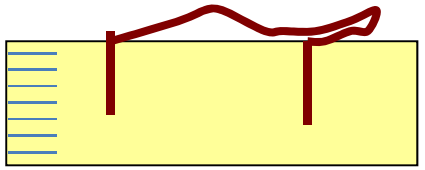
Case Study 2. How to prevent a staple from being crashed



References:

[1] Source: "Creative Problem Solving Methods: How to prevent a staple from being crashed " , Kazuaki Kamiya, Thesis, Osaka Gakuin Univ. (Guided by Toru Nakagawa), Feb. 2004

[2] Introductory article: "Everyday-life Case Studies (3) How to prevent a staple from being crashed " in " TRIZ: Creative Problem Solving Methodology for Innovation (13)", Toru Nakagawa, "InterLab" Journal, Jan. 2007;
"TRIZ Home Page in Japan", Jan. 7, 2007 (in Japanese)

[3] "A New Generation of TRIZ" , Toru Nakagawa, 1st TRIZ symposium in Japan, Sept. 1-3, 2005, at Shuzenji;
"TRIZ Home Page in Japan", Sept. 20, 2005 (in Japanese and in English)

[4] Description of this case study: "USIT Case Study (2)",
by Toru Nakagawa (OGU), May 12, 2015 (in Japanese), Jun. 3, 2015 (in English)

USIT Case Study 2. How to prevent a staple from being crashed

Introduction: Outline and Significance of this Case Study

The present Case Study is based on the thesis work carried out by **Kazuaki Kamiya** under the guidance by Toru Nakagawa at Faculty of Informatics, Osaka Gakuin University.

The thesis work aimed at learning the methods of creative problem solving and especially at working out a case study of applying TRIZ/USIT to some problem.

The problem is: "For the stapler of ordinary size, the staple is usually crashed when we try to bind more-than-30 sheets of papers. Improve the stapler to be able to bind some more papers without being crashed."

At first we thought that the looseness around the axis may be the root cause.

However, when we made trials to bind thick papers, the staple happened to stuck inside the stapler, and we found that the staple was in the M-shape.

We recognized the real problem, and got the idea of supporting the staple inside the staple holder. But the idea won't work because the support would interfere with the staple.

For solving the problem, we used the Altshuller's SLP (Smart Little People) successfully..

This case study contains good educational viewpoints of problem solving and useful.

The problem and the thinking process may be understood by children.

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

USIT Case Study 2. How to prevent a staple from being crashed

Table of Contents

[Case 2. Stapler] Step 1. Define the Problem (1) Preparation: Thesis work

In the Real World, raise an issue and prepare for the Project (Thesis Work)

(1) Preparation: Thesis Work for learning the Creative Problem Solving Methods

Situation: The capability of solving problems creatively is a basic and yet advanced and widely-applicable quality for students to master. In the thesis work, the students are expected to learn the methods and have the experiences of solving problems for themselves.

Target: To work to apply the TRIZ/USIT method to some familiar problem for solving the problem creatively and for mastering the methods and the thinking ways.

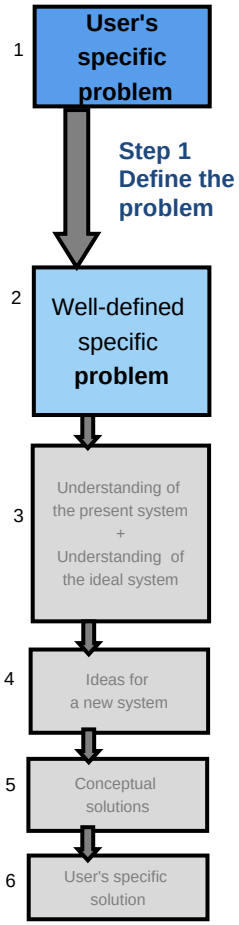
Project: Thesis work at Nakagawa's Seminar Class, Faculty of Informatics, Osaka Gakuin University. Students study in the Seminar Class during their 3rd and 4th years. The theme for the thesis is decided in June of the 4th year, and the thesis is submitted next February.
After the thesis work, Nakagawa brushed up the work and finished as a USIT Case Study.

Activities: The Seminar has a regular class of 90minutes every week. 5 Students in the Class. Nakagawa guided them both individually and collaboratively in the group work .

Team: 5 students in the Class. The students have their own individual themes and make practices and discussions together on all the themes.

Theme: This theme was proposed by Nakagawa, as a familiar problem.
Mr. Kamiya and all the students well understood the problem situations.

