USIT Manual

Toru Nakagawa
(Osaka Gakuin University, Professor Emeritus)

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The latest edition is always posted in the public Web site "TRIZ Home Page in Japan":
Japanese edition:
http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/jCrePS/jCrePS-USIT/jCrePS-USIT-Manual.html
English edition:
http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/eTRIZ/eCrePS/eCrePS-USIT/eCrePS-USIT-Manual.html

Preface: Purposes, Targets, and Means

- Purposes
  - To enable both beginners and practitioners to understand the USIT process and to apply it in practices.
- Targets
  - To understand the purposes and the goals for each step of the process
  - To understand the process and the methods for each step
  - To understand the points of care and know-hows for each step
- Means
  - By illustrating the overall view of USIT in a consistent manner
  - By showing the steps of the USIT process in a practical way, by pointing out their purposes & goals, processes & methods, and points of care and know-hows.
  - By providing a collection of USIT case studies which demonstrate actual ways of performing each step depending on the problem situations.

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Introduction: Purposes to learn and apply USIT

We know: In our everyday jobs, we are faced with many problems and only after overcoming them we can achieve technology developments and make good products and services, etc..

We also know: Only if our products and services are better than those of competitors and are well accepted by our customers, we can make businesses successfully.

We should know: The problems we have to overcome in our jobs are often so hard to solve by simply applying our current knowledge and methods.

Borrowing other person's or other company's knowledge/technology is not a proper solution for overcoming our problems.

We should think for ourselves creatively to generate some new solutions.

For the purpose, we need to master the methods for solving problems creatively and must have the capability of applying them to our real jobs.

USIT is a general and concise process for creative problem solving. So let's learn USIT and apply USIT to solve problems in our actual jobs.

Introduction: What is USIT?

- USIT is a concise and general process for executing 'creative problem solving'.
- USIT is now regarded as a concise and consistent process for executing the creative problem solving on the basis of the new paradigm, i.e., 'Six-Box Scheme'.
- Along the Six-Box Scheme of USIT,
  we first define the problem,
  then understand the present system and
  make an image of the ideal system, and
  go ahead to generate new ideas, and
  finally construct conceptual solutions.
- USIT is applicable in all the areas of technology, and
  also in non-technological and familiar, everyday life areas.

Introduction: What is USIT? (detail)

- **Historically, our creative problem solving methods are based first on TRIZ ('Theory of Inventive Problem Solving').**
  TRIZ was established by Genrich Altshuller (in the former USSR).
  He analyzed a large number of patents, developed many knowledge bases for supporting the evolution and development of technologies, and also made a variety of techniques for creative problem solving.

- **USIT ('Unified Structured Inventive Thinking) developed by Ed Sickafus (USA) is the second but direct source of our methods.**
  He developed, under the influence of TRIZ, a concise and consistent process for creative problem solving.

- **USIT in the present stage has been developed in Japan as a concise and consistent process for creative problem solving.**
  Since 1999, Toru Nakagawa et al. have integrated TRIZ and USIT and extended the revised USIT further in practice and in theory.

- **The 'Six-Box Scheme' is our new paradigm (in place of the conventional 'Four-Box Scheme').**
  It is the paradigm of CrePS which can integrate a wide variety of problem solving methods, creativity techniques, and idea generation methods.

Introduction: Characteristic features of USIT

- **USIT is a consistent process composed of clearly defined steps.**
- **USIT helps to visualize the logical and institutional thinking** in the form of words and figures, to build them up step by step, to form new understanding, and to generate creative solutions.
- **You can use USIT individually but more effectively in cooperative group work.**
- **USIT intends to be concise**, in its steps of the process and in the representation of the thinking results.
- **USIT encourages us to utilize our own thinking ability in its full extent**, without trying to depend on the outside knowledge,

  Handbooks, knowledge bases, software tools, patent search, information survey, etc. should be used, if necessary, separately in advance, afterwards, or in parallel.
- **Problem situations in real jobs should be sorted and set in focus in the 'Real World', and the problem should be solved with USIT in the 'Thinking World'.**

  The problem is taken out of the 'Real World' where society, business, and technology are predominant, and is solved in the 'Thinking World' where the free and abstract thinking are encouraged with the support of the solution techniques and technology.
- **USIT will support you to get new conceptual solution rapidly** even in cases of short and hurrying development by use of its effective methods of analysis and idea generation.

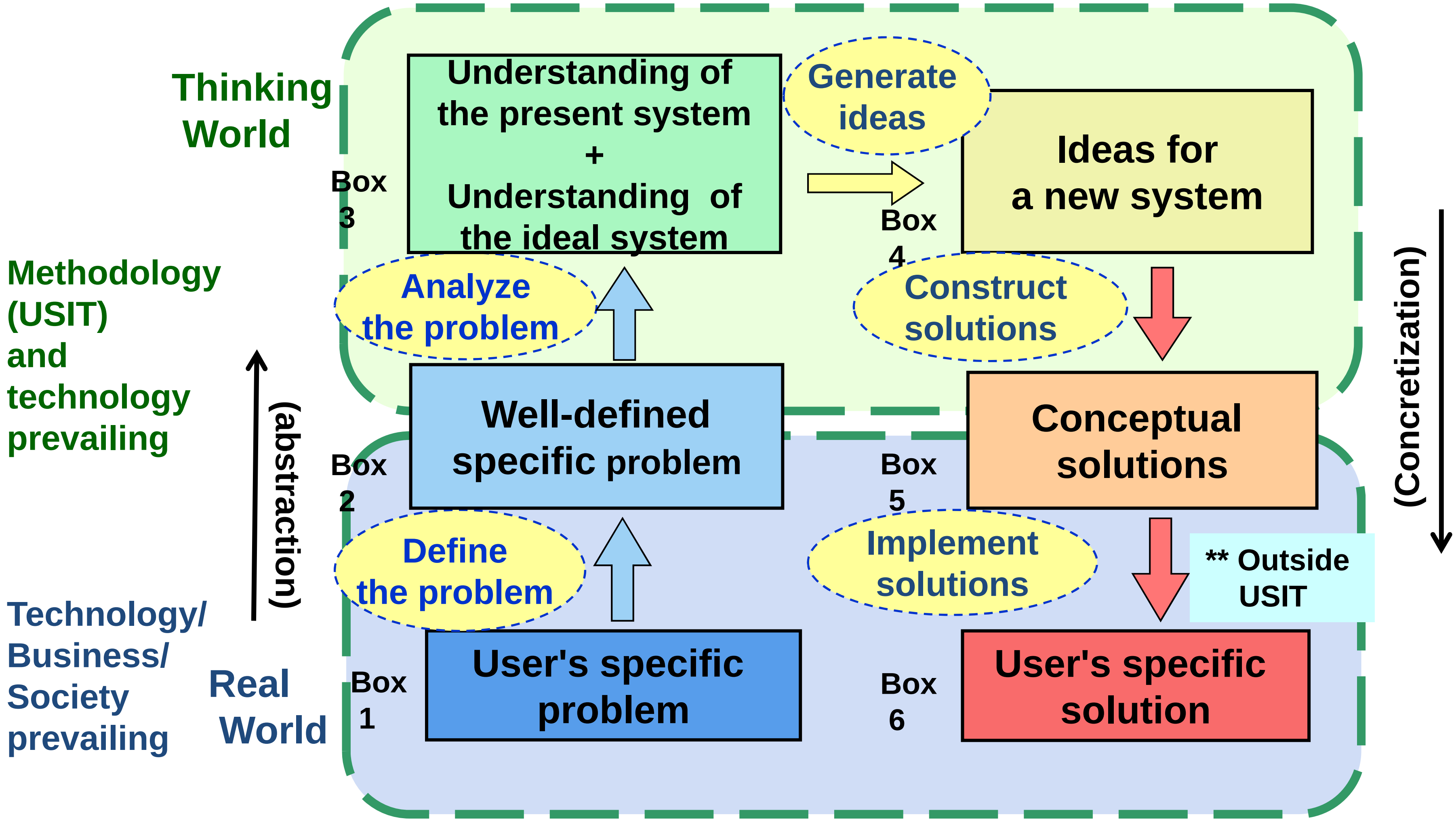
Introduction: How to use USIT.

- **The USIT process is executed along the well-defined steps. However, you may not stick to the steps rigidly.**
  - For instance, **the 'plausible root causes'** are defined at Step 1; but when the root causes become clearer at any later step, you should discuss and re-define them at the stage.
  - For understanding the present system, we analyze it at the aspects of **space, time, attributes, and functions.**
    The four aspects may be analyzed in any order, suitable for each problem. The order described in the present Manual will be appropriate in most cases.
  - Understanding of the present system includes the understanding of the **requirement to the system**, and the latter naturally stimulates the discussion about the ideals of the system.
  - At the steps of understanding the present or the ideal system, or even at the initial step of problem definition, **you may think of various ideas naturally**. You should individually take note of them and discuss about them later in the idea generation step.

- **You should express your ideas in words (i.e., in talking or in writing), make your images in figures, and display the overall views.**
  - Ideas and findings are to be written down **in cards** (e.g., Post-It-notes) one by one.
  - Keywords, short sentences, sketched, schematics, etc. are to be used.
  - In place of OA boards and PCs, **big sheets of paper** are recommended to use for posting the cards in a flexible manner and for keeping them displayed through out the process.

- **Besides the persons directly in charge of the problem, it is recommended to add members of different and wider views to the project.**
  -- A person who has mastered the USIT method **serve as the facilitator** (instead of a leader of the problem solving project.

