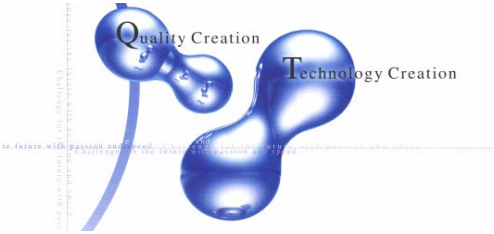
Technical Knowledge Transfer by USIT Application for Paper Handling Mechanism



Kunio Fukatsu
TOSHIBA SOCIAL AUTOMATION SYSTEMS
30-AUG-2007

Intention of the Presentation (1)

■Importance of the technical knowledge transfer is widely understood at present when technologies and technical talents are largely changing.

■We have been accumulating the knowledge about paper handling mechanisms and have posted it in our intranet Home Page. Such information should be useful for the improvement of products.

But it might become **an obstacle for the creation** of new concepts.

Intention of the Presentation (2)

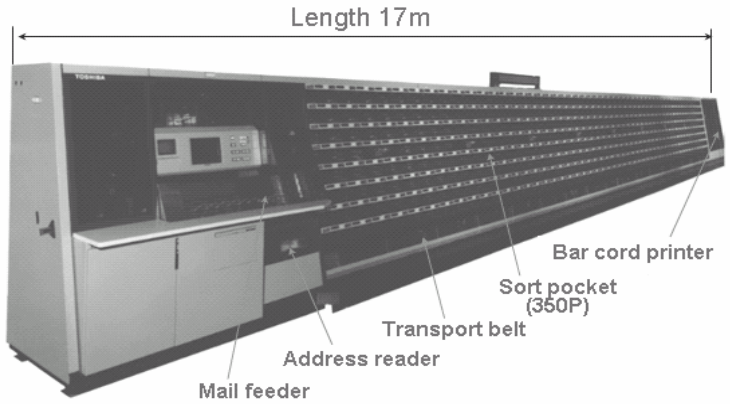
■For transferring technology to the next generation, transferring the methodology of technical idea creation must be more important than transferring technical knowledge.

■Recently, we learned TRIZ/USIT and applied it to the design of paper handling mechanism.

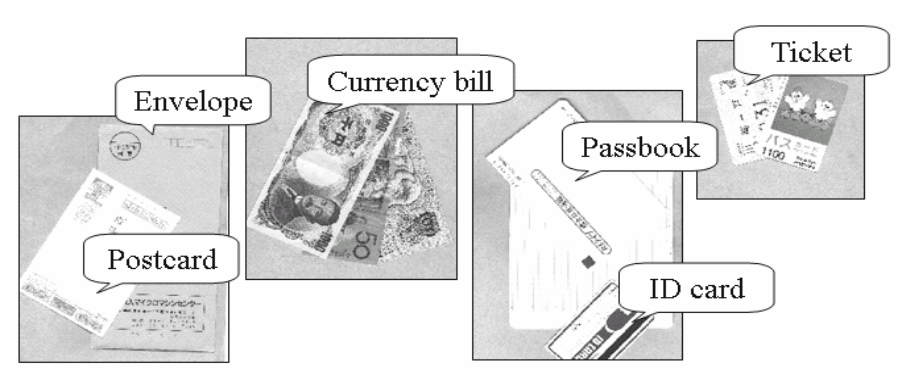
Having found USIT is plain in idea generation process and stimulates free conception, we understood it to be useful as a means of transferring knowledge to the next generation.

Social-automation systems

mail-processing systems



Media for Social Automation systems



Paper-handling technology

What's Paper Handling ?

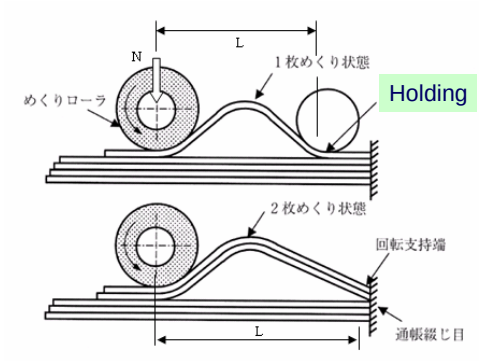
■The component technology essential for using the paper as a medium of information, including: paper feeding, transporting, printing, reading and stacking.