[Case 2. Stapler] Step 1. Define the Problem (2) Clarify the problem situations



Define the Problem (using the standard template in the USIT Manual)

Toru Nakagawa and Kazuaki Kamiya (2004)

Step 1. Define the Problem

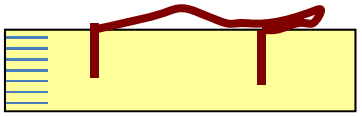
(a) An unwanted effect:

A stapler of the ordinary size (e.g. MAX10) can bind the papers up to 30 sheets. For more sheets of paper, the staple is crashed and fails in binding.

(b) Task statement:

With the stapler of the ordinary size, improve its capability of binding more sheets (e.g. 40-50) of papers.

(c) Simple sketch of the problem situation:



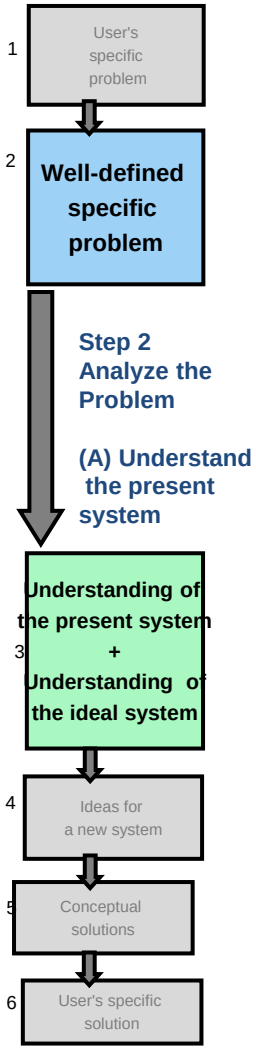
(d) Plausible root causes:

Since the staple is crashed always sideways, the looseness around the axle of the stapler is supposed to be the root cause.

(e) A minimum set of relevant objects:

Thick sheets of paper, the staple of the stapler, the stapler (magazine of the staples, driver, base plate, axle, etc.), human hand

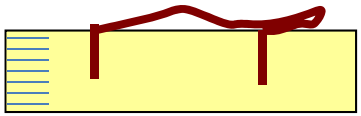
[Case 2. Stapler] Step 2: Analyze the Problem (A) Understand the present system



(A1) Understand the Space Characteristics

Repeating trials to bind the thick sheets of papers,
we have found that about 30 sheets are the maximum thickness of successful binding.

The staple is crashed sideways all the time.

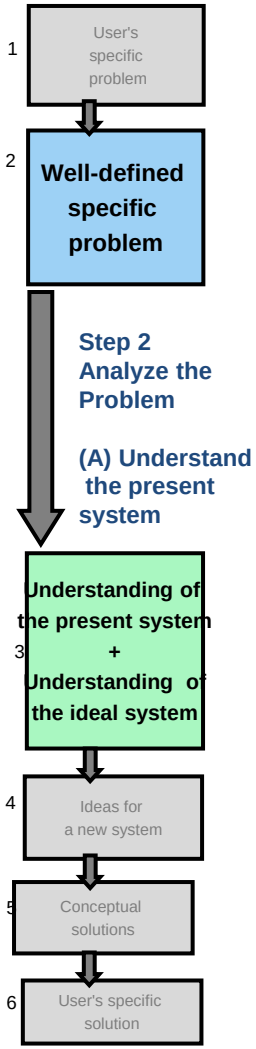


(A2) Understand the Time Characteristics

No temporal dependence.

This point was reviewed later.

