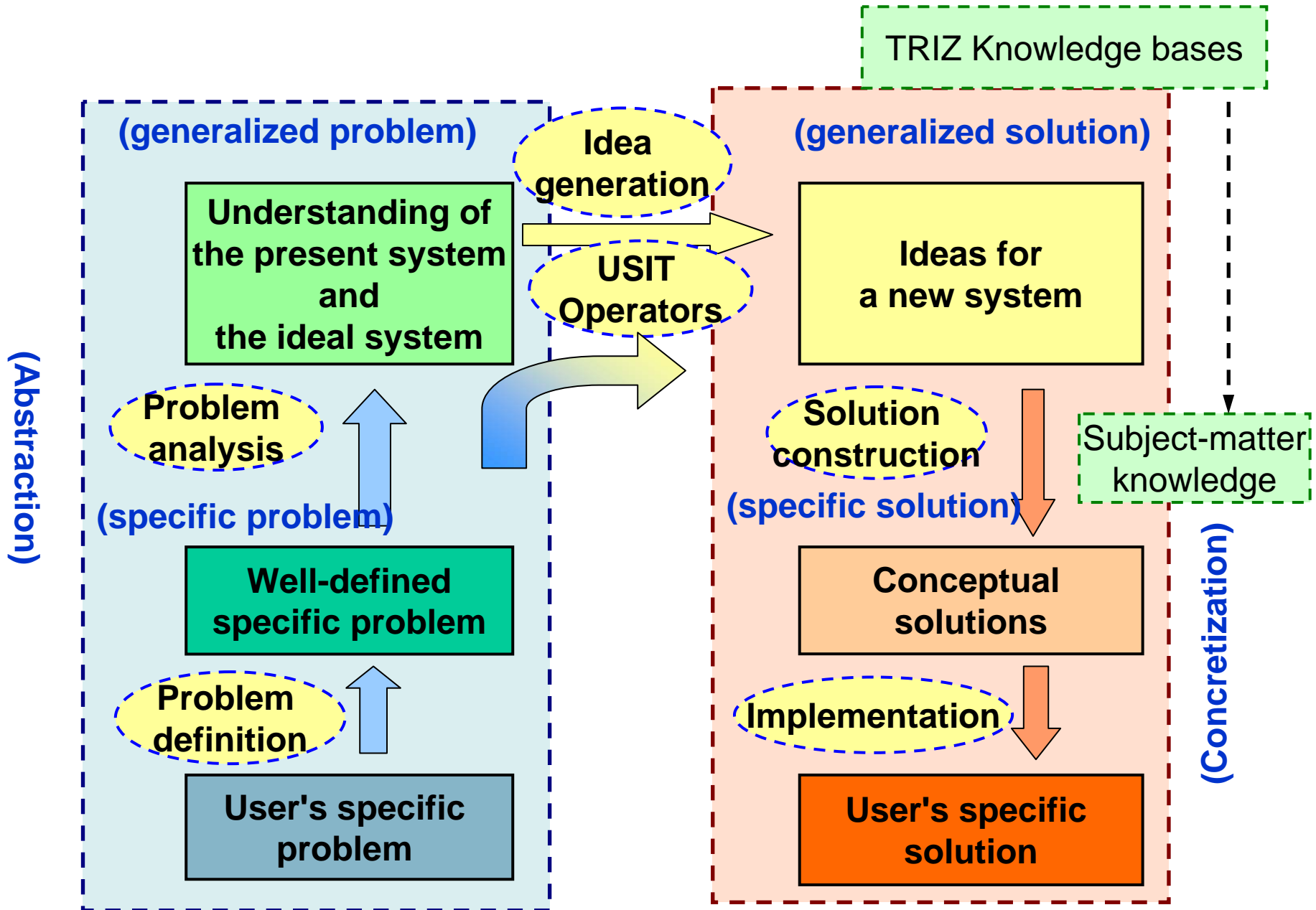
# Six-Box Scheme of USIT: Data-Flow Representation

## New Paradigm for Creative Problem Solving

A unified method across the fields



# 6-Box Scheme of Creative Problem Solving (USIT)





# 2.5 Practices of USIT

- 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

Introduction to TRIZ/USIT	L
	L
Problem Definition	P&D
	L
	GW
	P&D
	P&D
Analysis of Present System	L
	GW
	P&D

Analysis of Ideal System	L
	GW
	P&D
Solution Generation	L
	GW
	P&D
	GW
	P&D
	GW
	P&D
	GW
	P&D
Promotion in Industries	L
	D

## 2.6 Our New General Target

Reflection of the TRIZ penetration problem has guided me to a new target at a higher level (Nakagawa, 2012):

### **General Target :**

**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)".**

# General methodology of creative problem-solving

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 (and the new paradigm with USIT)

### 3. Education: Education of Creativity and Independence



Main subjects I taught at OGU (Faculty of Information Science)

- Several classes in information science

(Information processing exercise, Computer science, Introduction to information science, Numerical computation, Software engineering, etc.)