Not yet established as an engineering field.

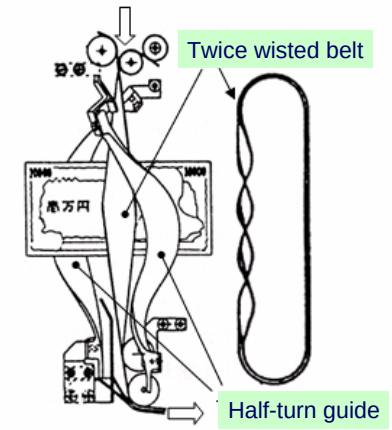
Conception and trial/error by former engineers produced this technology.

Their know-hows have been accumulated and passed over through generations.

Examples of essential technology generated by the conception

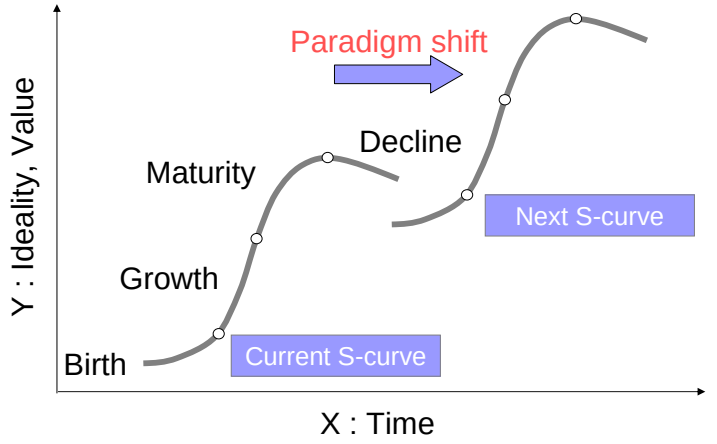


Automatic page turn



Automatic paper face turn

S-curves in system evolution

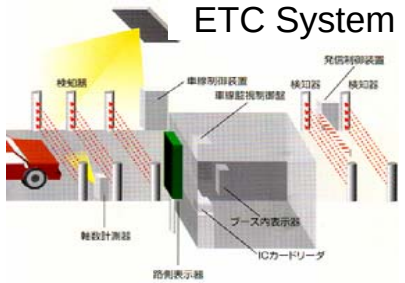


Paradigm Shift of Systems

Paper-Mechatro ➡ Wireless-Network
(Paper system will continue in niche areas)

Magnetic Paper ticket ➡ DSRC Communication | Magnetic Paper ticket ➡ Wireless IC Mobile phone

ETC System



Ticket Gate

cf) DSRC：Dedicated Short Range Communication

Methodology of Technical knowledge transfer

Conventional Methods

- **Standard design process**
- **Area specific technologies**
- **Cases of technical failures**

Useful for improving products further, but
can be obstacles against creating new concepts.

At present when technologies and technical talents are largely changing ……

Transferring the methodology of technical idea creation must be more important.

Contents of Presentation

■1■ Former activities
→Construction of intranet HP for transferring knowledge.
→Idea creation by “Virtual trial chain method”.

■2■ Recent activities after knowing TRIZ.
→Expansion of “9 windows method” which arranged former activities.
→Verify that USIT is effective for paper handling.

■3■ Conclusion
→ Transferring the methodology of technical idea creation is important for transferring knowledge to the next generation.

■1■ Former activities

■ Construction of intranet HP for transferring knowledge.

■ Idea creation by **“Virtual trial chain method”**.