[Case 2. Stapler] Step 2: Analyze the Problem (A) Understand the present system

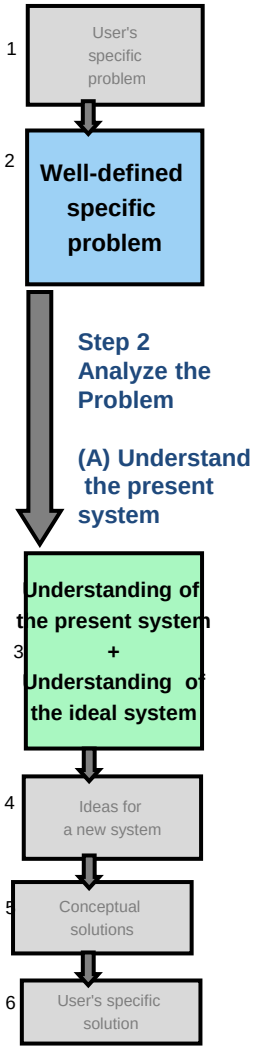


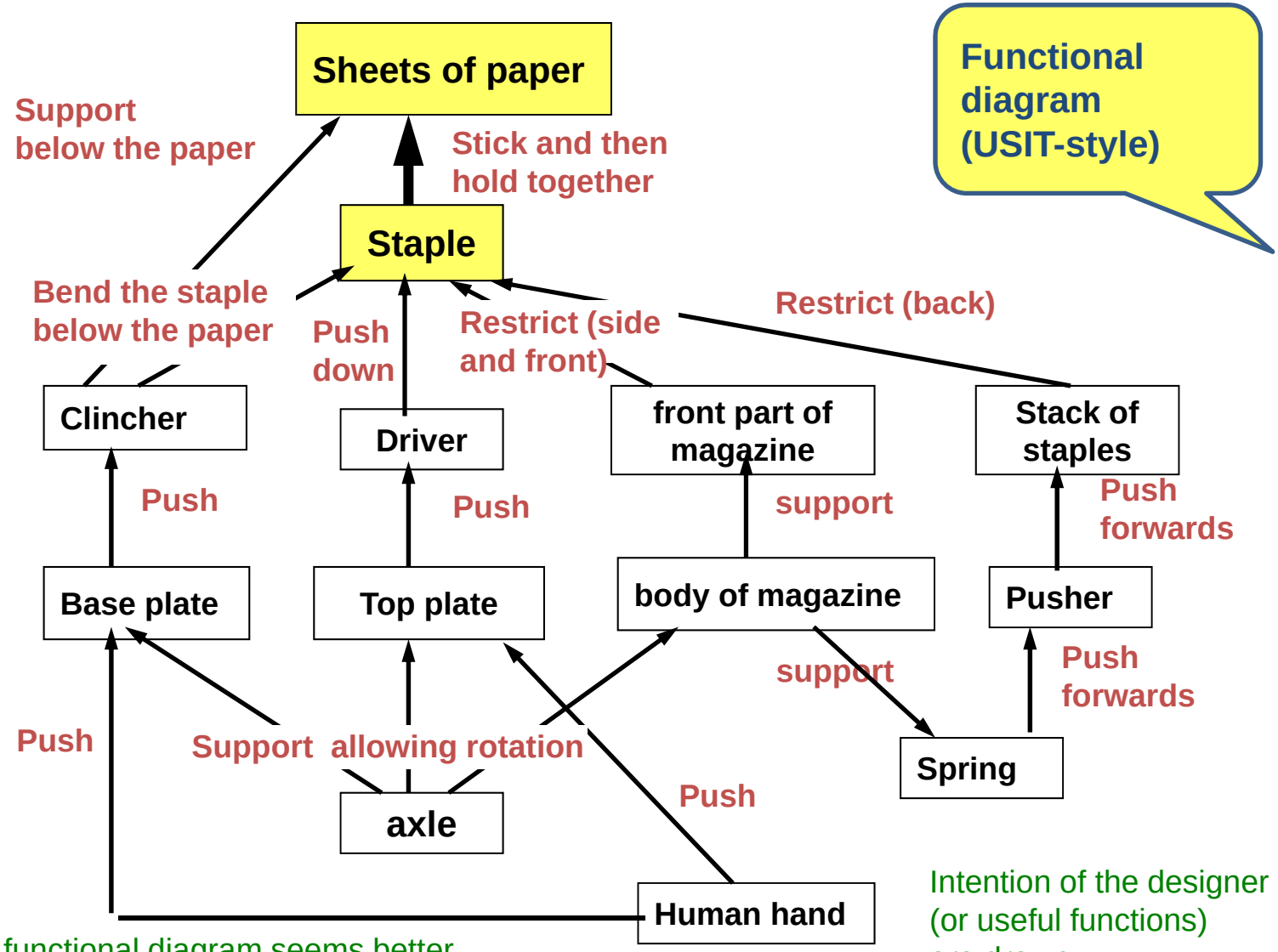
(A3) Understand the Attributes (properties)

Object	Attributes enhancing the easiness of being crashed	Attributes suppressing the easiness of being crashed
sheets of paper	Number of sheets, thickness of each paper, quality of paper	
staple	Thickness, length, friction with the paper	Strength of the material, sharpness of the point
magazine part	Space with the staple, looseness inside the stapler	
axle	looseness (in allowing the horizontal motion)	Thickness of the axle