#### ● Seminar IB (1st year students, 2nd term)

Discussion and training of report writing

Using "7 Habits of Highly Effective Teens" by Sean Covey

#### ● Seminar IIA (2nd year, 1st term)

Group work of surveying various products and think of their evolution

Ex: "A large variety of writing instruments -- Studying the evolution of Technologies in Familiar Items" (Nakatani & Nakagawa, 2010)

## ● Lecture: Scientific information methodology (2nd year, 2nd term)

Lectures (90 min. × 14) on "Methodologies of Creative Problem Solving".  Skip

Motivation, Needs of problem solving, Concepts of systems,  
Finding problems, Understanding the problem (functions, attributes, space & time, root causes), Imaging an ideal system;

Solution generation (using knowledge bases, contradictions, UIST operators);

Problem solving methodologies (Case studies, Overview of USIT, TRIZ)

## ● Seminar III (3rd year students)

Learning case studies of TRIZ/USIT, Group practices of problem solving

## ● Seminar for Thesis (4th year students)

Group discussion and individual practices of problem solving for thesis work.

Ex. How to fix a string shorter than the needle <=> USIT full process

How to Prevent Unauthorized Persons from Entering  
the Auto-locking Door of Apartment Building

<=> Solving psychological/social and technical problems altogether

## 4. Social Promotion of TRIZ

### 4.1 Organizing Japan TRIZ Society (NPO) and Holding TRIZ Symposium in Japan

Have organized Japan TRIZ Society  
(informally in 2005; formally as an NPO in 2007)



Japanese National AND (partially but as much as possible) International Conference

- Japanese and English slides are projected in parallel.
- Presentations and attendance by many industrial people
- Active and friendly presentations and discussions



Year		2005	2006	2007	2008	2009	2010	2011	2012
Presentations	total	21	35	37	46	43	40	40	45
	overseas	(3)	(11)	(11)	(13)	(14)	(13)	(9)	(12)
Attendees	total	104	157	201	180	137	165	115	127
	overseas	(4)	(18)	(10)	(15)	(19)	(46)	(11)	(20)



## Japan TRIZ Symposium: Keynote and Invited speakers

2005	Darrell Mann (UK)	T. Nakagawa (OGU)
2006	Hansjuergen Linde (Germany); Ed Sickafus (USA)	S. Hibino (Chukyo Univ.) K. Yamaguchi (Panasonic C.C.)
2007	Larry Ball (USA); Simon Dewulf (Belgium)	T. Hayashi (Hitachi), S. Tamai (Matsushita), N. Okuzumi (Toshiba)
2008	Amir Roggel (Israel); Sergei Ikovenko (USA)	Y. Fukushima (Matsushita)
2009	Boris Zlotin (USA); Darrell Mann (UK)	
2010	Nikolai Khomenko (Canada); Mahmoud Karimi (Iran)	M. Sawaguchi (Waseda U.), K. Yamaguchi (MOST); T. Kataoka (Patbrain); T. Shonai (Hitachi); T. Nakagawa (OGU)
2011	Simon Litvin (USA)	S. Suzuki (ET Society); O. Kumasaka; K. Shikakura (IM Jakpan); T. Kamimura (Ideation Japan); M. Hotta (SKI); T. Nakagawa (OGU)
2012	Denis Cavallucci (France); Jeongho Shin (Korea)	K. Yumino (Japan Creativity Soc.); H. Kasai (IDEA); S. Kurosawa; F. Kikuchi (Pioneer); T. Nakagawa (OGU); A. Ikeda (Sony)

## 4.2 "TRIZ Home Page in Japan" Web site and the vision of 'Global Network of Public Web Sites'

"TRIZ Home Page in Japan" Web site  
in Japanese and in English  
Established since Nov. 1, 1998  
Editor: Toru Nakagawa



An open forum for better understanding and usage of TRIZ.

Posting introductory articles, papers, case studies, news, communications, etc.

All my works are posted here.

**Articles written by many different authors in Japan and overseas are posted.**

Japanese pages and English pages in parallel as much as possible.

All the articles accumulated for 14 years can be accessed with one click from the categorized general index.

Updated irregularly, every 2 to 4 weeks. 1 to 5 articles every time.

Update Announcement is sent via email to ~700 in Japan and ~400 overseas.

