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USIT: A Concise Process for Creative Problem Solving Based on the Paradigm of 'Six-Box Scheme' -- USIT Manual and USIT Case Studies --

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Abstract

USIT (Unified Structured Inventive Thinking) was originally developed by Ed Sickafus in 1985 as a concise whole process of creative problem solving and has been developed further since 1999 in Japan. In 2002 we reorganized all the solution generation methods of TRIZ into a System of USIT Operators. In 2004, I represented the whole USIT process in a data-flow diagram and realized it as a new paradigm for creative problem solving and named it the 'Six-Box Scheme'. In 2012, I realized that what are really wanted by society are not individual methods but a more general way of thinking for creative problem solving. So I am proposing to integrate different methods of problem solving into a unified general methodology CrePS on the basis of the 'Six-Box Scheme'. Hence, USIT is now regarded as a simple process for executing the CrePS methodology.

In the present paper, the USIT Manual was prepared and more than10 published cases of creative problem solving have been documented along the 'Six-Box Scheme'. The present paper discusses about (1) the Six-Box Scheme in comparison with the conventional schemes, (2) possibility of integrating diverse methods of creativity and innovation into CrePS, (3) overall process of USIT, especially how to support the idea generation step, (4) documenting various case studies executed with other methods in the USIT Six-Box Scheme, (5) further issues and tasks for pursuing the new vision/target of establishing CrePS. .

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Keywords: USIT; Creative problem solving; Six-Box Scheme; CrePS; Case studies

1. Introduction

USIT (Unified Structured Inventive Thinking) was originally developed by Ed Sickafus in 1985[*] as a concise, consistent process of creative problem solving [1, 2] and has been developed further in Japan by the present author. USIT history in Japan can be characterized by the following four stages:

Nomenclature

TRIZ	Theory of Inventive Problem Solving
USIT	Unified Structured Inventive Thinking
CrePS	General Methodology of Creative Problem Solving /Task Achieving

[*] The year of USIT development (at that time called SIT) was written as 1995 in Sickafus (1999) [2]. But Sickafus writes in a recent communication: "the 1999 paper is a typo. I began studying the Israeli SIT in 1985 and later that year began teaching a modified version of it in Ford Research Laboratory. That program continued until my retirement in 2000."

(1) The present author introduced TRIZ into Japan since 1997 and also USIT since 1999, and tried to improve them further. Initially, we regarded USIT as a 'Simplified TRIZ' and used it as the key method of the 'Slow but Steady Strategy of Introducing TRIZ into Japan' [3] in contrast to the 'Rapid and Drastic Strategy' which was prevailing at that time in the world.

(2) In 2002 we reorganized all the solution generation methods of TRIZ and USIT. All TRIZ tools (e.g., 40 Inventive Principles, 76 Inventive Standards, Trends of Evolution of Technical Systems, etc.) were once decomposed into individual suggestions and then rebuilt into a System of USIT Operators, which are composed of 5 main Operators having 32 sub-operators [4]. Then we regarded USIT as 'A simplified, unified, next-generation TRIZ'.

(3) In 2004, the author represented the whole USIT process in a data-flow diagram (in place of a flow-chart) having 6 boxes, and realized it as a new paradigm for creative problem solving and named it the 'Six-Box Scheme' [5, 6]. This finding gave a solid basis for applying USIT in various areas.

(4) In 2012, while considering about the future directions for us to proliferate TRIZ widely and deeply, the author realized that what are really wanted by society are not individual methods like TRIZ, USIT, etc. but a more general way of thinking for creative problem solving and the methods supporting it. And he called it CrePS ('General Methodology of Creative Problem-Solving and Task-Achieving'). He also found that the 'Six-Box Scheme' can form the common basic paradigm of the general methodology CrePS and can integrate and unify different methods of problem solving, including TRIZ, USIT, and many others, in a systematic way [7]. And hence, USIT is now regarded as a simple process for performing the CrePS methodology.

In the present paper, the USIT Manual [8] was prepared to illustrate the typical ways of performing the USIT process. And more than 10 published cases of applying creative problem solving have been documented along the 'Six-Box Scheme' in detail, and they form 'A Collection of USIT Case Studies' [9]. The case studies show the common nature of the main steps of the whole process and the effectiveness of the 'Six-Box Scheme' as the basic paradigm.

