Altshuller Institute for TRIZ Studies
TRIZCON2009

USIT Case Study: A Mom's Bicycle for Safely Carrying Two Children

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Outline of Talk

We are going to report a case study of applying USIT
to a familiar problem of improving bicycles
by a group of participants at a USIT 2-Day Training Seminar.

The outputs of group practice were documented and
later refined via email discussions.

The whole process is presented here along the USIT process:
Problem definition,
Problem analysis of the present system and the ideal system,
Solution generation.

Some discussions are given in comparison with other solutions.

Aims of the Present Paper:

For learning problem solving methodologies,
such as TRIZ and USIT,
learning the way of thinking is important but difficult.

There are various ways of learning:
Reading textbooks, Listening lectures and seminars,
Training practices, Solving real problems, etc.

Case study reports are very useful to learn
if the actual ways of thinking in the problem solving are
described in a vivid way traceable by the readers,
and are discussed objectively on critical issues.

This paper intends to be such a Case Study report
of applying USIT to a familiar real problem
in a recent 2-Day USIT Training Seminar.

Mothers with two children
on bicycles.

But all these mothers are
violating Road Traffic Law
in Japan!!
On a bicycle, only one child
is allowed to carry.

TV news (NHK, Mar. 4, 2008):
"The National Police Agency has suggested recently,
on the strong requests from mothers,
to modify the law to allow to carry two children on a bicycle
if bicycles are improved to do so safely."

⇒ **On Mar. 7-8, 2008, at a USIT Training Seminar,**
we tried to propose solutions to this problem using USIT.