Home page contents

Approx. 500 contents

Inside information | Outside information

Failure cases

5 check lists
Approx. 80 cases

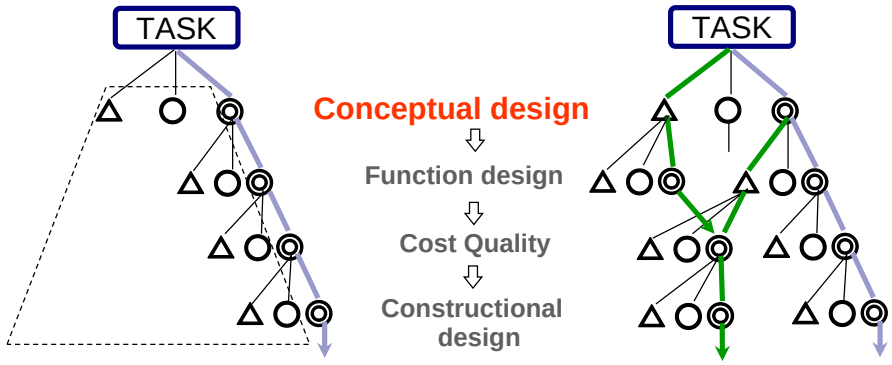
Design studies

Approx. 90 cases

Parts, news

Approx. 50 cases

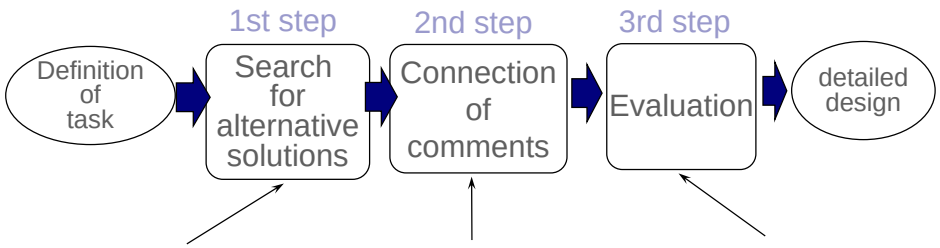
Virtual-trial chain (VTC)



Conventional design process

Conceptual design by virtual trial

Process of Virtual-Trial Chain



Brainstorming

Chain of problem and solution comments

Generation-matrix chart

grouping by [F/D/M/S]

Trials by sketch

Adaptation to environment

Extension of '9-Windows Method'

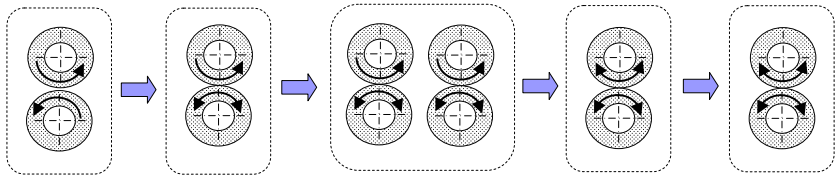
Check lists for Brain Storming in Virtual-Trial Chain

What comes after next ?	Prospect the next two generations
Change scene / time	Different installations／Timings／Users
Change to extremes	Maximize／Minimize／(＋－×÷)
Exception processing	Media end／System change ／Failure／Operational mistake
Close up the details	additional objectives and functions

Example of evolution by Virtual-Trial Chain

Expand the evolution of essential technology into various systems.

Rotation control of Rollers



Automatic ticket gate	Banknote handling	Mail handling	Mail handling	Book finisher
Plural tickets-fed prevention mechanism	Paper feed by MRR (Motored retard roller)	High speed Paper feed (double MRR)	Switch back	Paper Folding mechanism

Attempts of systematizing VTC

■Papers about VTC

1) 深津邦夫・井上克己，製品世代交代に着目した紙搬送機器設計の分析，日本機械学会講演論文集，[No.98-32]，DSC’98，(1998), 584-587.

2) Fukatsu. K, Inoue. K., Virtual-Trial Chain for the Development of Paper handling Devices Based on Four-Generation Design Cycle Model, Proceedings of ICED99, Vol.1, (1999), 77-82

3) Fukatsu. K, Inoue. K., Virtual-Trial Chain in a Competitive Product Design, Proceedings of TMCE2000, (2000), 313-323.

Limitation of the former activities

■ Intranet Home Page

The information in HP becomes obsolete quickly, and it might become the obstacle against the creation of new concepts.