2. The Six-Box Scheme as a new paradigm of creative problem solving

The Six-Box Scheme [6, 7] is a framework representation of the general process of solving problems and achieving tasks creatively. It is defined by the dataflow representation, shown in Fig. 1.

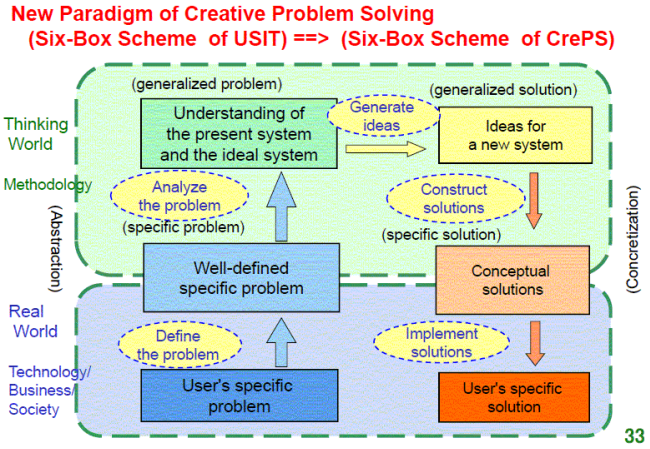

Fig. 1 Six-Box Scheme as the new paradigm of creative problem solving (CrePS/USIT) [6]

It is fundamentally characterized by the six boxes, which represent the information to be obtained at the specified stages of the procedure. The arrows stand for the process for obtaining the information requested for the next box, on the basis of mainly the information of the previous boxes and also of various other background knowledge relevant or even seemingly-irrelevant to the subject matter. The arrows show the main stream; it is natural in practice to have side streams for shortcuts, multiple paths, going back, loops, spiral motion, etc.

Distinguishing the Thinking World (i.e., four boxes in the upper half) from the Real World (i.e., four boxes in the bottom half) is an important concept introduced in this scheme. Problems start with the recognition in the Real World and should finish as concrete solutions implemented in the Real World, where the decision criteria need to reflect the value concepts and the actual situations of society, business, technology, etc.

On the other hand, the process of analyzing the problem and generating good and effective solutions should better be carried out in the Thinking World, where free, wide-scope, and creative ways of thinking are encouraged and guided

with some methodology. This is a general consensus in practice and in theory of pursuing creative problem solving. At the interface of the two Worlds, Box 2 and Box 5 show the information to be handed-on between the two Worlds.

In the Real World, where problem solving starts, there are a large variety of activities, jobs, stakeholders, products, etc. running in parallel. Specific problems are recognized first (Box 1) in the Real World and then need to be defined well (i.e., sorted out, examined, selected, focused, stated, etc.) to be solved, and is handed-on to problem solving projects.

In the Thinking World, the specific problem (Box 2) should first be confirmed in the problem/task statement, problem situations, and the request from the parent project in the Real World. Then the problem should be analyzed to understand the present system and to understand the ideal system (Box 3). Such understanding should be done in various aspects including time and space characteristics, objects - attributes - functions, root causes, mechanisms, etc. The analysis can be guided by some problem solving method, but the information source must be the knowledge of the real problem and real situations. Getting images of the ideal system is also crucial at this stage for generating good solutions later.

Then in Box 4 various ideas for a new system are to be obtained . They are, exceeding simple hints in other systems for suggestion, some basic ideas, e.g., to change or introduce a core component/function for a new system. For generating these ideas various methods, such as check lists, hints, guidelines, principles, operators, etc. may be used. However, during the previous process of obtaining thorough understanding of the present and ideal systems, our brain usually work actively to think of various ideas smoothly. Thus a large number of ideas are to be listed and organized in a hierarchical system.

Around some core ideas, conceptual solutions (Box 5) should be constructed . In this stage, capability and knowledge in the subject matter are necessary even more than the methodological capability, in order to build up effective and creative conceptual solutions.

Conceptual solutions (Box 5) are the final results of the problem solving in the Thinking World , and yet just the start to implement into real products/services/processes in the Real World. For the implementation, various processes such as prototyping, secondary problem solving, experiments, CAE, designing, manufacturing, marketing, etc. are necessary and should be carried out with the full power of the industry, etc.