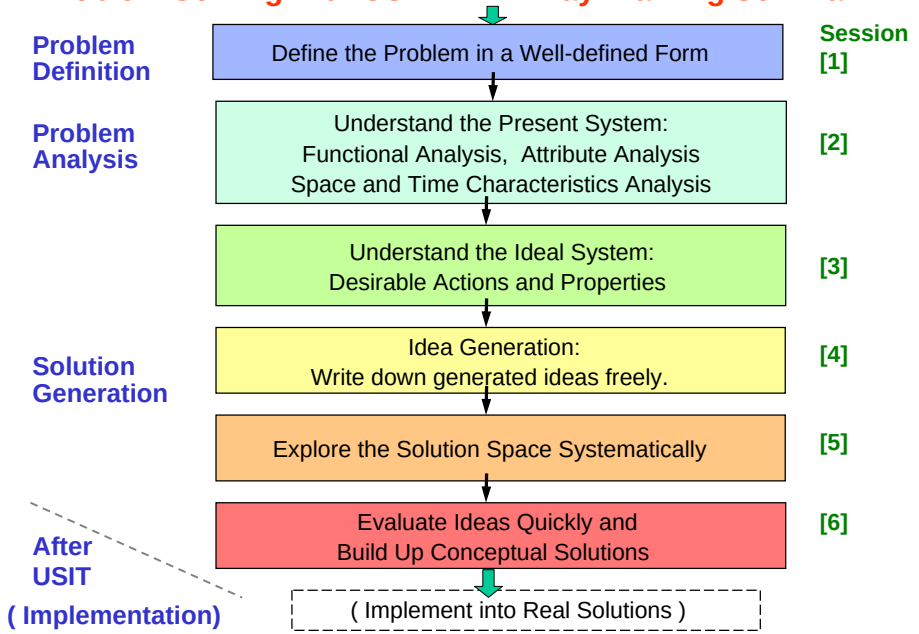
USIT 2-Day Training Seminar

Mar. 7-8, 2008, Tokyo. Instructor: Toru Nakagawa

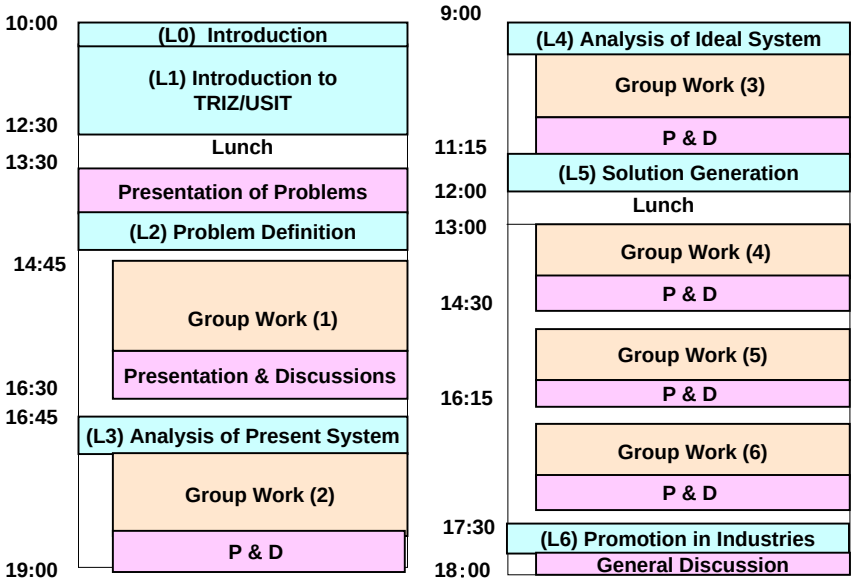
Open-entry multi-company situation.
Group practices for solving 3 real problems in parallel.




Problem Solving with USIT in 2-Day Training Seminar

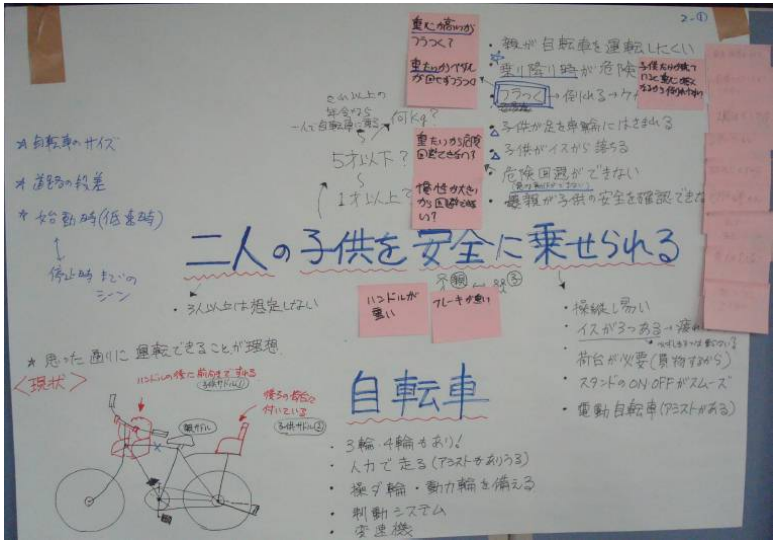


Agenda of USIT 2-Day Training Seminar



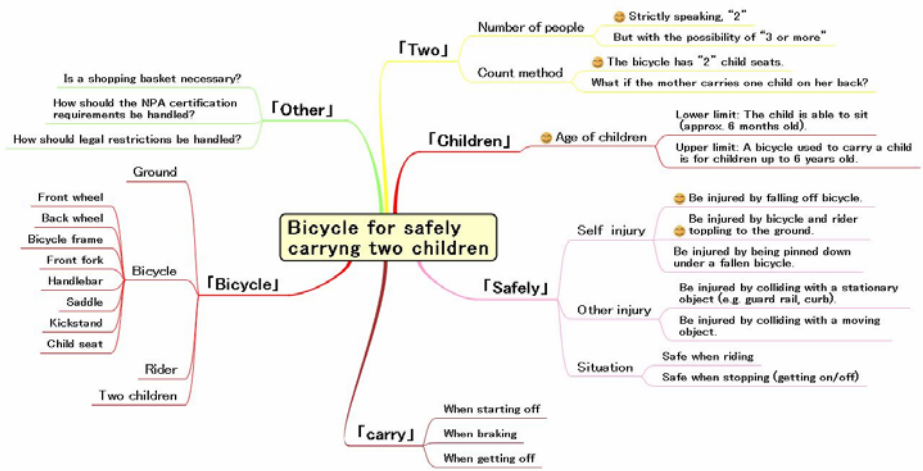
[Session 1] Problem Definition

Sharing the Problem: Photo of the original record in Japanese



Sharing the Problem and Examining the Scope

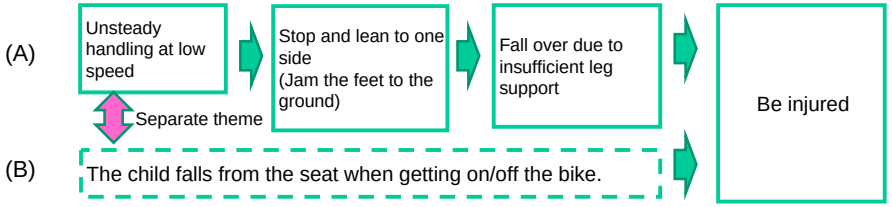
(later redrawn in a Mind Map in English)



Problem Definition

5 items with ★ are requested by USIT

★Unwanted effect



⇒We have chosen the problem (A) more significant.

