

# Development of High Durability Electric Motor Operated Valve by TRIZ

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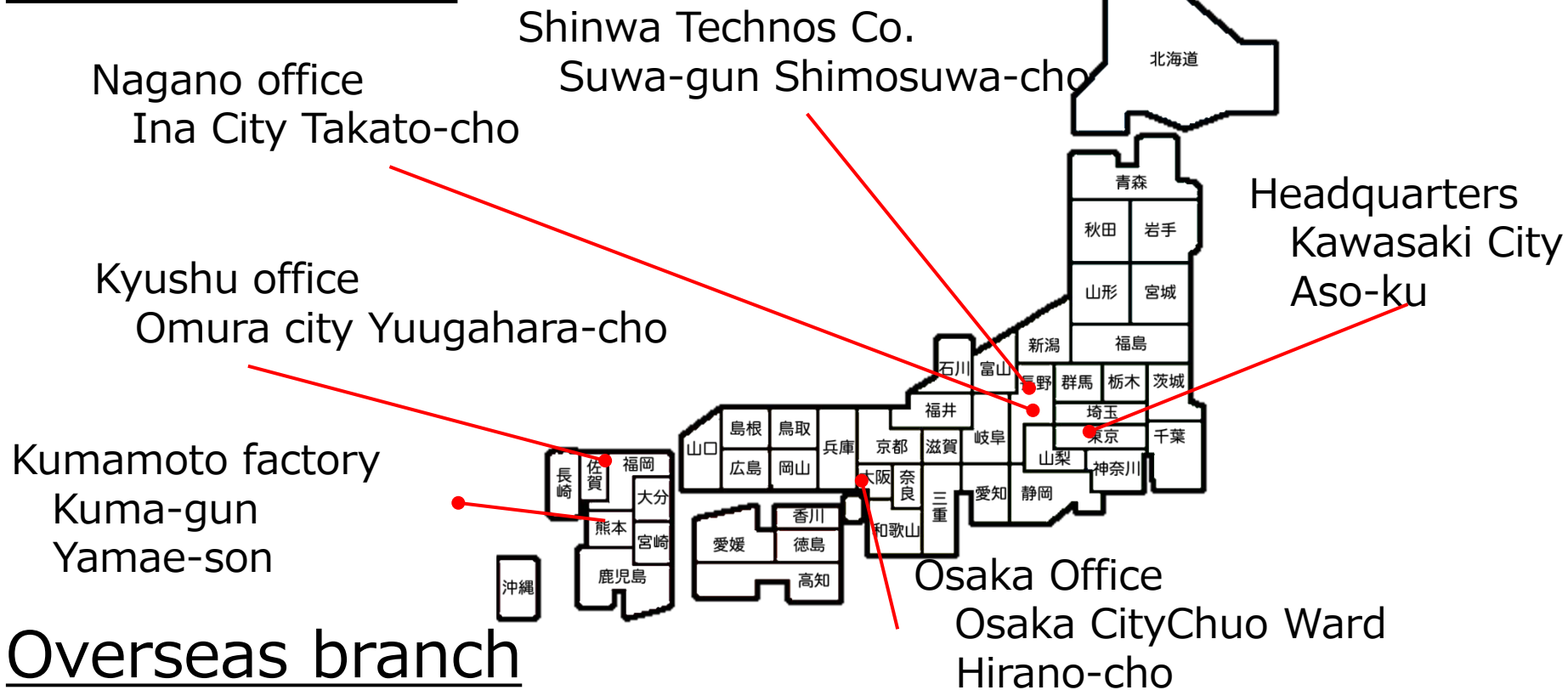
- Company overview
- Purpose of project
- Outline of project
- Approach of project
- Achievement for a project
- Development in the future



- Trade name Shinwa Controls Co.
- Establishment June 21, 1962  
(It starts as Shinwa industrial stock association company. )
- Establishment December 15, 1967
- The capital 50 million yen
- Activities Precise liquid temperature adjuster,  
Precise temperature humidity controller,  
Development, design, manufacturing,  
and sales of solenoid-controlled valve
- Number of employees 313 people  
(At the time of, June 30, 2014)  
They are 345 people in the entire group.
- Group businesses Shinwa Technos Company,  
台灣伸和控制工業股份有限公司



## Domestic base



## Overseas branch

- 台湾伸和控制工業股份 Ltd.
- China Service center (Shanghai and Beijing)
- South Korea Service center (Hwasung)
- The United States Service center (Portland)