Overall View of the USIT Process ('Six-Box Scheme') (data flow representation)



Overall View of USIT process ("Six box method") (explanation)

	Basic concept of each box (stage)	Main information in each box
Box 1	User's specific problem	Problem situations (recognition & description by the persons in charge)
Box 2	Well-defined specific problem	Problem (Unwanted effect), Task statement, Sketch, Plausible root causes, Minimum set of objects
Box 3	Understanding of the present system + the ideal system	Time & space characteristics, Attributes and their relevance, Functional relationships of objects, Mechanism of the present system, Image of the ideal results, Desirable behaviors and Desirable properties
Box 4	Ideas for the new system	Basic ideas for the new systems, A hierarchical system of ideas
Box 5	Conceptual solutions	Conceptual solutions (multiple), Preliminary evaluation of solution concepts, remaining problems, Report of the USIT project
Box 6	User's specific solutions	Implemented results in products, services, processes, etc.

processing step (main method)

- **Define the problem** (Box 1 → Box 2)
  (Raising issues in business)
  (USIT group discussion)
- **Analyze the problem** (Box 2 → Box 3)
  (Space & Time characteristic analysis)
  (Function & attribute analysis)
  (Particles method)
- **Generate ideas** (Box 3 → Box 4)
  (USIT Operators)
- **Construct solutions** (Box 4 → Box 5)
  (Basic capability in the subject matter)
- **Implement the solutions** (Box 5 → Box 6)
  (Real World activities outside USIT)

Execution steps of the USIT Process

The execution steps of the USIT process are shown below in about 20 slides along the path.

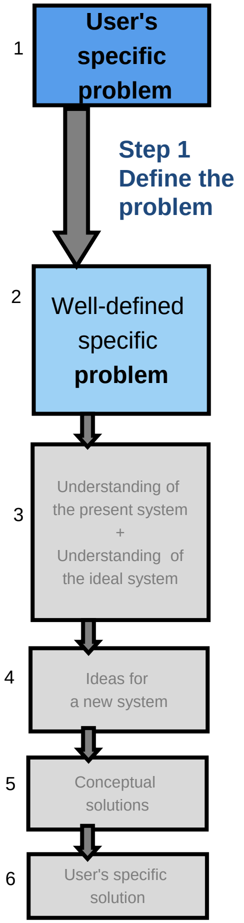
In the right half of each slide, an example of output of each step is demonstrated.

- One case study is demonstrated throughout the process for showing a consistent example.
- **Please refer many different cases documented in the Collection of USIT Case Studies.**
- Case Studies in the Collection mostly try to show the steps of the whole process;
  but some other cases show the steps partially, by skipping some.

  Case studies may have different steps particularly effective in use.

Step 1: Define the Problem: (1) Preparation: Form the USIT project

In the Real World, raise an issue and prepare for a problem-solving project .



We want to solve some real problems or to achieve some new tasks in the Real World, so we start to work for 'Creative Problem Solving'.
We want to think and work hard for solving a problem unsolved so far and for achieving a task unachievable so far.
We need to prepare well for the project.

· Think and survey the present situations of the problem/task

· Clarify what we want to do and set the target.

- Think if the USIT project for creative problem solving is appropriate, and decide to start it.

· Decide the size, duration, style, etc. of the USIT project.

· Decide the Organizer, Trainer, and members of the USIT project and organize the team.

· State these decisions clearly, communicate with the team, and start the USIT project.

The description above is relevant mainly to a real project for a real problem. You may have other projects for introducing the USIT method and for training people in USIT. The example in the right part is for USIT training.

Step1: Define the Problem.

(1) Preparation: To set up the USIT Training project.

Situations: Though we have various problems in the real jobs, we have few people who have mastered methods for solving them effectively.

Target: To introduce the method for creative problem solving (USIT) into our company and to apply it to our technology development in the near future.

Project: To execute an In-house USIT training project

Structure: Training for 2 days, 8 to 15 participants,
Lecture + real practices (on 2 problems in parallel)

Team: (For a general problem) Organizer: Head of training section, Trainer: USIT expert, Members: voluntary engineers from different sections.

(For a real problem) Organizer: Manager of the engineering section, Trainer: USIT expert, Members: people assigned in relevant sections

Execution: Execute the training for 2 days, and make the teams to report the results in a week after.

In the USIT training, general themes (e.g., textbook examples) should be explained by the lecturer, while real and familiar themes relevant to the teams should be used in the real practice.

Clarify the problem situations and focus the scope

1 User's specific problem

Step 1 Define the problem

2 Well-defined specific problem

3 Understanding of the present system + Understanding of the ideal system

4 Ideas for a new system

5 Conceptual solutions

6 User's specific solution

The person in charge reports the problem situations, and the team discuss to clarify the five items (a) - (e) on the fact basis for sharing the understanding of the problem situations

- Focus on one unwanted effect : easier to solve one by one than to handle multiple problems at a time.

- State the task to be achieved in 1-2 lines.
- Conciseness helps to clarify the focus point.

- Draw a sketch (or a schematic graph) so as to clarify the mechanism of the system.
- Figures of an overall view, enlarged micro views, and time-dependent views, etc. may be useful.

Consider possible causes of the unwanted effect.

- Sort out the problem situations (with IS/ISNOT analysis of the KT method) .
- Consider the (physical) mechanism of the problem system. -- This is most important.
- If you find difficulty in finding the causes, you may think to make the system in failure on purpose.
- Express the essence of the difficulty of th- problem in terms of the contradicti-

- Limit the scope of the problem, and express the objects in general terms.

Example: Picture Hanging Kit Problem

Step1: Define the Problem

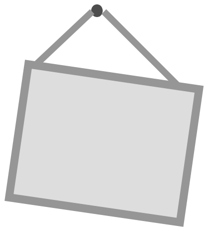
(a) An unwanted effect:

A picture is hung on a wall in a typical way by using a nail , a string, and two hooks, but it is apt to be tilted afterwards without knowing.

(b) Task statement:

Improve the ordinary picture hanging kit (with a nail, a string, and two hooks), so as the picture not likely to be tilted

(c) Simple sketch of the problem situation:



(d) Plausible root causes:

In case of vibration from the wall, the string slips on the nail and the picture frame is tilted .

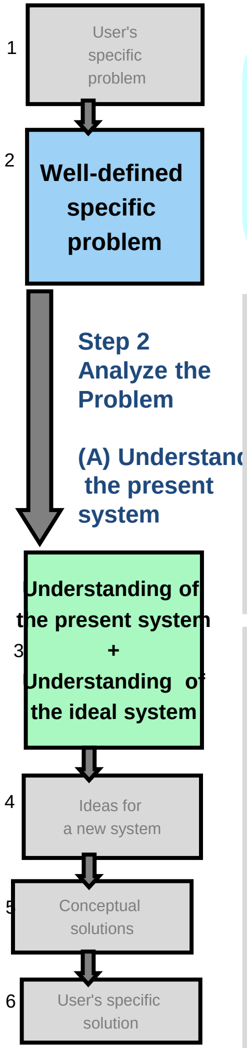
(e) A minimum set of relevant objects:

A picture frame (including the picture, frame, glass, etc.), a nail, a string, two hooks, and wall

This case study was described first by Ed Sickafus in his USIT text book, and was later extended by Toru Nakagawa for use in the USIT training.

Step 2: Analyze the Problem (A) Understand the present system
(A1, A2) Understand the space and time characteristics

Understand the Space and Time Characteristics of the present system



The present system is analyzed in the four aspects, i.e., space, time, attributes, and functions. The order of the 4 aspects may be chosen differently depending on the problem. The order described here may be appropriate in most cases.

Analyze the system's behavior and characteristics **depending on the space**:

- Draw the structure of the system and understand the mechanism and the problems.
- ・Differences/distributions on parts or places.
- ・Macro views (the whole system & environments) and micro views (milli, micro, and nano)

Analyze the system's behavior and characteristics **depending on the time**

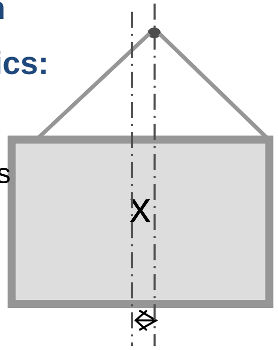
- Temporal change of phenomena and problem.
- ・In cases of processes like manufacturing, reveal the stages of process and their characteristics.
- ・Draw a graph of temporal change in some specific characteristics (e.g. unwanted effect, root cause property, etc.)
- ・Macro view (long term change, pre and post phenomena) and micro view (detailed process of instantaneous change).
- ・Analyze the conditional changes as a part of the time characteristics. 'In the case of ...' = 'When ...'

Step2: Analyze the Problem

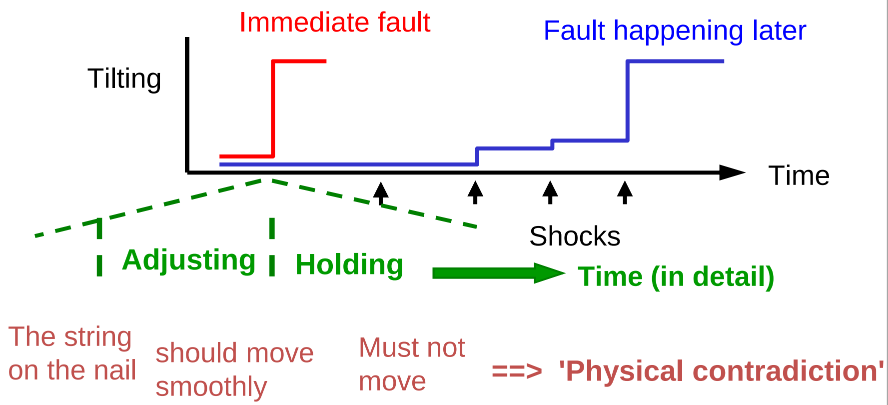
A. Understand the present system

(1) Analysis of space characteristics:

When we adjust the frame in the horizontal position, the center of mass of the frame must be located just below the nail. Otherwise, due to a torque the string slips at the nail and the frame will be tilted.