[Case 2. Stapler] Step 2: Analyze the Problem (A) Understand the present system

(A4) Understand the Functional Relationships



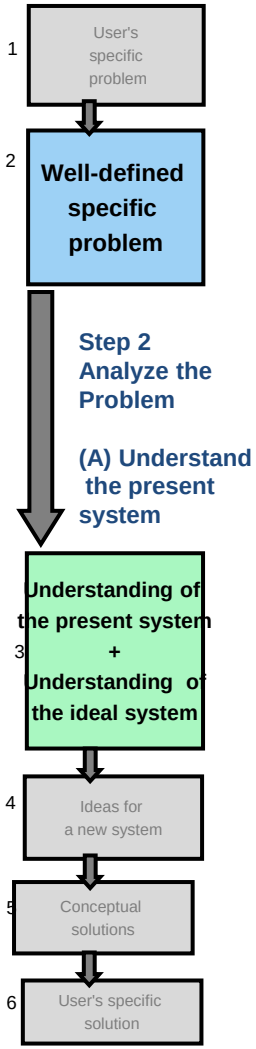


Functional diagram (USIT-style)

Intention of the designer (or useful functions) are drawn.

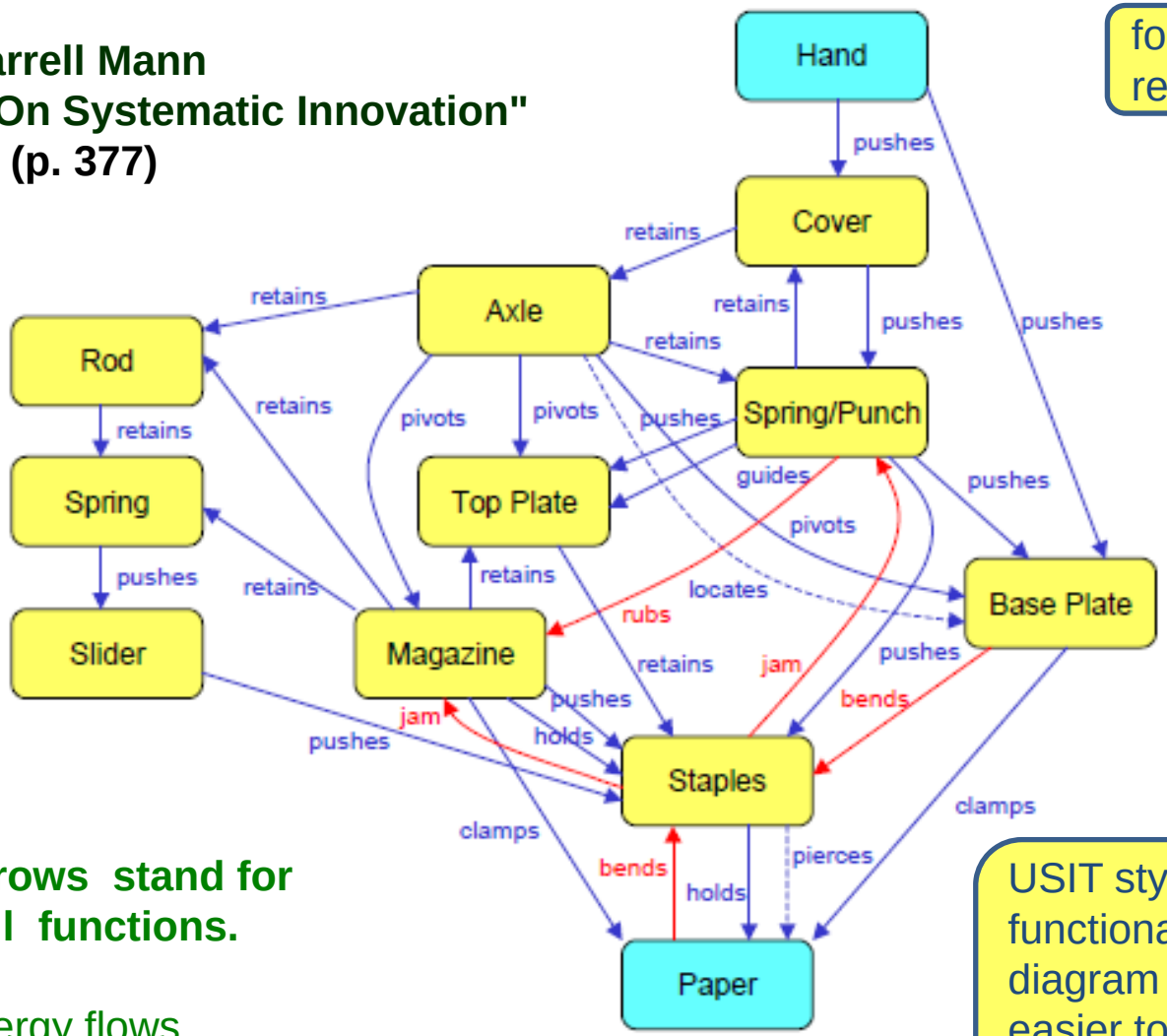
The USIT way of functional diagram seems better than the one in Darrell Mann's textbook.