★ Problem definition statement :

The design should enable steady riding at low speed, easy supporting with legs when stopping and leaning to one side, and preventing from falling over.

★Sketch :

Next slide

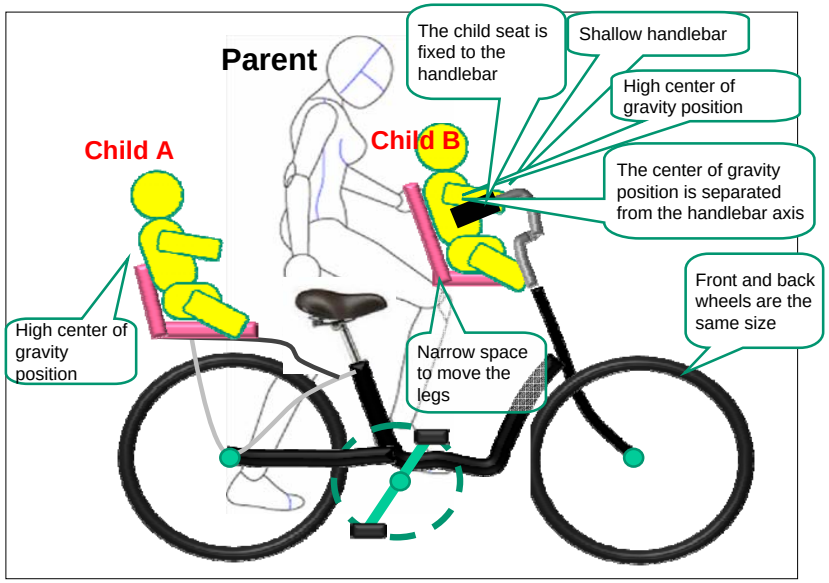
★Root cause : **When a bicycle stops, it falls over without a support.**

★Minimal set of related objects

Ground, wheels, bicycle components, parent, child A, and child B

Sketch of the Present System

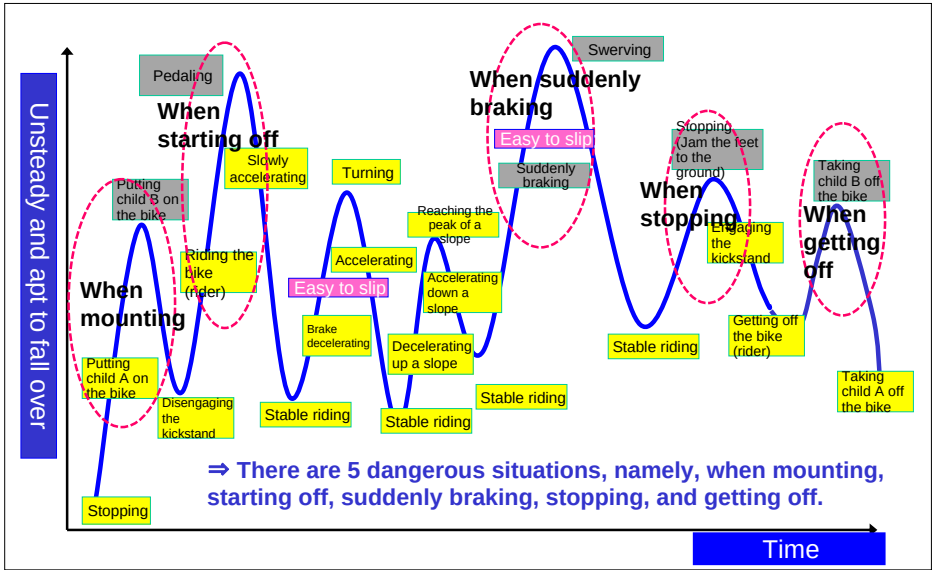
(Brushed up later)



[Session 2] Understanding the Present System

Time-Characteristics Analysis

(Brushed up later)