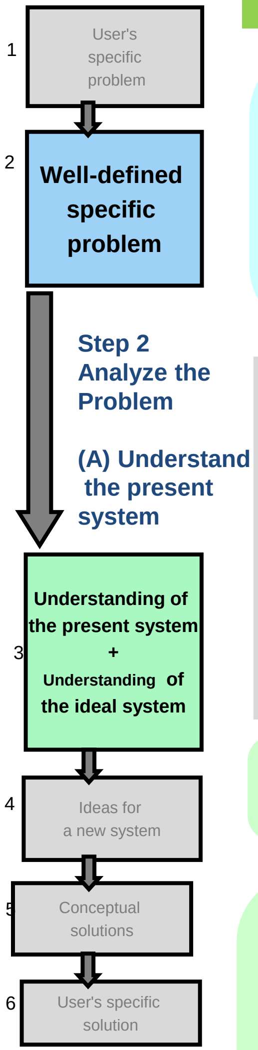
(2) Analysis of time characteristics:



Analyze the present system, and clarify the requirements for the desirable situations (and also ideals)

- Find the differences in requirements depending on places and on time regions ==> Clarify them as the essence of the difficulty and (physical) contradictions.

Understand various attributes of the objects in the present system: Attributes increasing/decreasing (or irrelevant to) the unwanted effect



Objects: Components of the system, entities existing by itself, occupying space; ('information' is especially included)
(Ex. an airplane, a picture frame, a nail, an electron, air, light (photons), signals)
Attributes: Categories of the properties of objects.
(Ex. color, weight, shape, position, reflectivity)
Note: red,, 10 kg, etc. are values of attributes.

Consider various attributes of all the relevant objects and list them up under classification:
If the attribute value is increased/strengthened,
the unwanted effect increases --> enhancing
ibid decreases --> suppressing
ibid behaves specifically --> specific
ibid does not change --> irrelevant

Also consider explicit/common-sense/implicit **constraints** in various attributes.

This step examines again the **plausible root causes** (see Step 1(d)) more deeply and fully.

Unexpected (inventive) solutions are generated when the attributes relevant to the problem are **changed qualitatively** (or drastically): e.g., an attribute causing the unwanted effect is discarded, made irrelevant, or turned into useful.

Such solutions can be generated by **lifting/breaking the constraints in attributes.**

(3) Analysis of attributes:

Unwanted effect of the present problem = Easiness in tilting

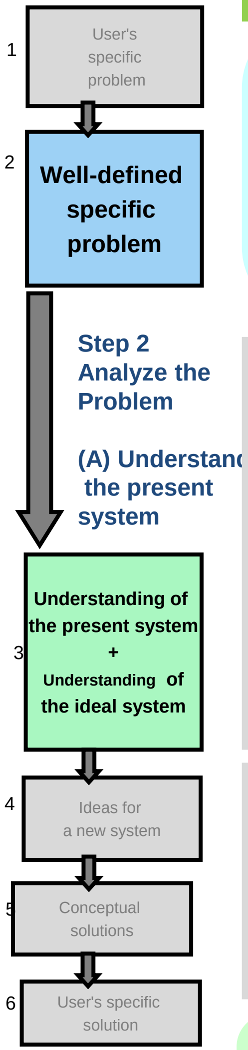
Object	Attributes which increase easiness of picture frame tilting	Attributes which decrease easiness of picture frame tilting	Attributes irrelevant to the easiness of picture frame tilting
Picture frame	Offset of the center of mass from just below the nail., Asymmetry of shape & weight		color, width, length, thickness, weight
Hooks	Offset from the symmetric positions	adjustment of positions	
String	Slipperiness	Friction of string with the nail	Thickness, length, color
Nail	Slipperiness on the surface	Friction with the string, angle	Material, length, thickness
Wall	Vibration of wall	Friction with the frame bottom	Color, oldness

Note: Though the QC diagrams were introduced by Sickafus, this tabular format may be more familiar for beginners.

USIT considers the problem 'qualitatively' (i.e., in their essence), and hence does not handle the values of the attributes directly.

Step 2: Analyze the Problem (A4) Understand the functional relationships

Draw the functional relationships among the objects, and understand the designers' intentions and the problems of the present system



Terms related to the Interactions between objects:

- **Action:** The interaction is viewed as a work from one object to the other.
- **Effect/influence:** Results of the action
- **Cause:** The source (starting point) of the action
- **Function:** Action regarded useful
- **Harm:** Action causing bad results (for people)

Functional Analysis:

First, draw the functional relationships (or designer's intention) among the objects in the minimal relevant set.

- **At the top**, draw the object most important for the system's purpose.
- Draw the objects which are serving for the object above **in a functionally-desirable relationship** ** one by one below the upper objects.
- Draw an arrow from the lower to the upper object and write the function between them.

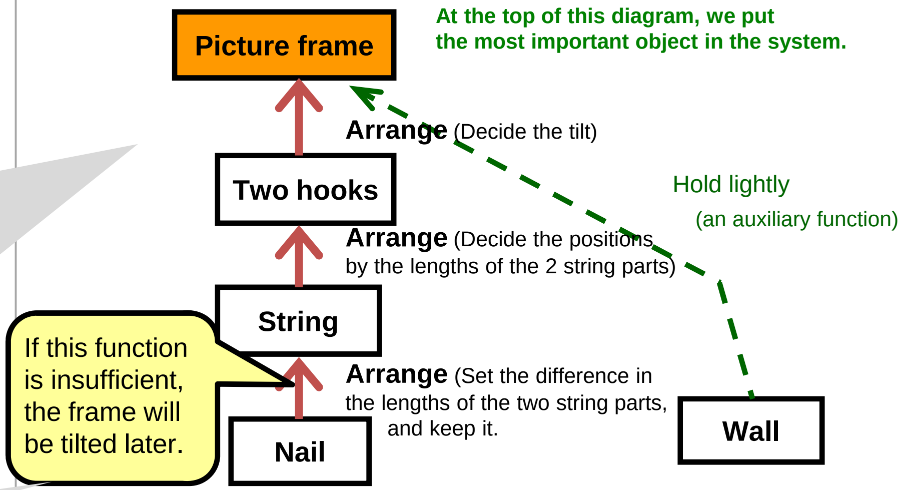
Notes on additional drawing:

- You may additionally draw some objects not intended by the designer, if necessary.
- You may draw, if necessary, the functions with insufficient, excessive, unstable, and harmful effects.

Functional analysis is useful for understanding the mechanism of the system and also their relationships with the unwanted effect.

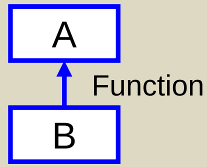
(4) Analysis of the functional relationships

The mechanism and designer's intention of holding the frame without tilting in the present system .



**** A functionally-desirable relationship between the objects:**

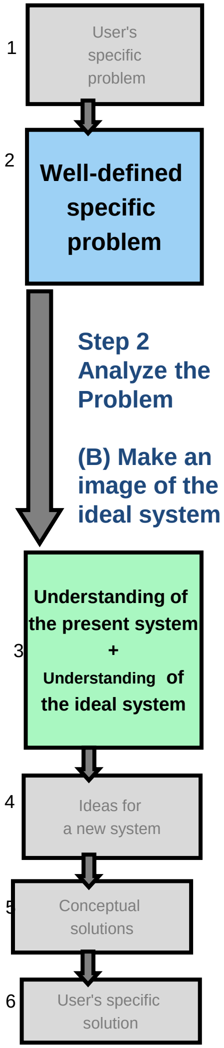
- B is in contact with A, and causes an effect.
- A is more important than B, and B serves for A.
- If A is discarded, B loses its significance of existence, and becomes unnecessary.



Note: This diagram is called as 'Close world diagram' by Sickafus, but is called more commonly as 'Functional diagram'.

Step 2: Analyze the Problem (B) Make an image of the ideal system

Make an image of the ideal situations and clarify the directions of solutions



Clarifying the ideal system and the directions for the ideal is crucial both for solving problems in the present system and for developing new products. **USIT advises to execute this step always.**

For solving contradictions, TRIZ advises to set the **ideal state where the contradicting requirements are both fulfilled.**

Particles method by Sickafus:

(a) Draw the sketch of the present system to clarify the mechanism.

(b) Draw the image of the ideal result:
You must not try to draw the means and mechanisms for achieving the ideal, because they are not known yet.

(c) Put x marks (Particles) at the places where you find any difference between (a) and (b):
The Particles are magical things/fields which can have any property and can make any behavior.

Altshuller developed the **'Smart Little People method (SLP)'** in TRIZ and used symbols of dwarfs; while Sickafus uses more abstract x marks. You may use whichever you like.