[Case 2. Stapler] Step 2: Analyze the Problem (A) Understand the present system



(A4) Understand the Functional Relationships

Ref.: Darrell Mann
"Hands-On Systematic Innovation"
Fig. 17.8 (p. 377)



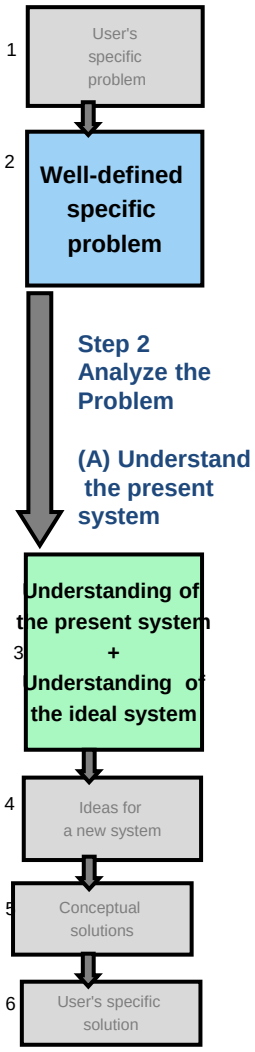
for reference

Red arrows stand for harmful functions.

The energy flows from top to bottom

USIT style of functional diagram seems easier to understand.

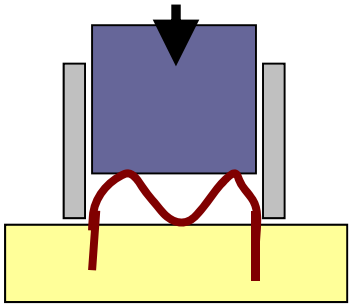
[Case 2. Stapler] Step 2: Analyze the Problem (A) Understand the present system



(A5) Unexpected finding in experiments

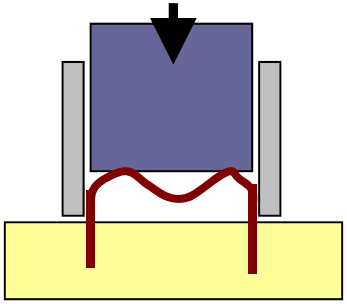
We were repeating the experiments, thinking that "the axle of the stapler should be made stronger and tighter".

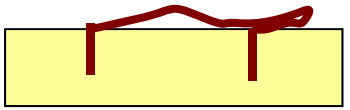
The staple was suddenly caught in the stapler and did not move. The staple was in the form ===>



So we made new experiments of releasing the power 'just before the staple is crashed'.

Then we have found that the staple bends into an M-shape just before being crashed.

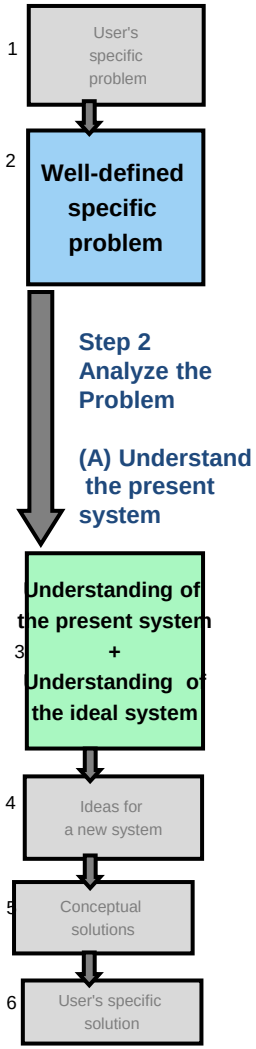




Why does it bends like this?
Why the middle of the top part of the staple bends down?
We do not push that part...