3. Possibility of integrating diverse methods of creativity and innovation

3.1. Requirements of proliferation by the society

For us, those who have encountered TRIZ and realized its tremendous possibility, it has been an eager hope of establishing TRIZ further as an effective methodology for solving various problems creatively and proliferating it widely. The actual progress of proliferation of TRIZ, however, has been much slower and limited than our expectations. In 2012, I was drawing the expected fields and themes of TRIZ applications, e.g., in industries, in government and public sectors, in academia and universities, in education, at home , in society, in mass media, etc. Then I realized that the people in all these areas of application do not want individual methods like TRIZ; they really demand some general methodology for creative problem solving applicable and effective in various areas. It should be a general methodology to be established newly at a level or two higher in the hierarchy of methodologies. I named the target methodology as CrePS (General methodology of creative problem solving/task achieving) [7].

The new target/vision is stated as [7]:

"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)"

3.2. Classifying various approaches of component methods

As a preparation for integrating such diverse and big methods, we should better decompose them into their component methods and classify them according to their types of approaches and intentions. A preliminary table of such component methods is shown in the following [7].

It is noticed that big methods are composed of various sub-methods and those sub-methods are largely overlapped with one another having some differences in detail and that many methods have their emphases in some aspects in this table and often intend to make shortcuts in the problem solving process. The current situations of the methodologies for creative problem solving (including creativity and innovation methodologies) are apparently unorganized and unnecessarily competing with one another, thus failing in contributing well to the society.

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

Table 1. Various methods for creative problem solving, decomposed and classified in their approaches [7]

The main reason for the unorganized competing situations of such a divergence of methods and sub-methods, as shown in Table 1, is the defect/weakness of the conventional paradigm, i.e., the Four-Box Scheme in science and technology in general, including TRIZ.

Introduction of the Six-Box Scheme as the new paradigm of creative problem solving (CrePS) will certainly serve for re-organizing these diverse methodologies and their numerous sub-methods [7].

3.3. Positioning the Six-Box Scheme in the Real World

The Six-Box Scheme (Fig. 1) says that the process of actual problem solving should start and finish in the Real World which contains the problem. We meet various problems and we want to solve them in the real situations, which differ widely in case by case. It is not theoretically sound if we assume such real situations belong to individually-specific Real Worlds. We should rather think of a number of different types of Real World corresponding to the areas where we want to apply. For example, in the case of industrial applications, we should consider a Real World where typical industrial activities are taking place, as shown in Fig. 2 [10].

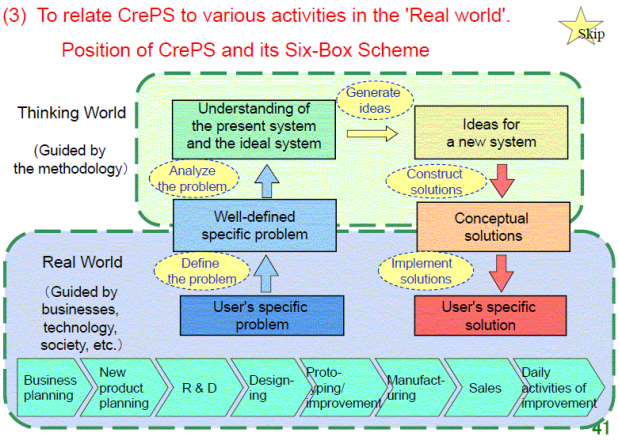

Fig. 2. The Six-Box Scheme placed in the Real World, e.g., an industrial world. [14]

It is important that the problem solving process (Box 2 through Box 5) in the Thinking World is more universal and less dependent on the problem types in the Real World. The USIT process, as illustrated in detail in the next section, is a concise process for such a general purpose problem solving in the Thinking World.

The step of solution implementation (from Box 5 to Box 6) should be carried out again in the Real World (of industrial application in the present case), and need to be adjusted well to different types of problems and solutions.

4. The USIT process -- its overview

The overall process of USIT is illustrated in Fig. 3 [7, 8].