■ Virtual Trial Chain

VTC has been developed as an independent methodology in a design division and some parts remain as tacit knowledge, and hence it is not easy to penitrate it widely.

■2■ Recent activities

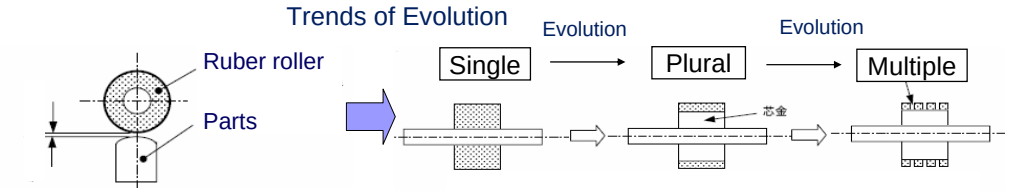
After knowing TRIZ

■ Expansion of “9 windows method” which arranged former activities.

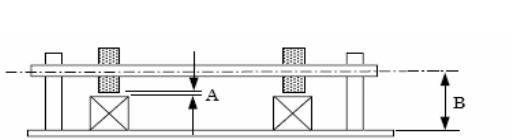
■ Verify that USIT is effective for paper handling.

Examples of design with TRIZ-like ideas

Keep the gap between Roller and parts constant in various heat conditions:



TRIZ knowledge of "Effects"



■Length

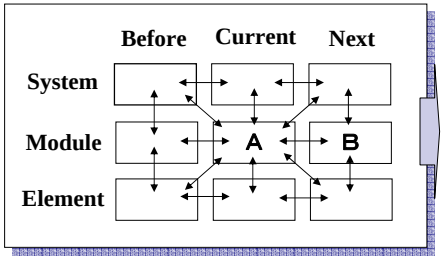
(Change) Ellipse, shape memory effect, magneto striction, electric strain, Piezo, Magnus effect, cam,

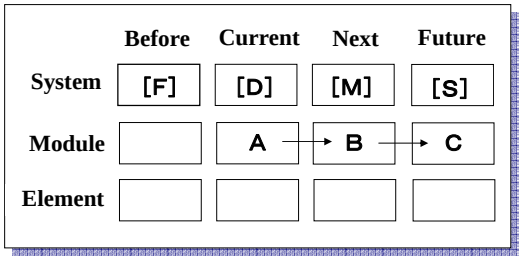
(Enlarge) Thermal expansion

(Decrease) Heat contraction

(Stabilize) Material of coefficient of thermal expansion zero

Expansion of TRIZ "9 windows method"





Expansion of the windows to show "what follows after next", on the basis of the concept of VTC.

USIT Open Training

Held by: IDEA Inc.,

Trainer: Prof. Nakagawa (Osaka Gakuin Univ.)

Sept 27—28, 2005

<Subject>

Improve a Paper Stacker with Impeller

Practice Group Members

- ■ Mr. A : Management of technology and patent
- ■ Mr. B : Manufacturing technology
- ■ Mr. C : Manufacturing technology
- ■ Mr. D : Value engineering
- ■ Mr. E : Machinery engineering
- ■ **Speaker** : Professional in paper handling

Improve a Paper Stacker with Impeller

Present structure

This mechanism is highly reliable. But the impeller of a large diameter occupies the stacking space, and has become a restriction for downsizing of the mechanism.