(B) Make an image of the ideal system

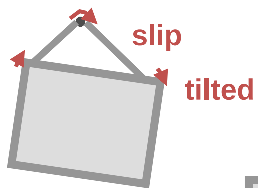
(1) Set the ideal which overcomes 'Physical contradiction':

State the ideal by use of the 'Physical Contradiction':

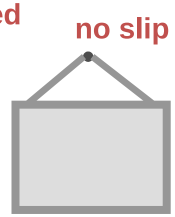
The string moves smoothly on the nail while adjusting, AND the string stays without moving on the nail after the adjustment for a long time while holding the frame.

(2) Consider the ideal system with the Particles method:

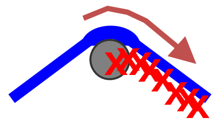
(a) Sketch of the present system



(b) Sketch of the ideal system (as the result of achievement)



(c) Draw x marks at the places of any difference between (a) and (b): Call x marks 'Particles'.

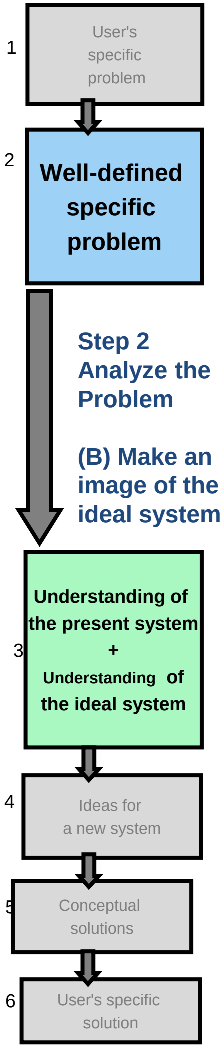


TRIZ assumes "**Technical systems evolve toward the direction of the increase in Ideality**, where
Ideality = system's main useful function /(cost + harm)"

TRIZ also has the concept of **'Ideal Final Result (IFR)**', where the main useful function is achieved with no cost and no harm. A function which is performed **'by itself'** is a form of IFR.

Step 2: Analyze the Problem (B) Make an image of the ideal system (Particles method 2/2)

Consider desirable behaviors and desirable properties systematically, with the help of magical Particles



(d) Think of what you want the Particles to do, and draw them in a tree structure

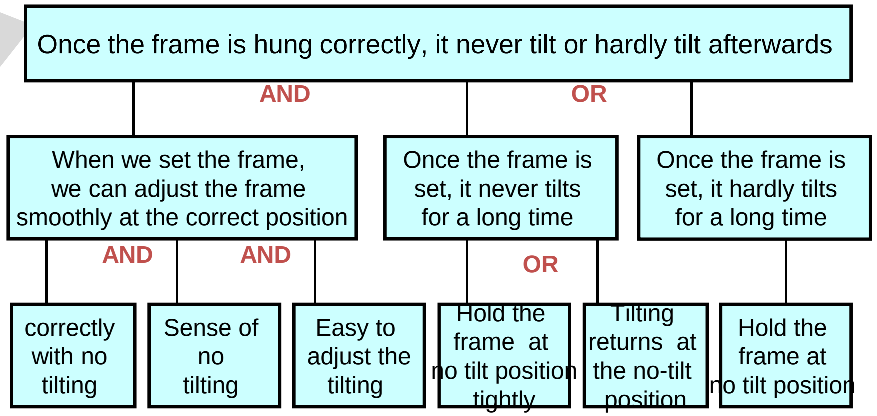
・State what you want them to achieve finally in a sentence and write it at the top of the tree diagram.

・Divide compound requirements into simpler ones and think of any behavior that the Particles would do and draw them in the diagram while breaking them down.

- Since Particles are magical/imaginary, you may make images of their actions in a relaxed view: "Particles would behave like this, ..."

・Use familiar plain words, instead of technical terms. This would avoid from being trapped in the psychological inertia of the technical terms.

(d Desirable behaviors



(e) Think of desirable properties that the Particles would have for performing such behaviors.

・Think of any desirable properties that the Particles would better have for performing the behaviors and list them up below the tree diagram.

・Do not try to check the feasibility of such properties and think freely at this step.

・When we write down such a property, we may naturally make images of applying/realizing it. Remember or write it down separately in a card (e.g., Post-It-Note). (Group discussion of them will be done later at the Step 3(1).

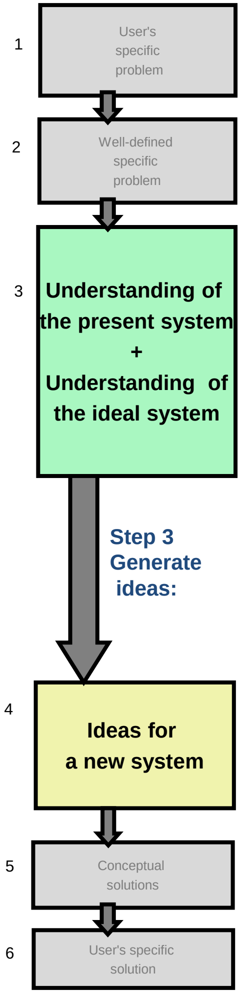
(e) Desirable Properties

- Lengths of string in two parts
- Balance of the center of mass
- Hook adjustment
- Wall support
- Auto-adjusting
- Horizontal degree of the frame
- Vertical degree of the frame
- Smoothness of nail
- Smoothness of string
- Degree of freedom of adjustment
- Fixing the string at the nail position
- Strength of the fixing
- Clinging
- Fixing to the wall
- Resilience
- Elasticity
- Automatic adjustment
- Electro-magnet
- Friction
- Roughness of nail surface
- Pressure
- Strength of holding
- Vibration suppression

Sickafus calls this diagram as 'AND-OR Tree', suggesting to write the AND/OR logic of the behaviors. But in this Manual, the emphasis is on the hierarchical and systematic representation of ideas without difficult terms.

Thinking about ideal systems clarifies the directions of solutions. In this step , the image of the ideal system is thought of in a free and relaxed manner by using familiar plain words and sketches.
The tree diagram (d) is built (finally) in a top-down structure, and the images of possible ideal systems are guided to be systematic and hierarchical.

Step 3: Generate ideas: (1) Write down the ideas stimulated by the analyses



Generate ideas by the stimulation from various analyses, and write them down and build them into a hierarchical diagram.

The problem analysis from various aspects have stimulated us to generate many, different ideas (e.g., items to be examined further, improvement ideas, drastic change ideas, etc.).
Write them down on cards one by one, and extend them further in group discussion, and arrange them into a hierarchical system of ideas.

- (Root) Causes => Eliminate the causes.
- Time characteristics => Solution ideas during the critical time zones
- Space characteristics => Solution ideas to be applied to the places/parts in trouble.
- Functional analysis => Solutions to handle the objects having harmful/insufficient functions
- Attribute analysis => Suppress the problem-increasing attributes, and enhance the problem-decreasing attributes
- Images of Ideal results => Directions of solutions
- Differences in requirements in respect to time/space/ conditions => 'Physical contradiction' => Combine partial solutions.
- Particles method: Desirable behaviors and properties => many ideas and a hierarchical system of ideas
- System of desirable behaviors => A hierarchical system of solution ideas

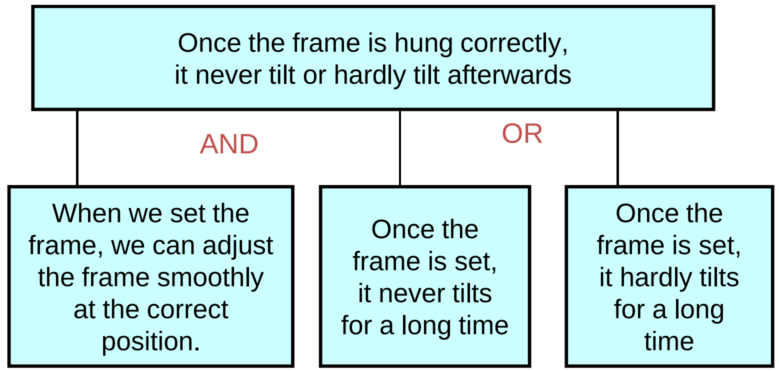
Generate various ideas as much as possible:

A lot of individual ideas: For instance,

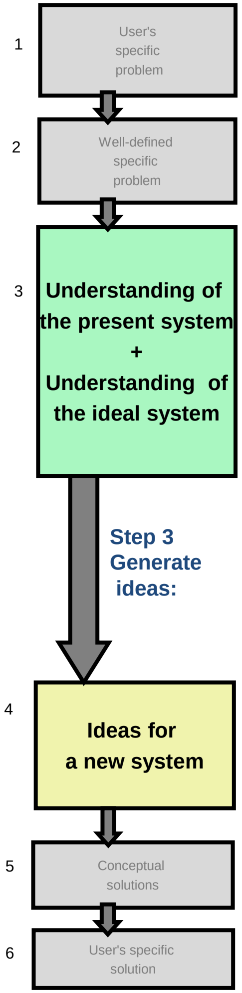
- Increase the friction between the nail and the string. (Make the nail surface rough; apply an adhesive; ..)
- Use two nails.
- When the adjustment is finished, apply some treatment for fixing or making hard to slip the string on the nail. (e.g., clip, press with a screw, apply an adhesive, etc.)
- Make the frame bottom edge not slip on the wall. (e.g., apply a cushion, fix with a double-faced adhesive tape)

Build them into a hierarchical system

The ideas are arranged in a hierarchical system as shown in the skeleton below:



Step 3: Generate ideas: (2) Extend ideas with USIT operators



Apply various USIT Operators intently to generate more ideas and extend/improve them further

The USIT Operators are the integrated and reorganized system of all the solution generation methods developed in TRIZ and USIT.