Observation and noticing like this is important.

[Case 2. Stapler] Step 2: Analyze the Problem (A) Understand the present system



(A5) Unexpected finding in experiments (continued)

When the staple is pressed tightly, it wants to release the energy by bending (rather than by becoming thicker or shorter), because it is the easiest way.
The staple bends in an M-shape because it is the simplest form of deformation.

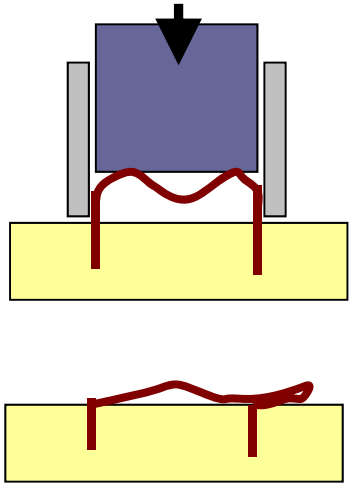
The staple is not supported on the inner side.

Once the staple starts to bend, it will be bent very easily.
(just like to hit a bent nail with a hammer.)

This is the real root cause of this problem !

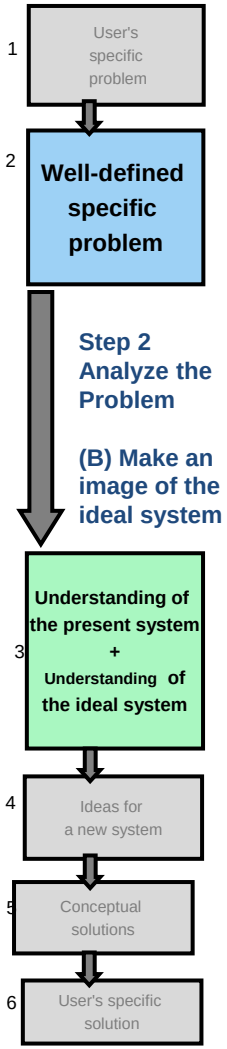
We also realized the importance of the consideration/observation of various phenomena in a close up view in time.

==> Understand the time characteristics.



A real root cause is now found.

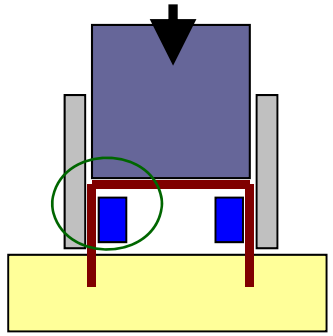
[Case 2. Stapler] Step 2: Analyze the Problem (B) Make an image of the ideal system



(B) Make an image of the ideal system

The observation in the previous sub-step (A5) showed us an ideal image:

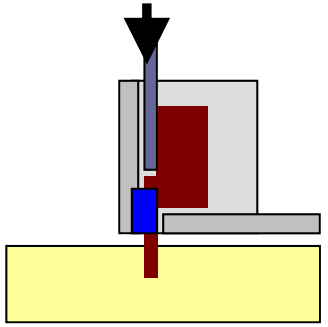
Yes! we should just support the staple on the inner side, as shown in the right.



But Wait! Something is not quite right!

Such a support becomes the obstacle of the staple to stick through the sheets of paper.

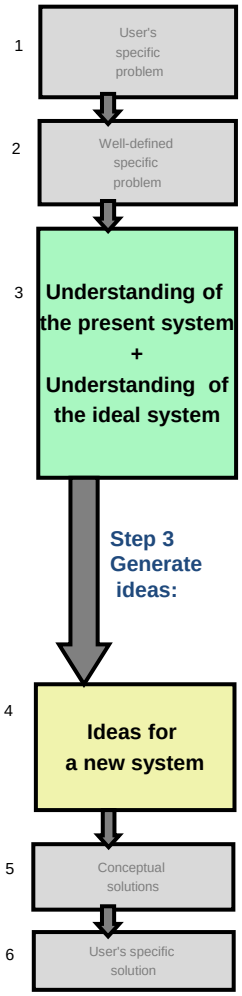
The Idea system is:
the staple is supported by something on the inner sides, AND the staple can stick and hold the sheets of paper smoothly without being blocked by the support.



The ideal image may have apparently contradictory requirements.

Such contradictions should/can be solved in the next step of idea generation.