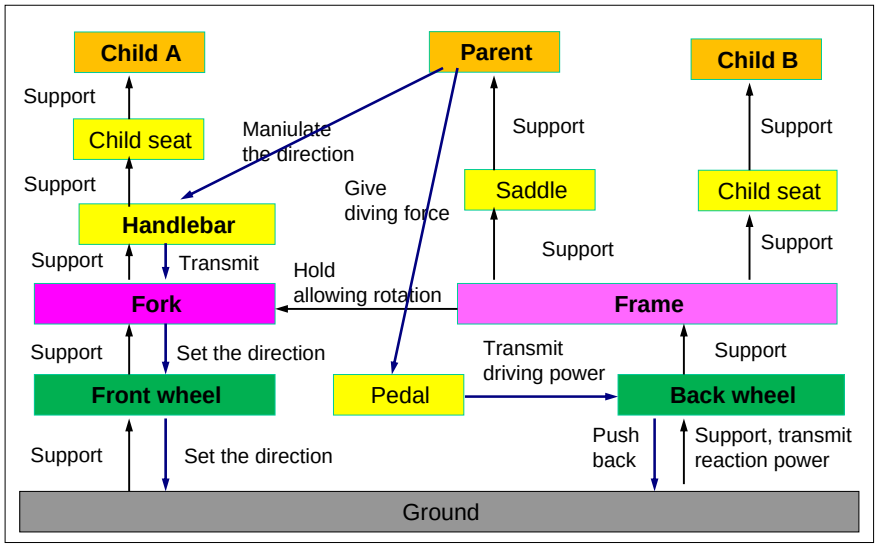


⇒ **There are 5 dangerous situations, namely, when mounting, starting off, suddenly braking, stopping, and getting off.**

Functional Analysis

This diagram was refined after the seminar.

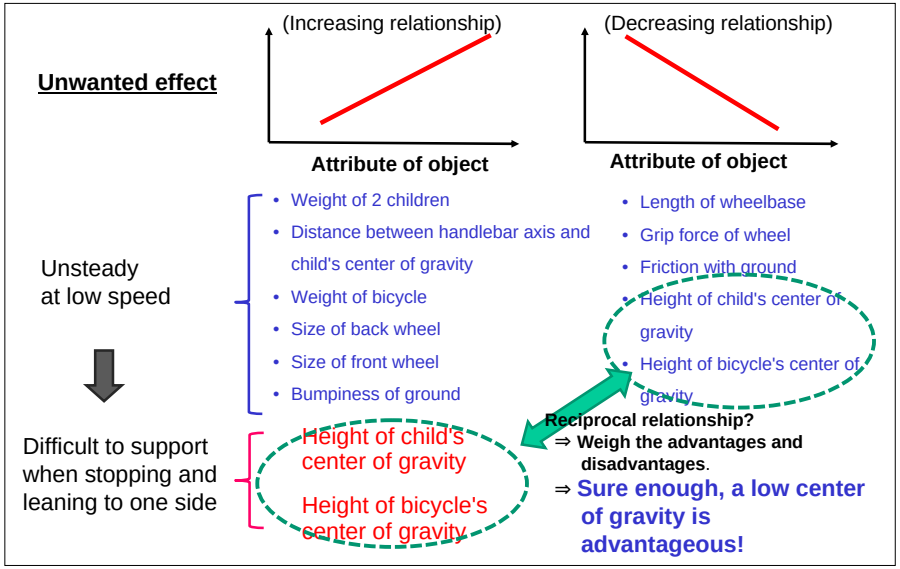
Draw the intention of the current design (i.e. useful functions)



Attribute Analysis

Refined after the Seminar.

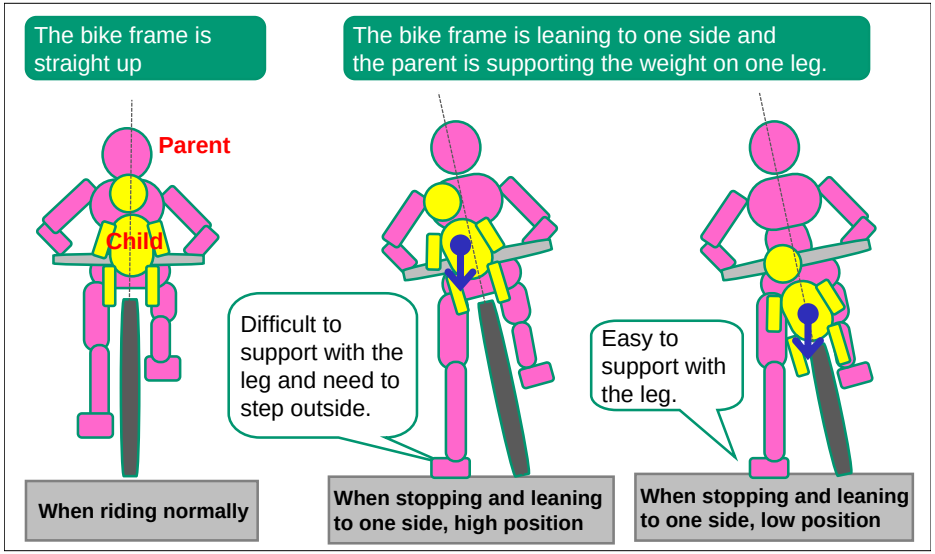
Reveal any attribute which is relevant to the unwanted effect.