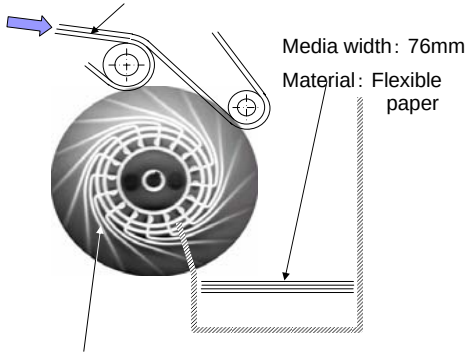
Objectives

Make these Compatible

Downsizing | High Reliability

Approach direction 12 p/s

Clamp transport by flat belt Speed: 2m/s



Impeller: Dia. 104 mm 2 wheels, 16 separators

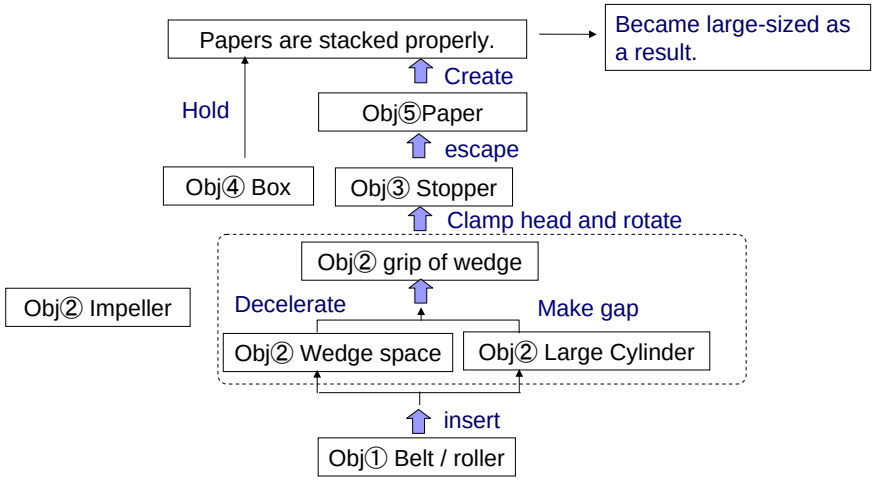
Speed: 45 degree in 1/12 sec.

Problem Definition

a	Undesirable effect	The impeller, for holding the paper and guiding it to the stacker without jamming, has to be large in diameter in proportion to the size of the paper.
b	Problem statement	To make a small-sized paper stacker which does not cause “paper jams”.
d	Root causes	① The impeller need to be large in diameter in proportion to the size of the paper for avoiding the paper jam. ② The impeller has many wedge spaces which are not necessary to exist simultaneously.
e	Mimimum set of objects	① Approach device (Belts / rollers) ② Impeller ─ Wedge spaces made between two blades. └ Cylinder holding plural blades. ③ Stopper ④ Store box ⑤ Papers

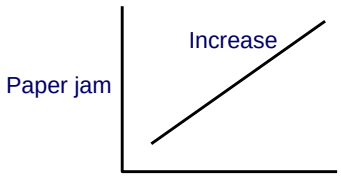
Function analysis of the current system

Closed world diagram

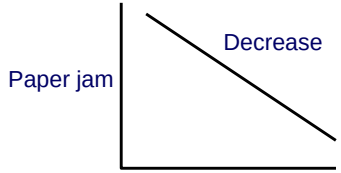


Attribute analysis of current system

Qualitative change graphs

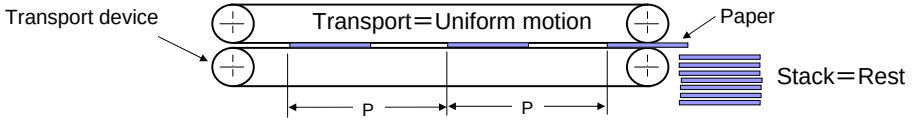


- When stiffness of paper would be weaken.
- When paper velocity would be fast.
- When paper friction increases.
- When static electricity of paper increase.
- In higher humidity.

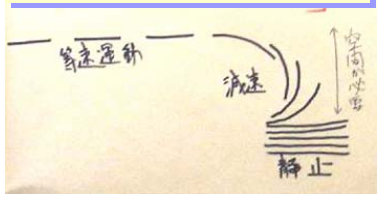


- When diameter of impeller is enlarged.
- When distance between front and rear paper is larger.
- When paper is decelerated securely.
- When grip power of the wedge is large