[Case 2. Stapler] Step 3: Generate ideas (1) under the guide of the ideal image



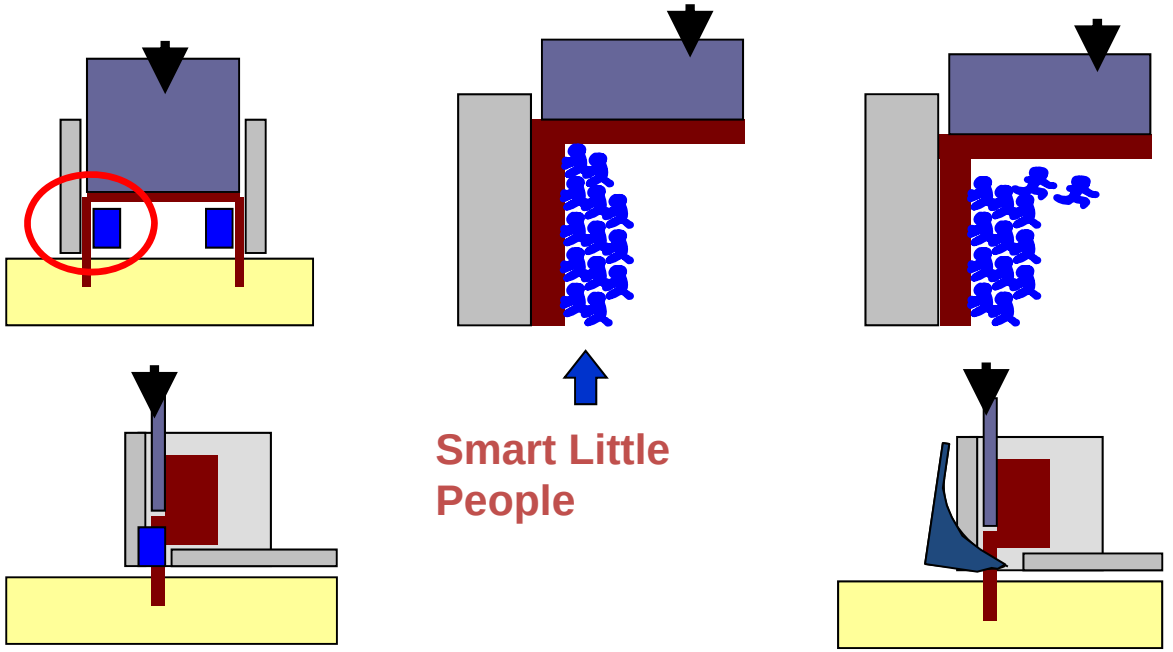
Generate ideas under the guide of the ideal image

Altshuller's SLP (Smart Little People) method was used:

SLP is essentially same as the Particles Method of USIT

Suppose that the component are formed by a group of Smart Little People.

Imagine how the Smart Little People behave in this problematic situations:

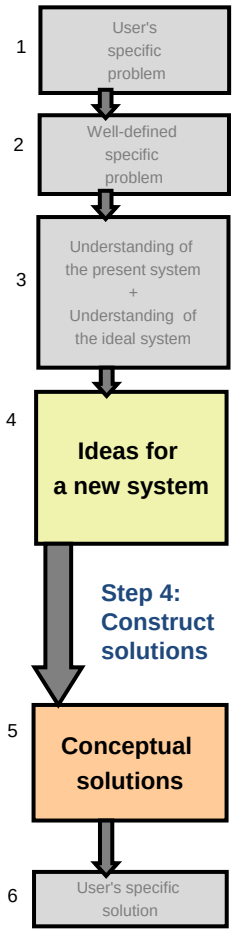


Smart Little People

The SLP who are pressed much want to escape one by one.

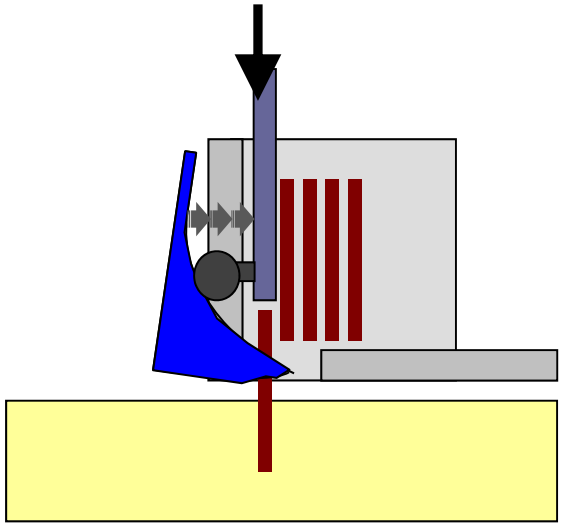
The SLP find the way to escape in the front direction of the stapler.