Space Characteristic Analysis

Drawn after the Seminar.

Front view has revealed the effect of the position (height) of the children.



[Session 3] Understanding the Ideal System

USIT requests to 'Draw an image of the Ideal System without drawing any means for achieving it.'

Original drawings

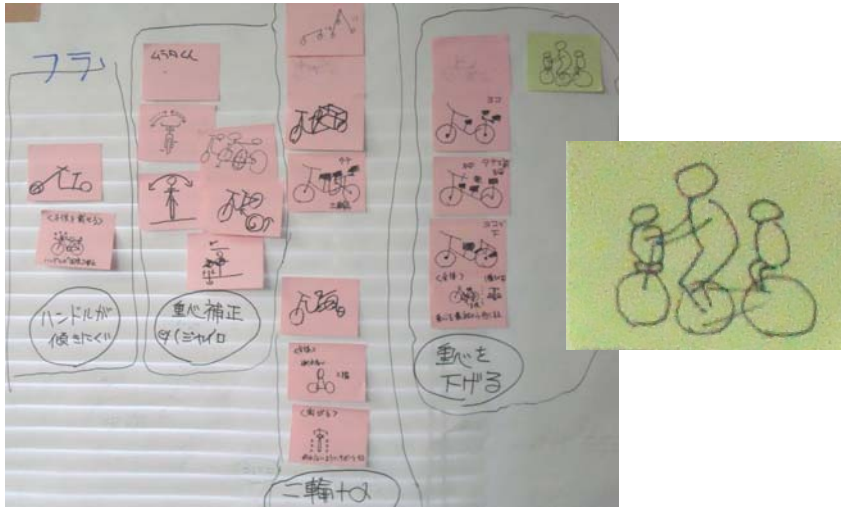
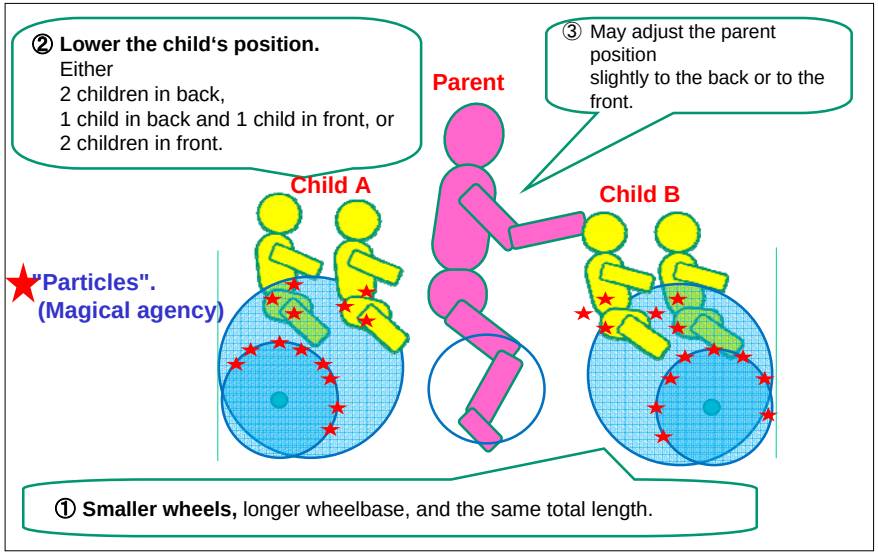