USIT Operators applicable to system elements:

- **'Multiplication'** of objects
- **'Dimensional change'** of attributes
- **'Re-distribution'** of functions

USIT Operators applicable to solution ideas:

- **'Combination'** of a pair of solution ideas
- **'Generalization'** of solutions

Please refer the System of USIT Operators (5 main- and 32 sub-operators) in a separate document.

You can understand them better when you re-consider which USIT Operators are used in individual solution ideas.

Apply a USIT Operator to any possible target (see above) somehow literally, and then think of an idea of making good use of it.

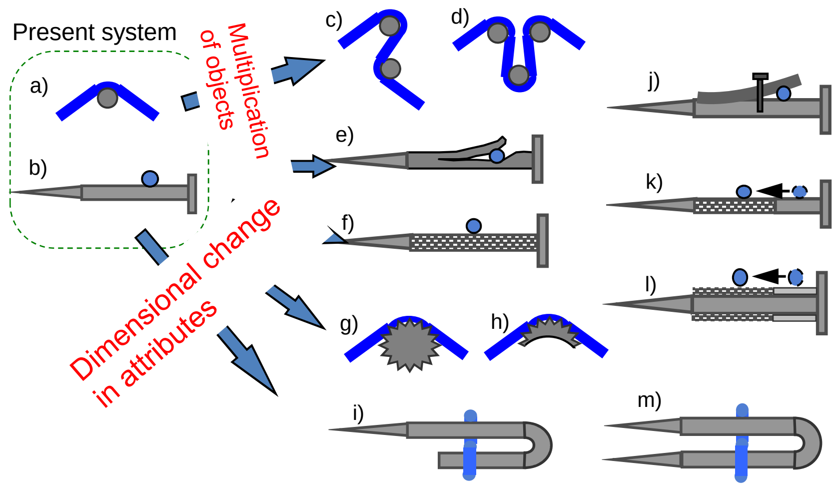
There can be various ways of good use.

You should think in a flexible manner.

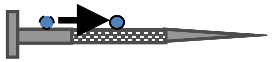
There are a huge number of combinations of USIT sub operators and their possible targets; so you should not and need not try to exhaust the combinations.

USIT Operators are implicitly used everywhere in this Manual and in the USIT case studies.

Ideas obtained with various USIT Operators (Examples)



One idea can be derived with different USIT operators:



Adjust

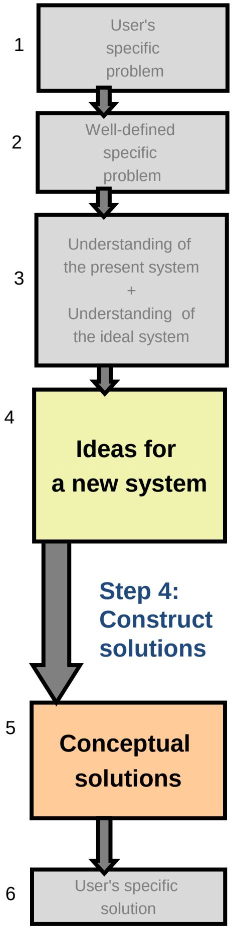
Maintain

- Divide the nail into two parts, differ the surface properties and combine them again.
- Smoothness attribute of the nail was changed by places.
- The adjustment and maintenance functions of the nail are alocated to different parts of the nail.
- Solution of a smooth nail and solution of a rough nail are combined by the places
- The two solutions are combined in time..

If you are already familiar with the original TRIZ (or other) idea generation methods (e.g., 40 Inventive principles, Trends of evolution, Inventive standards, separation principles, etc.), you can use any of them here.

Step 4: Construct solutions: (1) Evaluate and select ideas

Evaluate a lot of ideas generated so far and select significant ones to be examined and extended further



Evaluate a lot of ideas obtained so far and select significant ideas to be examined and extended further.
Rather than detailed individual ideas, we should consider the directions and intentions of solution groups and decide at slightly higher level in the system of solution ideas.

Generally speaking, the followings are the three main criteria:

- **A. Effectiveness** (estimated effectiveness)
- **B. Feasibility** (from the aspects of technology, cost, timing of delivery, business, etc.)
- **C. Novelty/originality/patentability**

TRIZ Viewpoint:

Is the 'Contradiction' overcome?

Qualities of solutions can be evaluated.

The criteria of evaluation should be adjusted to match the purpose of the problem solving project, i.e., the intention of the parent project.

What are requested for this USIT project?

- Finding directions towards future, ideals
- Innovative ideas, even if containing some risks
- New solution concepts feasible in 2-3 years
- Realistic solutions implementable within a year
- Solutions implementable immediately

See Step 1 (1)

Example of idea evaluation:

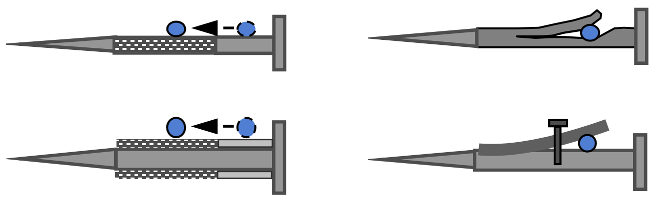
We have found **the essence of this problem is the Physical Contradiction in TRIZ**; thus our solution overcoming it is:

"During adjusting the frame, the string should move smoothly on the nail, while later during holding the frame for a long time, the string should never move on the nail. "

Thus any solution that does not distinguish these two contradictory time zones has not overcome the contradiction.

(Ex. 'Make the surface of the nail rough for more friction.')

Solutions where **the string 'never' move** on the nail during holding should be evaluated highly than those where **the string 'hardly' move**. It is also desirable that the treatment for making the string 'never' move is simple, without disturbing the adjustment, and also can be released when we want.

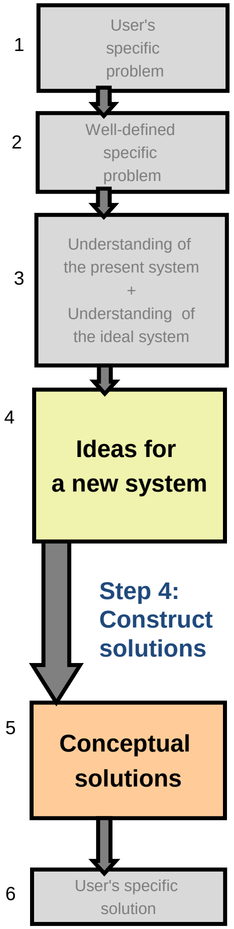


The string 'hardly' move on the nail. The string 'never' move.

Evaluation in this step needs thorough understanding of the parent project and of the subject matter (in the Real World).

Step 4: Construct solutions: (2) Construct the conceptual solutions

On the basis of the capability in the subject matter, construct the conceptual (or preliminary) solutions



On the basis of the ideas selected in the preceding sub-step, construct conceptual solutions by use of both creative thinking and the capability related to the subject matter.

Among many ideas obtained in Step 3, try to build up good conceptual solutions on the basis of selected ideas. (Selection of ideas in the preceding sub-section helps us to concentrate our efforts.)

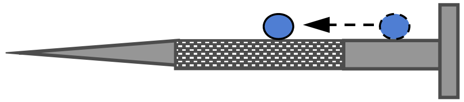
Consider from various viewpoints to construct good and convincing conceptual solutions.

- Describe the essence of ideas in the new solutions, its significance, effectiveness, novelty, etc.
- Describe further about unknown aspects, expected difficulties, aspects necessary to examine/ experiment, unsolved secondary problems, etc.
- Consider also on patentability, on possibility of infringing other's patents, etc.

If necessary, restart the steps of USIT process for solving the secondary problems.

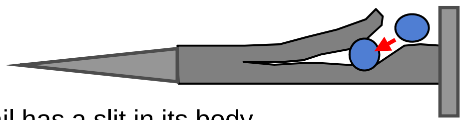
The solutions to be constructed in the present step are conceptual, i.e., in the Thinking World. To the best of the project team, these solutions are supposed to work well and solve the original problem.

Ex. A conceptual solution making the frame hardly tilt:



Make the surface of the nail rough at the front half of the nail while smooth at the hind half
Adjust the string on the smooth part of the nail, and after finishing adjustment push the string onto the rough part of the nail for holding string without moving for a long time.
This type of nail can be manufactured easily.
While holding, the frame hardly tilt, but it might tilt.

Ex. A conceptual solution making the frame never tilt.

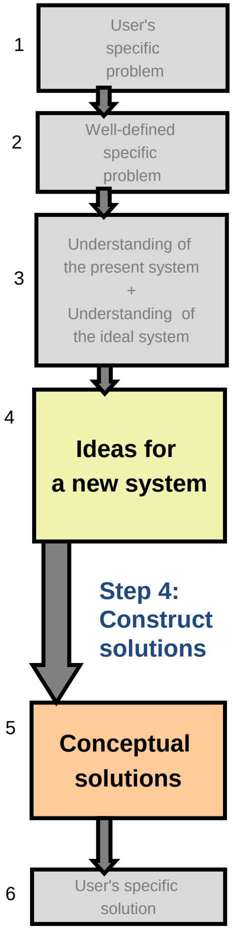


The nail has a slit in its body.
Adjust the string at the ordinary axis part, and after finishing the adjustment push the string forward to set tightly in the slit.
Manufacturing the nail costs some. Simple and cheap.
After the adjustment, the string is essentially fixed, and it may be released by hand easily whenever necessary.