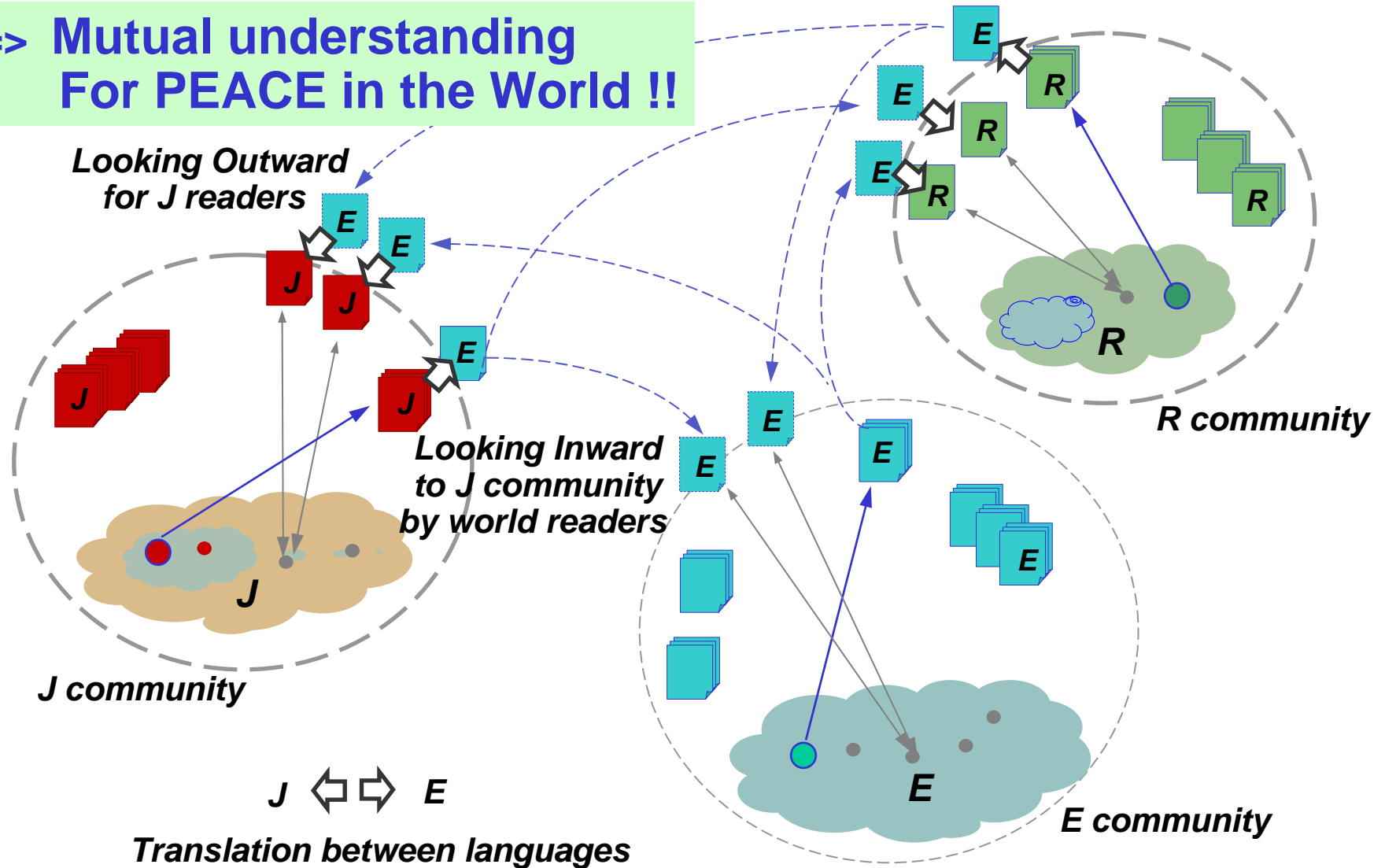
**==> A model of "Public Web site".**



# Global Network of (Regional) Public Web Sites in TRIZ

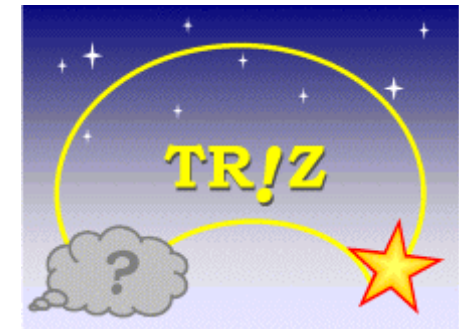
==> Autonomous growth of Global TRIZ Community by overcoming language barriers

==> Mutual understanding For PEACE in the World !!



*Thank you  
for your attention*

Toru Nakagawa  
(Osaka Gakuin Univ., Japan)  
nakagawa@ogu.ac.jp



“TRIZ Home Page in Japan”

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