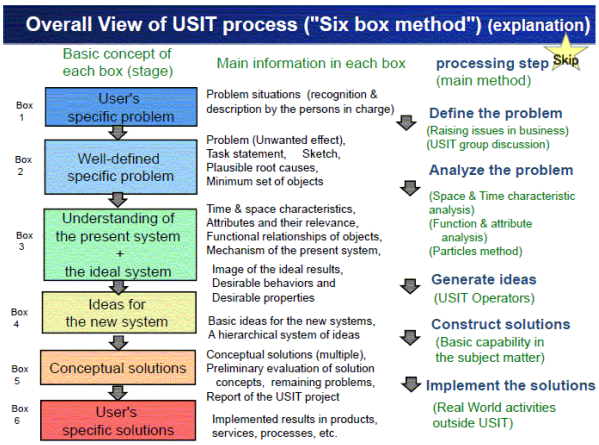

Fig. 3. Overall process of USIT. Basic concepts of the six boxes, main information in each box, and processing steps. [7]

The left column in Fig. 3 shows the six boxes along the main stream of the Six-Box Scheme, while the middle column describes the main information to be obtained in each box in the USIT process. The right column lists the processing steps and their main methods used in USIT. It should be noted that the information in the boxes and the methods in steps are typically used in their standard USIT ways for various types of problems, while allowing minor adaptation to the problems [8].

The concepts and applications of the Six-Box Scheme (in the forms of TRIZ-extended, USIT, CrePS, etc.) have been publicly presented at conferences and posted in Web sites, especially in "TRIZ Home Page in Japan" [11]. Recently, the present author posted a full set of documents of CrePS/USIT in [12], including CrePS/USIT references, USIT manual, USIT case studies, USIT operators, etc. The USIT process is now described in detail in the USIT Manual [8] with the illustration of one case study consistently, and its usage is shown in more than 10 case studies documented in the consistent manner with the USIT Manual. In the next two sections the manual and the case studies are described.

5. USIT Case Studies described in the Six-Box Scheme

5.1. General intention of USIT Case Studies

As is described so far, we are now making efforts for integrating/unifying various creativity & innovation methods into a general methodology of creative problem solving (named CrePS) based on the Six-Box Scheme and for developing some easy and effective processes (e.g., the USIT process for a general purpose) of practicing the methodology. And we want to show its actual usage as the case studies.

We have already published a number of examples of applying the USIT process originally. So we have revised them as USIT case studies in accordance with the process and style of the USIT Manual.

Besides our own works, there are many more excellent case studies of solving problems creatively by use of TRIZ and other methods and published in various places. They

are good resources for showing case studies of the general methodology CrePS and its process USIT, I believe, if we review and restructure them in the paradigm of the Six-Box Scheme. So I started to select some case studies which are published by other authors applying different methods, and to review and rewrite them in the form of the USIT Case Studies. This work of rewriting case studies of different methods into the USIT Case Study in the Six Box Scheme is found productive for understanding various methods and for integrating/unifying such methods.

5.2. A Collection of USIT Case Studies

Fig. 4 lists the ten USIT Case Studies described so far both in Japanese and in English [9]. Each case study describes, in about 20 slides, the full procedure of USIT in accordance with the USIT Manual. You can read these case studies in its full length in the Web site, "TRIZ Home Page in Japan" [11].

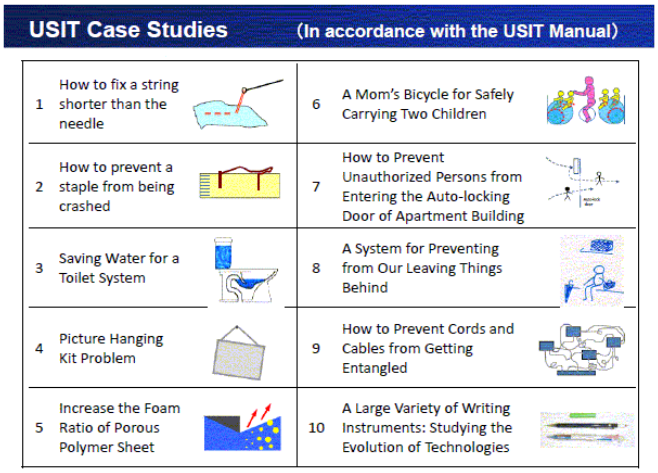

Fig. 4. 10 USIT Case Studies described in accordance to the USIT Manual

5.3. USIT Case Study 1. How to fix a string shorter than the needle

This case study is based on a thesis work by Tsubasa Shimoda at Osaka Gakuin University applying the USIT standard procedure to a familiar problem. For saving the space of the present paper, only the overview summary slide is shown in Fig. 5. The information obtained in each box is briefly shown with some illustrative sketches.