Image of the Ideal System

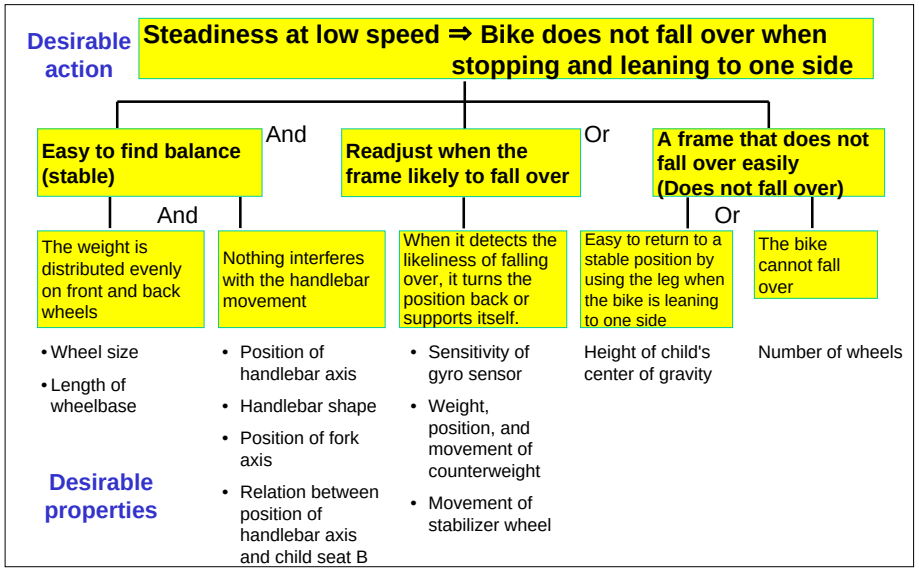
Refined after the Seminar.



Ideal System: Desirable behaviors and desirable properties

Particles Method

Made at the Seminar



Solution Generation

[Session 4] Free Idea Generation

Many ideas have been obtained already during the analysis, and are stimulated further with other member's ideas.

Write them down in Post-It Notes.

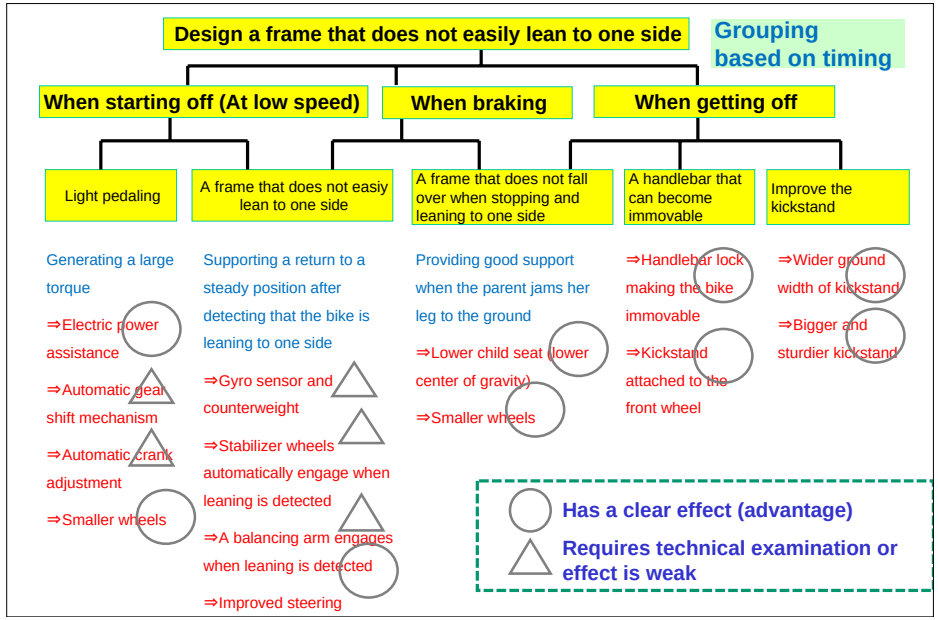
[Session 5] Explore the Solution Space Systematically

Build a hierarchical tree diagram of possible solutions in a bottom-up way with the elements of ideas and in a top-down way from the ideal system image.

Apply USIT Operators if possible.

Tree diagram of Possible Solution Space (Part 1)

Made at the Seminar



Tree diagram of Possible Solution Space (Part 2)

Made at the Seminar

Lower the center of gravity and position the child seat so that it has good balance.

Grouping based on child seat position

Back seat

2 in back

Back
- Move the parent forward.
- Make the wheelbase longer.
- Move the child forward of the back wheel.