[Case 2. Stapler] Step 4: Construct solutions:(2) Construct the conceptual solutions



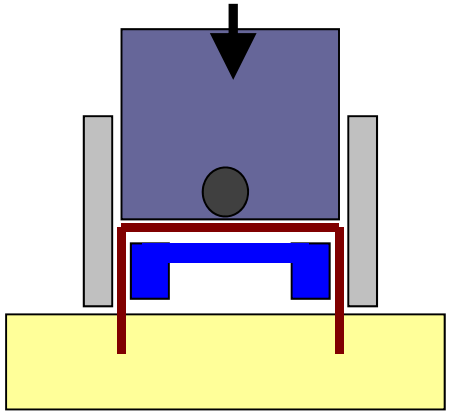
(2) Construct the conceptual solutions;

Consider the idea obtained in the previous step more concretely.



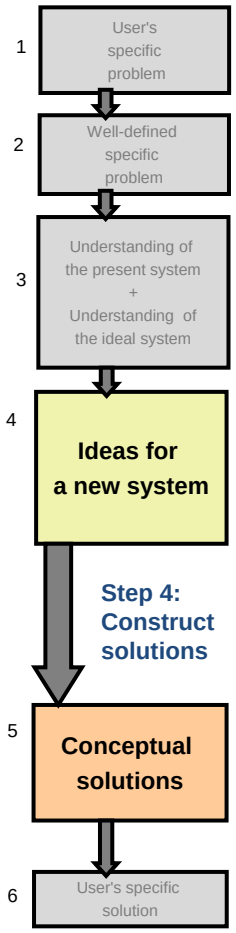
'Little People escape one by one to the front of the stapler' can be realized by 'a triangular supporting part (shown in blue) is pushed forward with the pressing down of the staple.

A ball is attached to the driver (a metal plate). As the staple is pushed down with the driver, the ball pushes the (curved) triangular part forwards.



The metal triangular part is pulled back by a spring.
When the staple is pressed down completely, the driver goes up and the supporting part is pulled back for supporting the next staple.

[Case 2. Stapler] Step 4: Construct solutions (3) Report the results



Report as a Case Study. Conclusion of the Case Study.

A familiar problem of a stapler: 'How to prevent the staple from being crashed for binding thicker sheets of paper` is solve effectively by use of the USIT process.

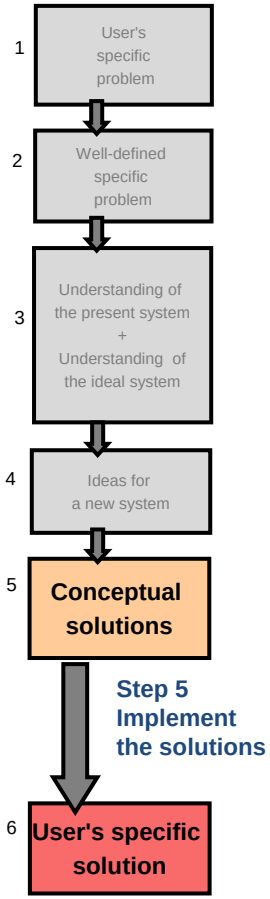
The standard USIT process was useful,
but particularly in this case it was important that
while repeating the experiments with real material,
we met a accidental trouble and observed an unexpected phenomenon,
and realized a real root cause different from the initially supposed one.

The idea of the root cause guided us an image of the ideal situation,
and then the contradictory requirements in the ideal are solved
by use of the Smart Little People (SLP) method.

This is a nice case study, which may be understood by children and high school students.

On the basis of a thesis work, the case study was further brushed up and were presented in a journal, conferences, seminars, and Web sites.

[Case 2. Stapler] Step 5: Implement the solutions: (Real activities in the 'Real World')



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

After publishing this case study in a journal, we sent the report to a manufacturer of staplers in Japan, but we had no response.

We may need to survey various commercial products and patents of the staplers and relevant tools.
There may be known examples of similar technologies.

More powerful stapler or stapler-like tools in the fields of construction equipment etc. may possibly exist.

Even though there are preceding known solutions, the present case study has its unique value for illustrating the thinking method in USIT.

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)