In this step , the capability in the subject matter is more important than the USIT methodology as a guide for the creative thinking.

Step 4: Construct solutions: (3) Report the results of the USIT project

Prepare reports of the results of the USIT project, and state proposals.

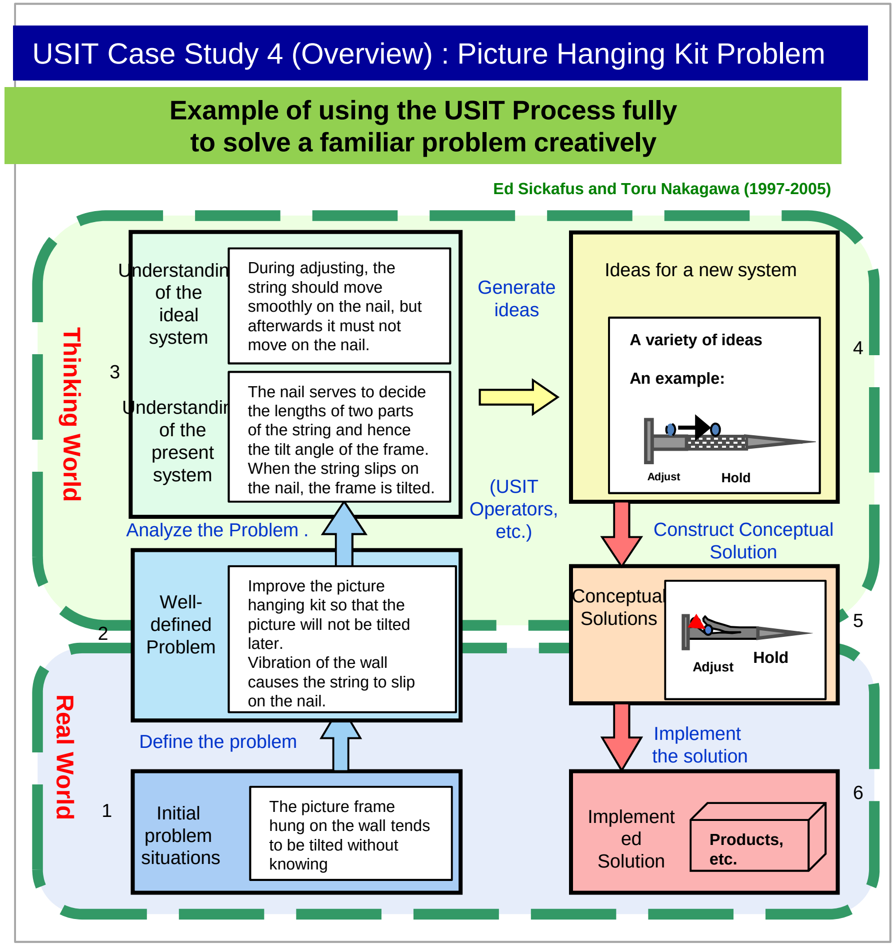


Summarize the whole process by writing reports at the end of the USIT problem solving process. Conclude with the proposals of final conceptual solutions and describe the whole thinking process for supporting the conclusion.

The conceptual solutions (in Box 5) are the most important results of the problem solving project.

For supporting the conclusion, describe the full process of the USIT problem solving process and **explain why and how the team reached the proposals.**
Since this USIT Manual guides the whole problem solving process in a logical way, documents of statements, diagrams, etc. made along the steps are useful as the base materials of the reports.
As a brief summary of the whole logic, the overall view shown in the Six-Box Scheme may be useful.

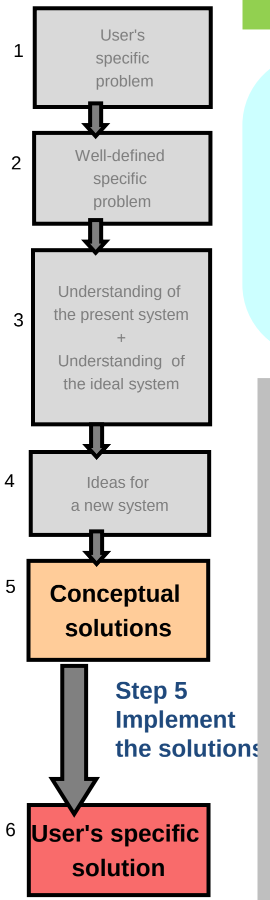
Several examples of case studies are shown in the style of Six-Box Scheme, and attached at the Appendix of this Manual. They are summaries of cases documented in the **Collection of USIT Case Studies.**



For real projects, only the reports and proposals are the results of the USIT problem solving projects.
For USIT training/trial projects, writing reports of the experiences and contents is essential for mastering the USIT process.

Step 5: Implement the solutions: (Real activities in the 'Real World')

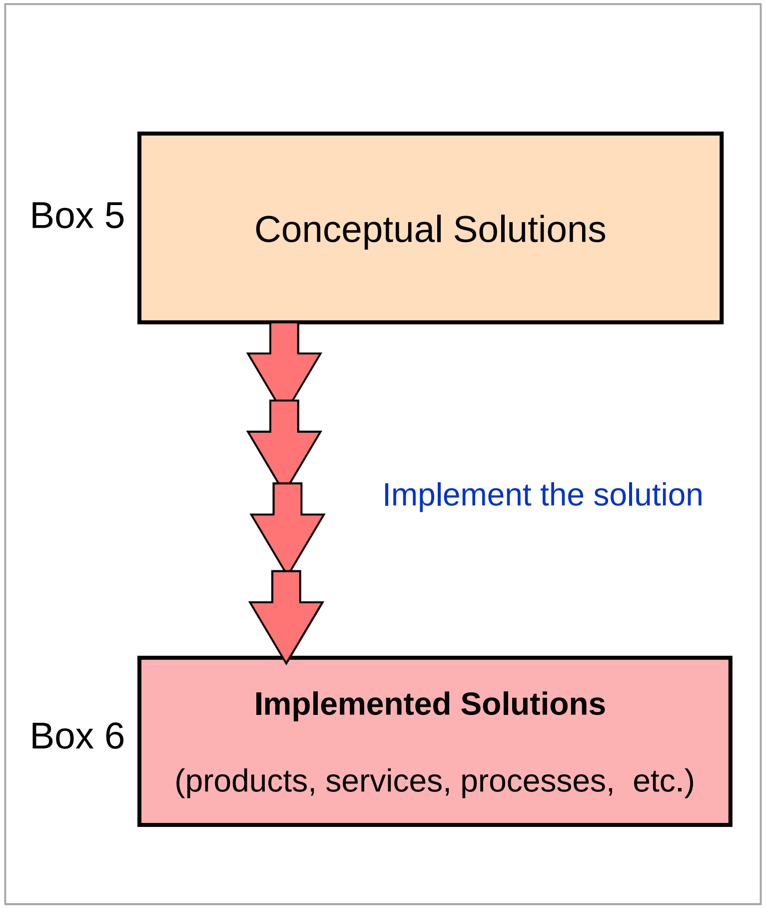
Utilize the results of the problem solving project, and implement the new solutions through the activities in the 'Real World'



This step is out of the USIT process (in the 'Thinking World') and to be carried out as the real activities of technology/business/ society etc. (in the 'Real World'). Use the 'Real World' criteria in decisions and activities.

After having obtained the conceptual solutions, we need company-wide activities for implementing them as real products, services, processes, etc. :

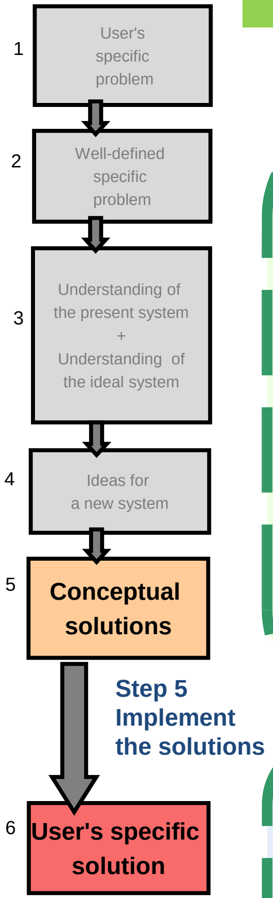
- Evaluate and examine the conceptual solutions in the parent project and decide the directions to do in the Real World
- Solve secondary problems, and develop necessary technology, etc.
- Experiments, simulations, etc.
  Use Taguchi Method, prototyping, testing, etc.
- Designing
- Manufacturing
- Marketing, sales,
- Obtaining/clearing intellectual properties