Function analysis of ideal system

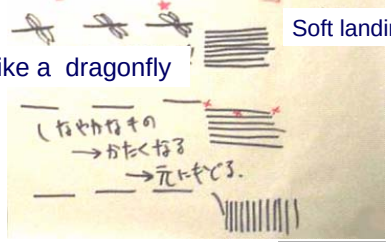


Sketch of current image



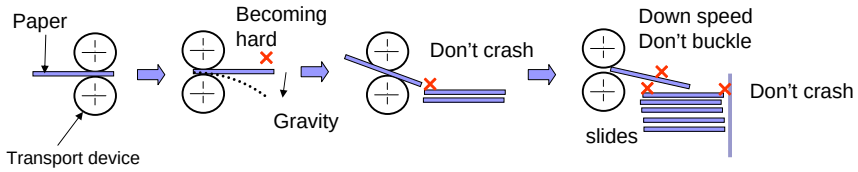
Uniform motion ⇨ Slow down ⇨ At rest

Sketch of ideal image



Flexible ⇨ Hard ⇨ Flexible

Desirable actions of the 'Particles'

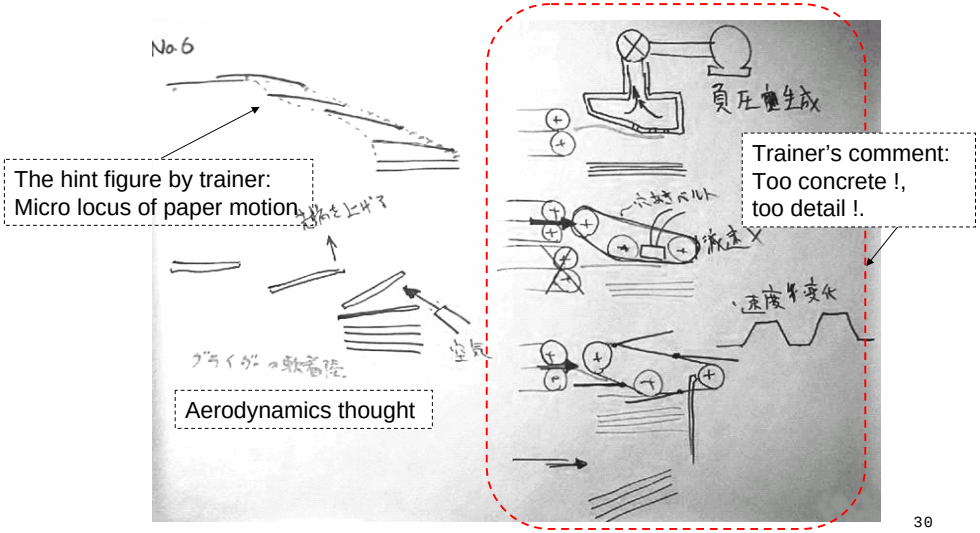


Actions

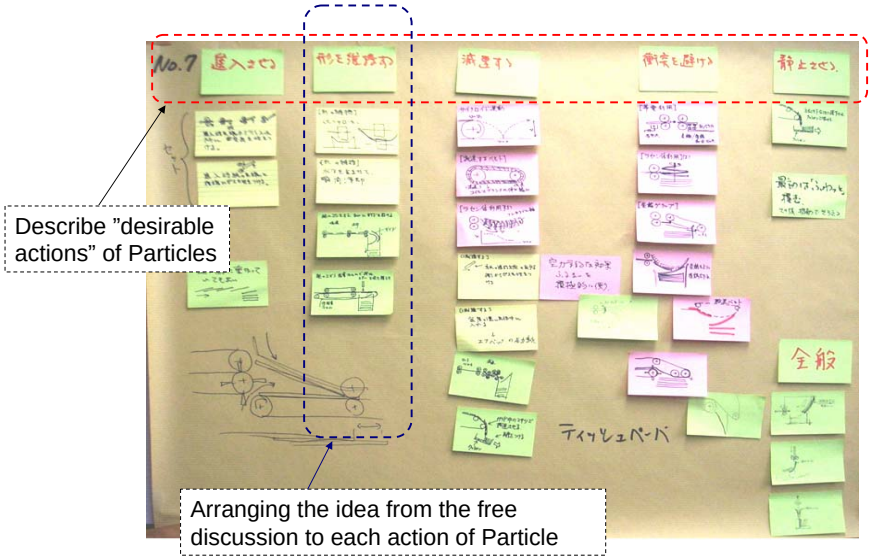
Put the flexible sheets of paper transported in equal pitch at rest in the smallest space, while maintaining the shape and order of the papers.