1 in back, 1 in front

Back
- Make the wheelbase longer.
- Move the child forward of the back wheel.

Front
- When riding over the handlebar, align the axis.
- Ride over the frame, not the handlebar.

Front seat

2 in front

Front
- Move the parent backward.
- Shift the fork axis and handlebar axis.
- When riding over the handlebar, align the axis.
- At the very least, 1 child should be seated over the frame.

Tree diagram of Possible Solution Space (Part 3)

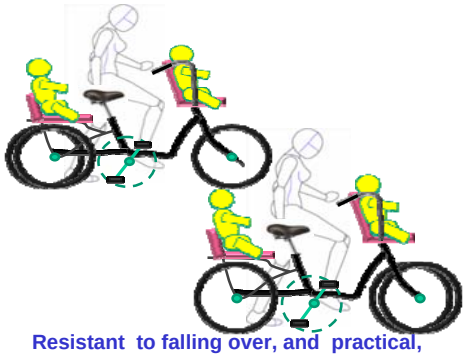
Refined after the Seminar

3 or more wheels

More wheels

Cycle with 3 wheels

2 back wheels | **2 front wheels**



Resistant to falling over, and practical, but a bit poor in cornering.

3 or more wheels with attachment

Side car

The total width must be 600 mm or less (JIS bicycle standard).

⇒Under current law, this type of bicycle could not be ridden on the sidewalk.

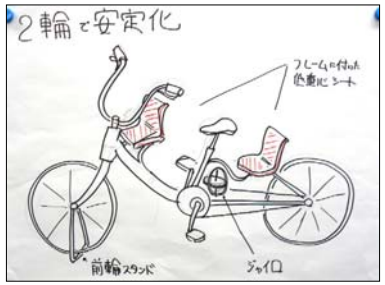
Rear buggy

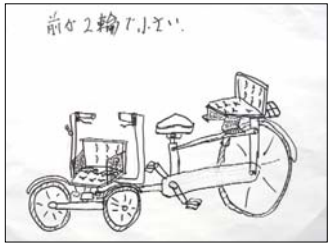
The total length must be 1,900mm or less (JIS bicycle standard).

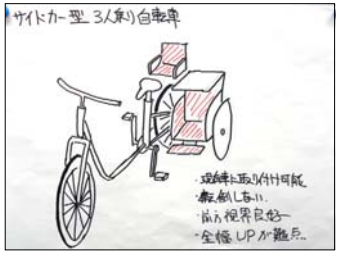
These types are problematic from the viewpoint of ridability and laws and regulations.

[Session 6] Evaluate the Ideas Quickly and Build Up Conceptual Solutions

Original drawings at the Seminar







Front child seat fixed to the frame.

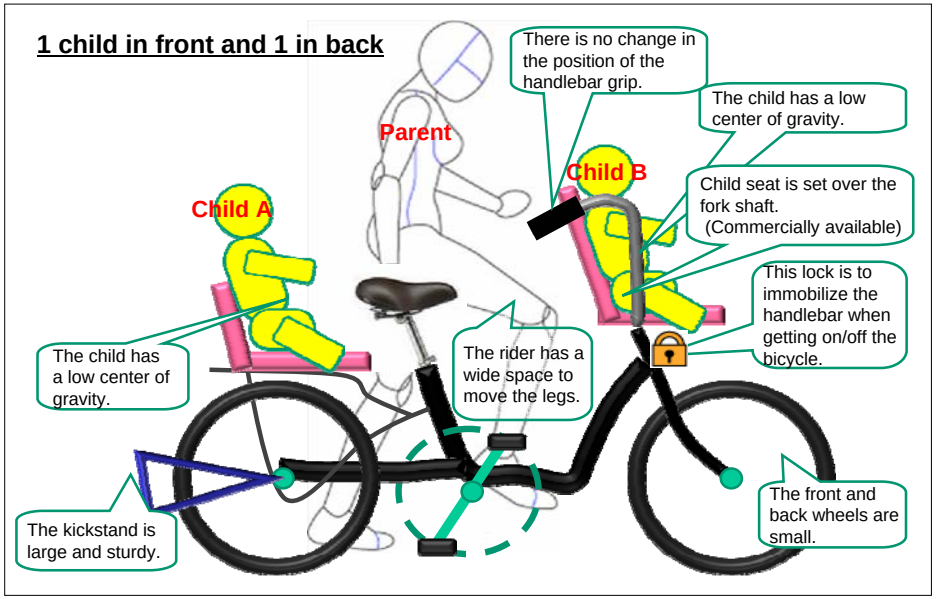
Gyro fixed to the frame.