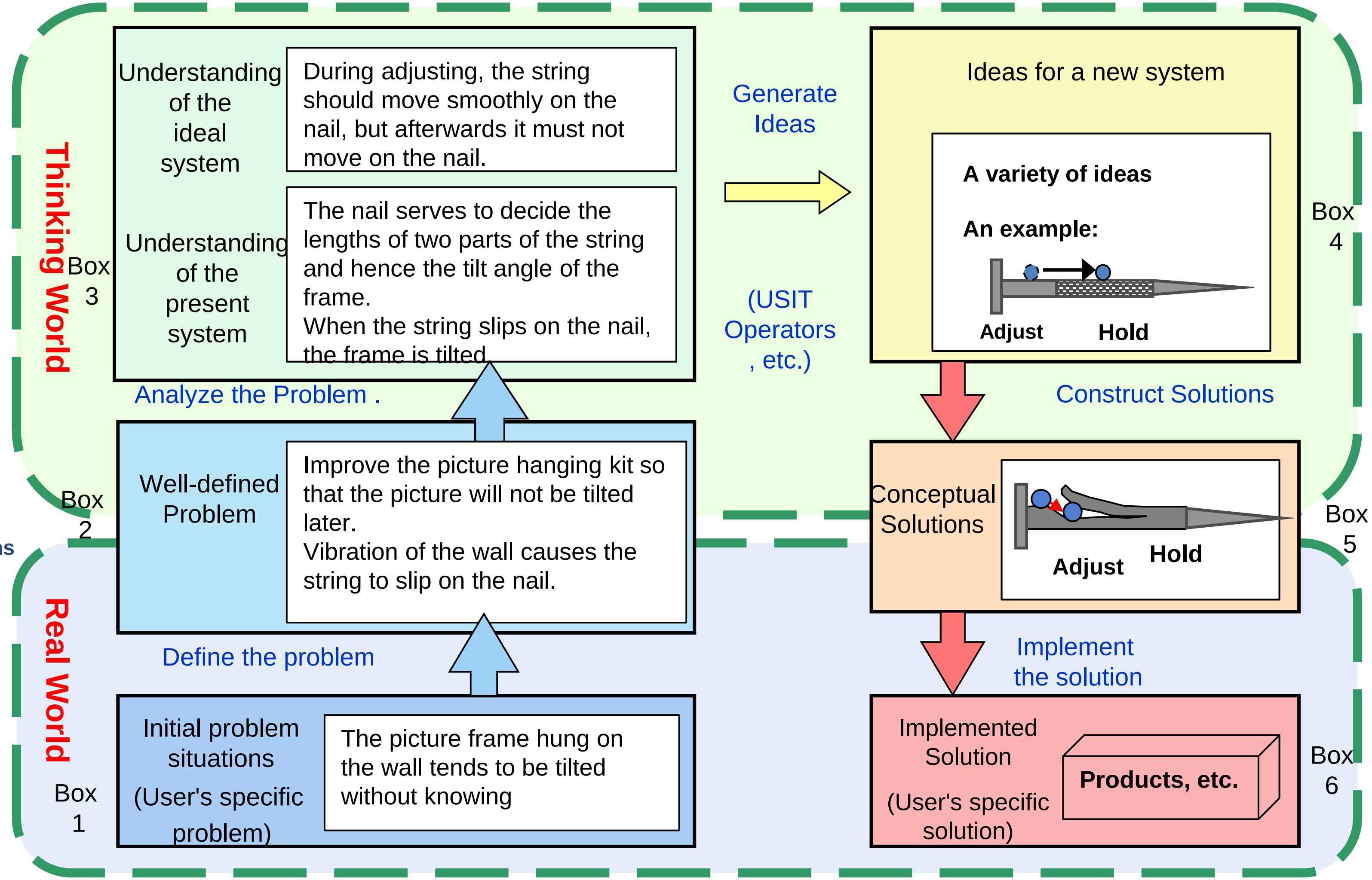
Without carrying out this step of implementation, 'Creative problem solving' does not make any fruit. Make results of the 'real problem solving' in the 'Real World'.

USIT Case Study 4 (Overview) : Picture Hanging Kit Problem

Example of using the USIT Process fully to solve a familiar problem creatively

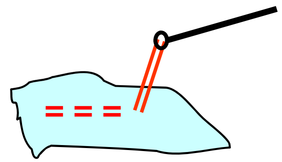
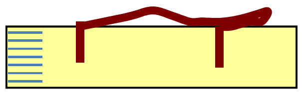
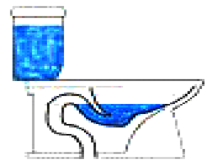
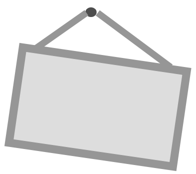
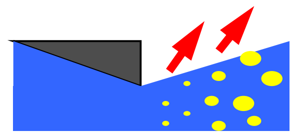


Ed Sickafus and Toru Nakagawa (1997-2005)



USIT Case Studies

A Collection of USIT Case Studies: (1) - (5)

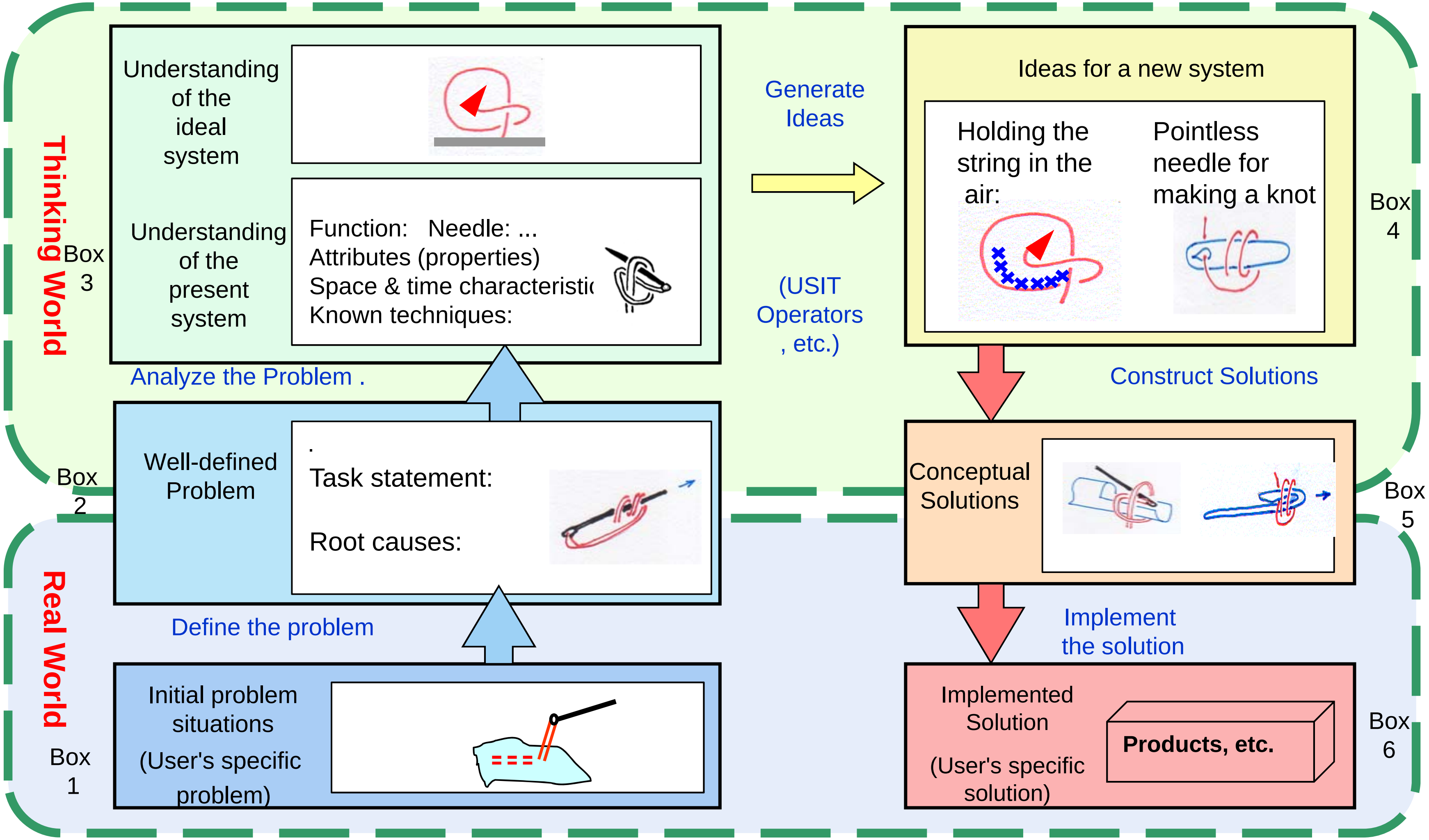
No.	Theme	Feature
1 Sewing	How to fix a string shorter than the needle	Whole USIT Process is well illustrated for a familiar problem 
2 Stapler	How to prevent a staple from being crashed	A familiar problem was solved by finding the real root cause and by using the SLP method 
3 Toilet	Saving Water for a Toilet System	Example of catching big problem in daily life as physical contradiction, and solution 
4 Picture	Picture Hanging Kit Problem	A standard USIT Case Study on a familiar problem, easy to understand for everybody and yet deep in thoughts 
5 Porous	Increase the Foam Ratio of Porous Polymer Sheet	A real problem in the field of chemical engineering is solved with the Particles Method 

Overview of individual cases are shown below in the 'Six-Box Scheme'.