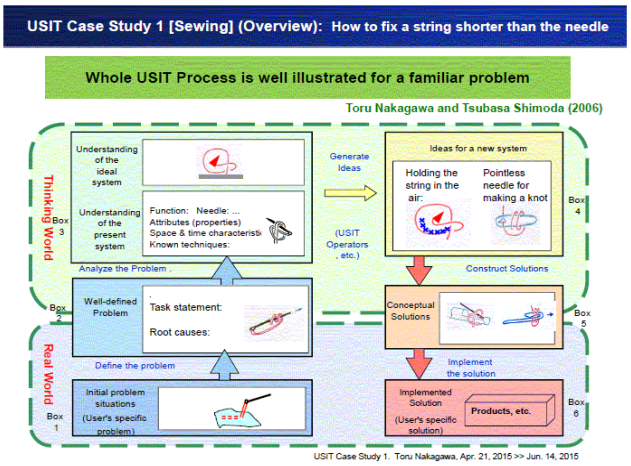

Fig. 5. USIT Case Study 1. Overview summary [9].

6. USIT Manual describing the USIT process in detail

When I explain about the Six-Box Scheme (Fig. 1) and the USIT process (Fig. 6), people often ask questions about how the idea generation step (i.e., from Box 3 to Box 4 in Fig. 1) is supported in USIT. Thus, for the purpose of illustrating the USIT process, two pages of the USIT Manual in the Idea Generation step are shown in the next page.

Fig. 14 shows the instructions at the first sub-step of Idea Generation step, with the illustrations of the standard case study (i.e., USIT Case Study 4: Picture Hanging Kit Problem). In the previous step for obtaining thorough understanding of the present system and of the ideal system (Box 3), the problem is fully analyzed from various aspects. During the process our brains are working actively and various ideas usually come up with spontaneously. You are encouraged to rely on your capability as a problem solver you have obtained through your education and training for many years.

Fig. 7 shows the second sub-step of Idea Generation in USIT. For the purpose of generating more ideas systematically, the USIT process has the system of USIT Operators, which were developed by the reorganization/ unification of all the TRIZ solution methods. For details of the operator system and its usage please refer to our paper [4] and documents [12]. Fig. 7 shows the instructions about the USIT Operators and their usage with illustrations.

USIT Operators are more systematized and easier to apply than 40 Inventive Principles, 76 Standard Solutions, etc. in TRIZ. However, if you are well familiar already with such TRIZ principles and solutions, you can of course use them at this sub-step in place of the USIT Operators.