Conceptual Solution (1)

Improvement of the present system

Refined after the Seminar

1 child in front and 1 child in back



Conceptual Solution (2)

Discussed after the Seminar

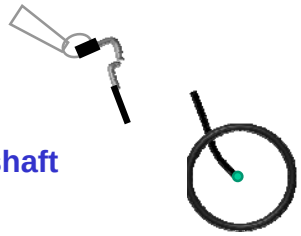
Struggling for a breakthrough:

We want to fix the front child seat to the frame
for more comfort for the child and
for lighter steering operation.

But it interferes the parent's leg movement
and steering operation.

We need wider space
between the parent and the front wheel.

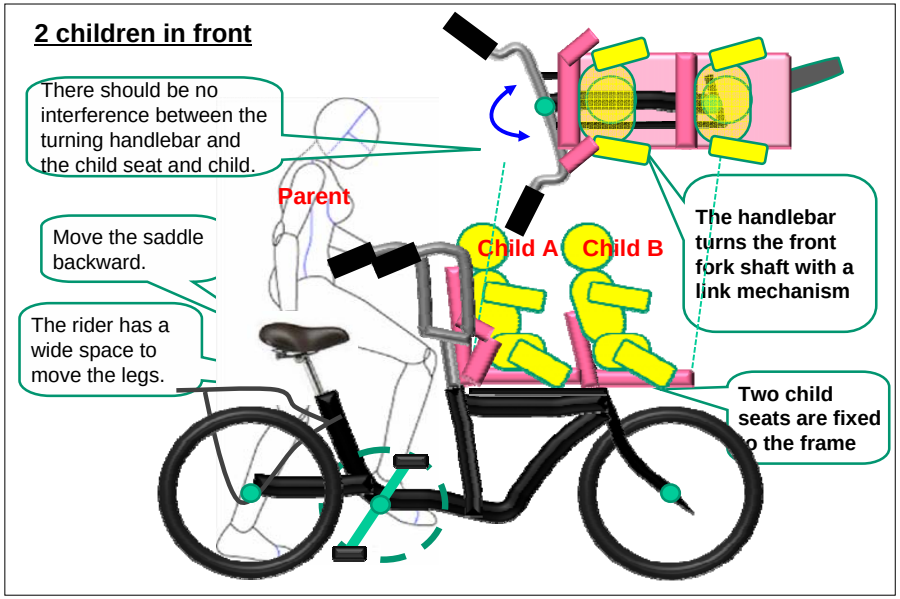
But the parent has to hold/manipulate
the handlebar.



We should separate the handlebar shaft and the fork shaft.

Our Novel Solution

Obtained after the Seminar



Discussion

(A) Activities of Japan Bicycle Promotion Institute (JBPI)

Apr. 24, 2008 Call for design proposals for bicycles able to carry two children safely.

Jul. 14, 2004 Selected 12 from 14 proposals and granted R&D funds for making prototypes by the end of Feb. 2009.

The 12 designs (by Japanese bicycle manufacturers) were disclosed.
Most of them are found within our scope of discussions and ideas.

Essences of our idea are not included in the above 12 designs.

- **Fix the front child seat to the frame** (for more comfort and easier operation
- **Separate the handlebar shaft from the front-wheel fork shaft**
  (for making a wider space between the parent and the front wheel).
- **Place two children in front of the parent** (without choosing a tricycle).

(B) Bicycles in the Netherlands and in the World

In Nov. 2008 in the Netherlands, Nakagawa saw bicycles of the type shown in the photo.

In the boat-like container children were happy even in the cold wind.

Mothers drove these bicycles without difficulty.

Our ideas were found NOT NEW in the world.
However our ideas are proved feasible and practical.

In the Japanese road situations, our solution may be more suitable than the solution used in the Netherlands.

Summary

A group practice in a 2-Day USIT Training Seminar and later enhancement have achieved a meaningful conceptual solution to a real, familiar problem.

The ways of applying standard methods in USIT are described and discussed in detail.

Since USIT uses these standard methods in the whole procedure of problem solving, it is useful to master them through case studies.

USIT is a simple, unified, and yet effective procedure in the family of the TRIZ methodology.