USIT Case Study 1 [Sewing] (Overview): How to fix a string shorter than the needle

Whole USIT Process is well illustrated for a familiar problem

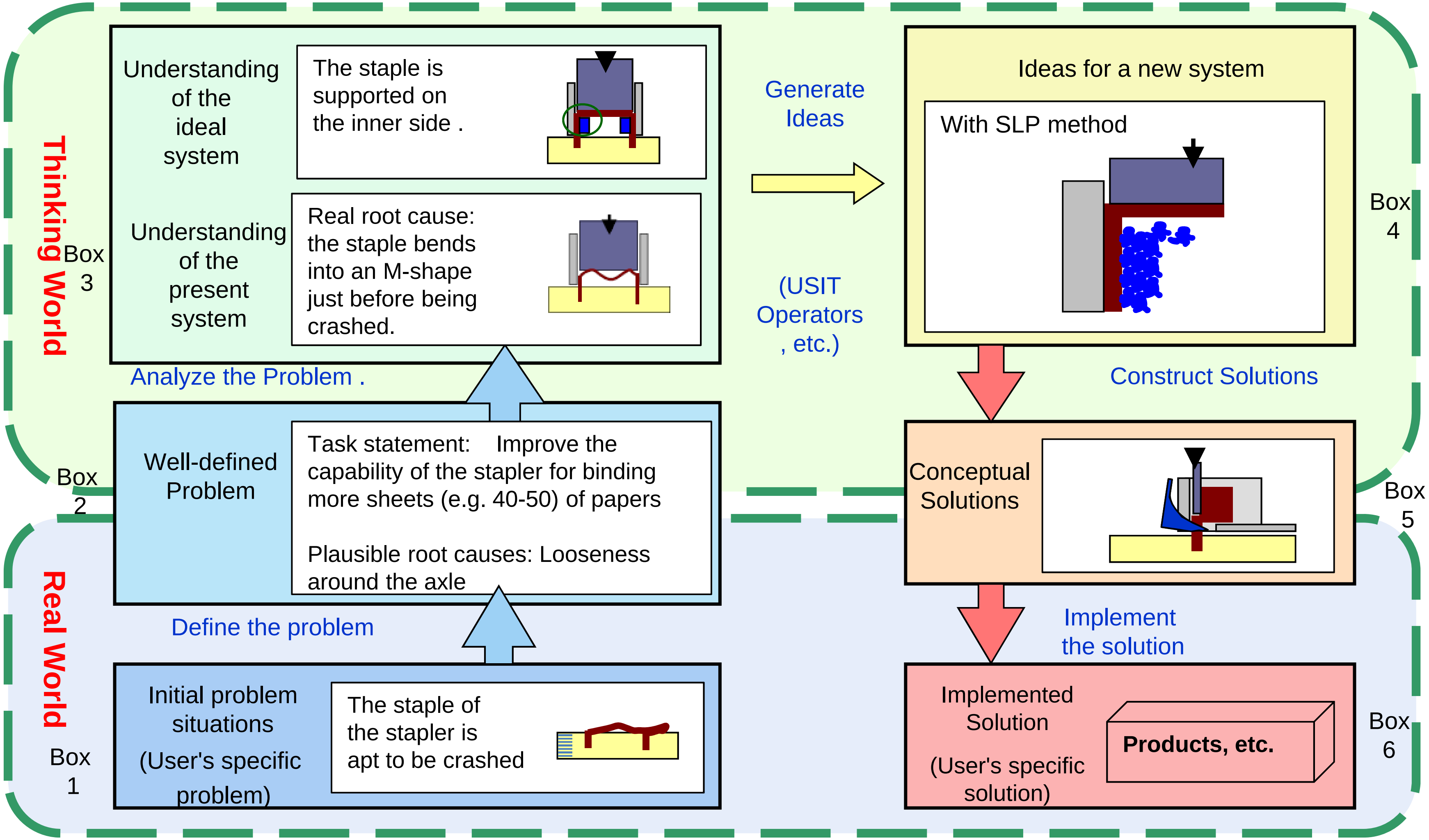
Toru Nakagawa and Tsubasa Shimoda (2006)



USIT Case Study 2 [Stapler] (Overview): How to prevent a staple from being crashed

A familiar problem was solved by finding the real root cause and by using the SLP method

Toru Nakagawa and Kazuaki Kamiya (2004)



USIT Case Study 3 [Toilet] (overview). Saving Water for a Toilet System

A familiar, important problem was solved nicely with the concept of Physical Contradiction in TRIZ.

H.S.Lee and K.W. Lee (Korea) (2003)

Thinking World

Box 3

Understanding of the ideal system: Ideal system is: The S-shape pipe exists during the ordinary period of time AND it does not exist during flushing the water.

Understanding of the present system: The S-shape pipe is necessary and useful AND YET it is an obstacle and harmful, and must be eliminated for flushing with less amount of water. (Physical Contradiction)

Analyze the Problem .

Generate Ideas

(USIT Operators, etc.)

Box 4

Ideas for a new system

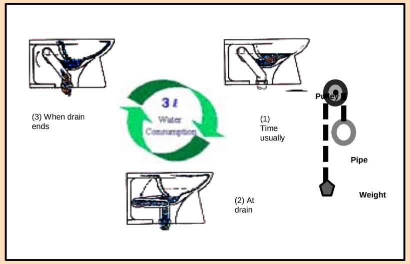
Make the s-shape pipe flexible and change the shape; the middle part is lifted in ordinary period and lowered during the flushing.

The pipe moves up/down by itself with the weight of water in the pipe, by use of pulley and balance.

Construct Solutions

Box 5

Conceptual Solutions



Box 2

Well-defined Problem

.Want to reduce the amount of water requirement in the toilet system.

The S-shape pipe is necessary but is an obstacle for flushing the stool away with water. .

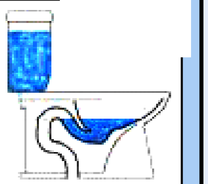
Define the problem

Real World

Box 1

Initial problem situations (User's specific problem)

Toilet system requires a much amount of water (about 13 liters)



Implement the solution

Box 6

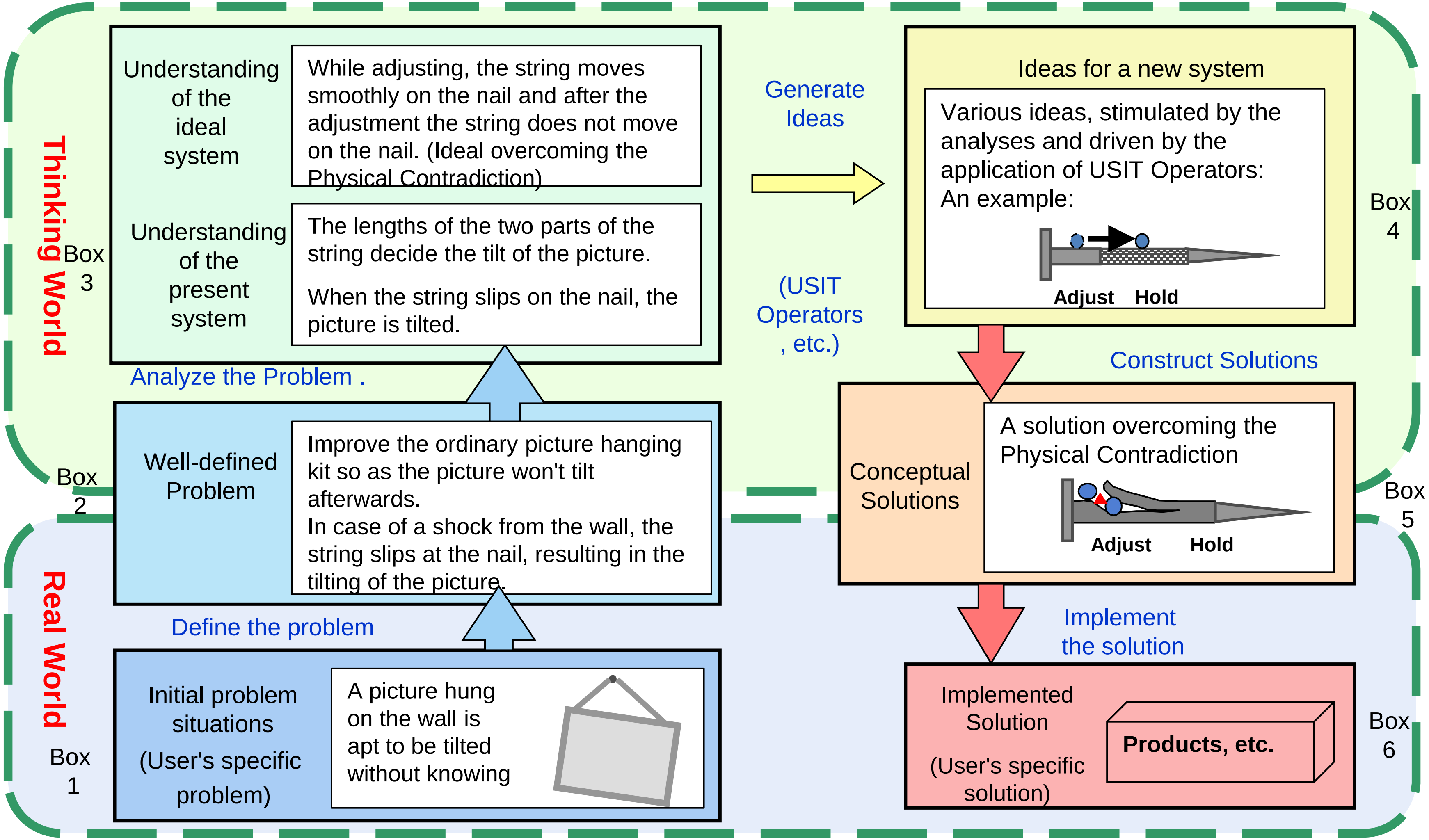
Implemented Solution (User's specific solution)

Prototype is made and tested 3 liters of water

USIT Case Study 4 [Picture] (Overview). Picture Hanging Kit Problem

**A standard USIT Case Study on a familiar problem,
easy to understand for everybody and yet deep in thoughts**

Ed Sickafus and Toru Nakagawa (1997-2005)



USIT Case Study 5 [Porous] (Overview). Increase the Foam Ratio of Porous Polymer Sheet

An open Case Study addressed to a real problem in the field of chemical engineering

Toru Nakagawa (1999)