Insert	Keep the shape	Decelarate	Don't crash	Rest
■ Change insert angle ■ Change insert position	■ Harden paper ■ Pull front edge of paper ■ Iron paper	■ Frictional brake ■ Soft landing	■ Front paper make room for rear paper ■ Change contact position ■ Raise front edge	■ Frictional brake ■ Bump to soft object

Consideration towards ideal system

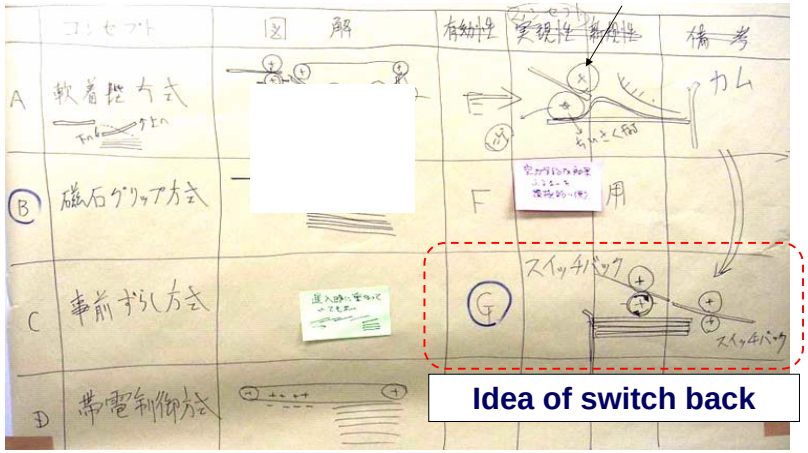


Free discussion



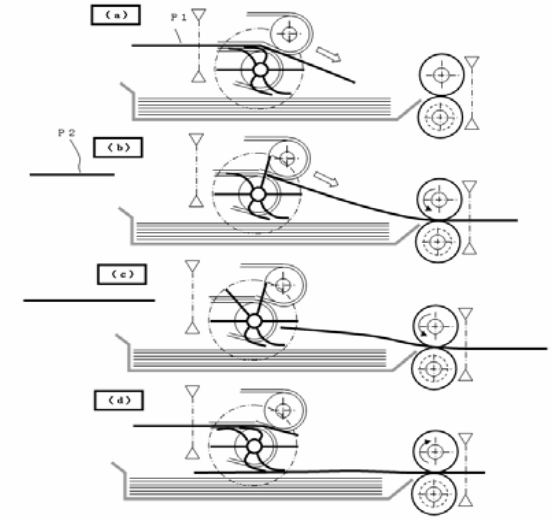
Solution concepts

The specialist does not put the roller in here.



Concrete sketch for detail design

Idea of switch back



USIT Exceeded the Professional thought

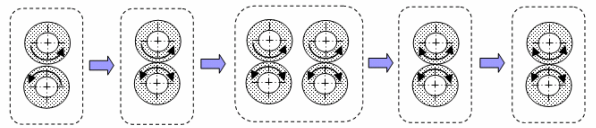
Technical evolution by the "VTC"

Professional

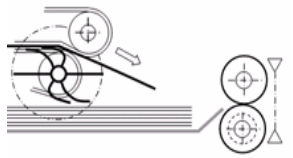
Creation by USIT

Non-professional

Rotation control of Rollers



Automatic ticket gate	Banknote handling	Mail handling	Mail handling	Book finisher
Plural tickets feed mechanism	Paper feed by MRR (Motored retard roller)	High speed Paper feed (double MRR)	Switch back	Fold mechanism



switch back

■3■ Conclusion（1）

■ Experience of USIT Open Training proved the USIT method by non-specialists can introduce new solutions which specialists could not guess out.

USIT has a possibility to support young engineers' idea creation

■3■ Conclusion（2）

■ Transferring the methodology of technical idea creation is important for transferring knowledge to the next generation.

USIT has a possibility to support transferring knowledge to the next generation

■3■ Conclusion（3）