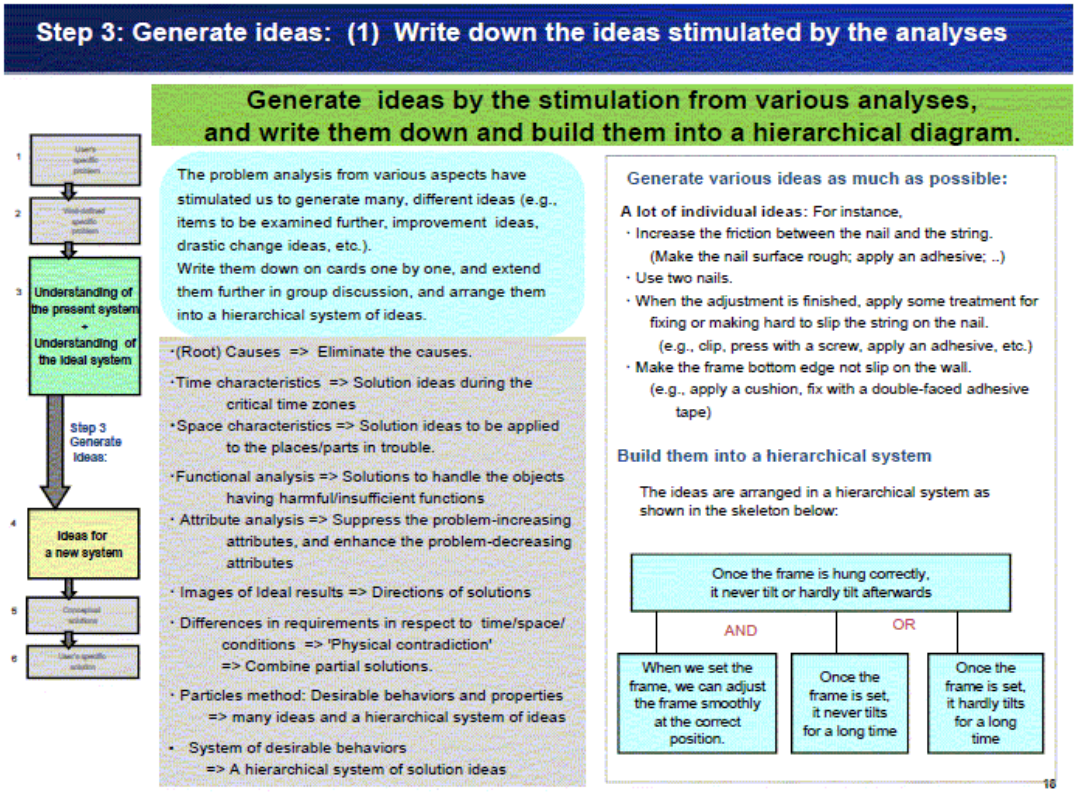

Fig. 6. Instructions for the Idea generation stage (1) Spontaneous idea generation based on the understanding of the problem

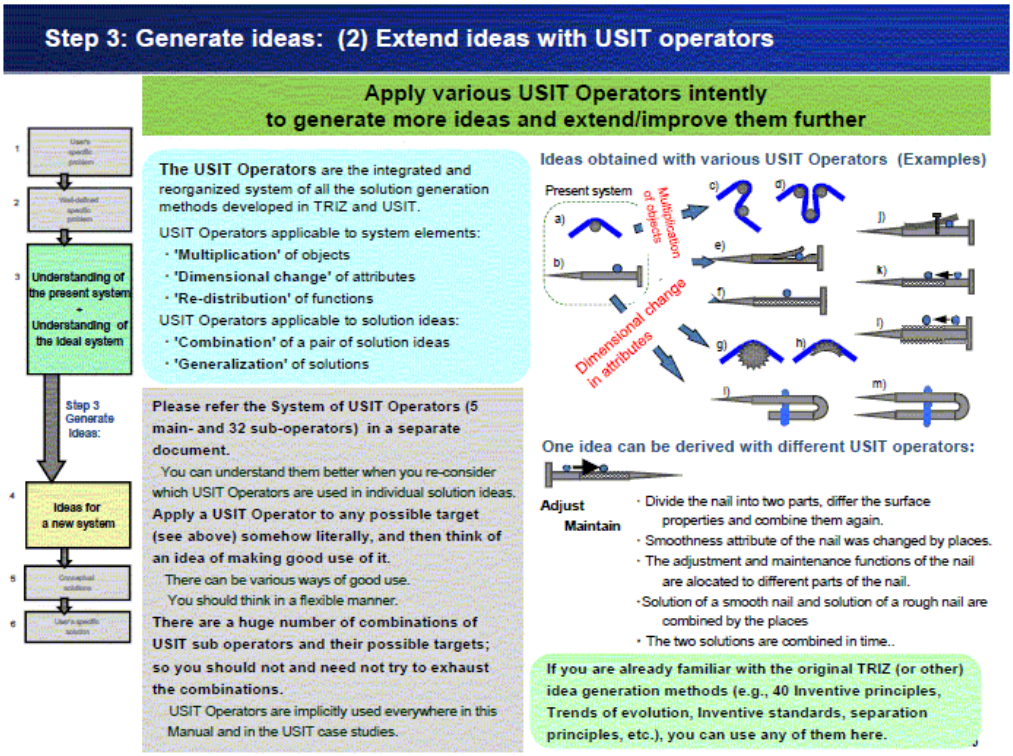

Fig 7. Instructions for the Idea generation stage (2) Extended idea generation by use of USIT Operators

7. Concluding Remarks

The present paper proposes to build a General Methodology of Creative Problem Solving (CrePS), for fulling the basic demand of creative ways of thinking, by integrating and unifying a large variety of methods and sub-methods developed so far in the world. The Six-Box Scheme is proposed as the new paradigm of CrePS for the integration. The USIT process is demonstrated as a concise and practical process for executing the Six-Box Scheme.

For further development of the CrePS methodology, we need to pursue the following aims and tasks:

- Case studies of applying various methods of creativity & innovation to different types of real problems should be collected, examined, and documented systematically to form the basis of developing CrePS and its processes.
- Activities in various types of Real World (such as shown in Fig. 2) should be examined and categorized in the aspect of creative problem solving, and suitable processes of creative problem solving in the Thinking World should be developed in accordance to the Six-Box Scheme.

Collaboration with you, researchers and promoters of different methods of creativity & innovation, is indispensable for establishing a general methodology proposed here. I should heartily appreciate your understanding and collaboration.

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