# Our Products

Medical treatment, analysis,  
and oil pressure industry

Semiconductor, liquid crystal, and organic EL industry

Valve

Precise liquid  
Temperature-control  
device

Precise temperature  
humidity  
Controller

Ultra clean  
Device

Flow rate control

Temperature limiting

Temperature and moisture  
control

Gassy contaminant removal control

High-speed response valve

Latch type electromagnetic valve

Motorized valve

Solenoid-controlled valve

Chiller

Chiller  
All-in-one design  
System  
T&H

T&H

System  
T&H

Dry air generation device

Chemical removal device

F l u i d c o n t r o l t e c h n o l o g y



Medical equipment • Instrument for analysis • Fuel cell • Space satellite etc.  
It uses it for the fluid control in an industrial field that covers wide range.



- Direct driven type without coupling  
Control of wide fluid pressure
- Diaphragm type  
The fluid and iron are separated, and it corresponds to the corrosive fluid.
- Magnet latch type  
Conservation of energy that consumes electric power only when valve opening and shutting is switched

- Motorized valve  
A highly accurate flow rate control is achieved by the motor drive control.



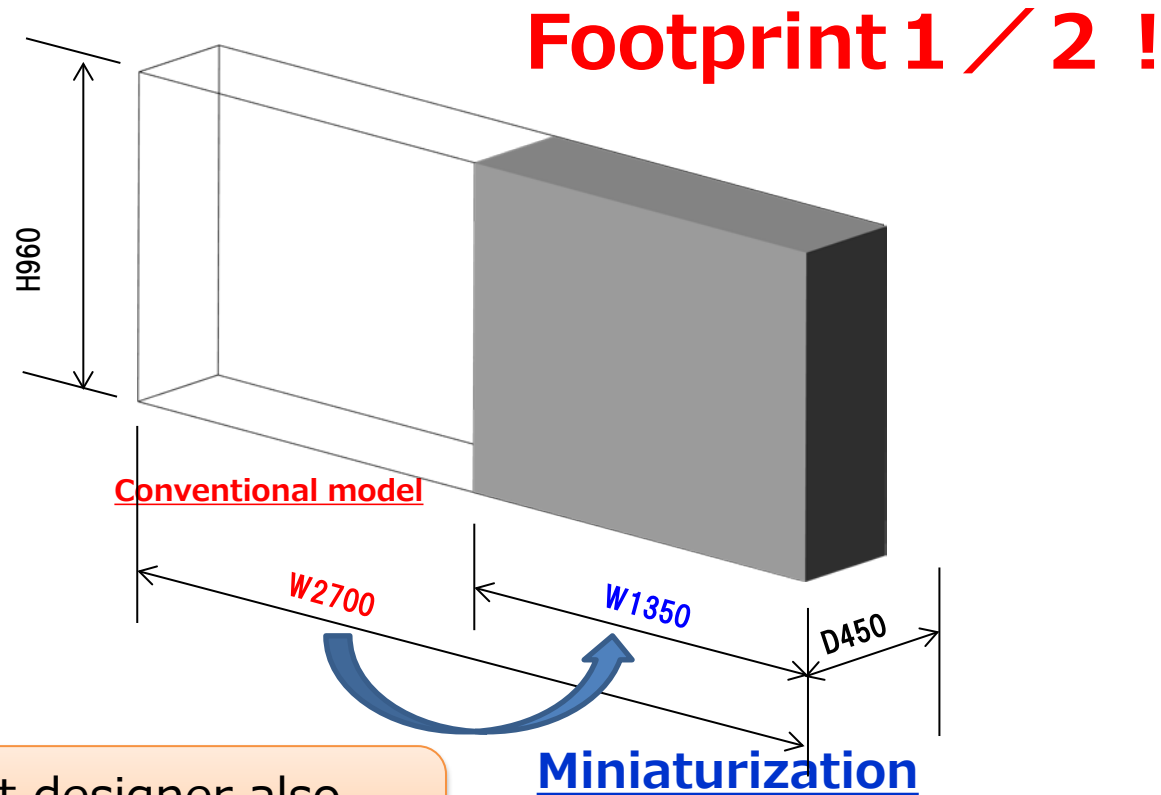
Necessary temperature and device in manufacturing process of semiconductor and FPD that manages humidity

- Heat removal in wafer generation process
- Tepid and moisture control in spreading and development process
- Heat removal at etching
- Temperature limiting of wafer inspection, dicing, and final inspection
- Temperature limiting of liquid crystal panel etching equipment

The technology of our company uses it by all scenes in the semiconductor manufacturing process.



The development case with the device business is announced in the 8th Japanese TRIZ symposium 2012.



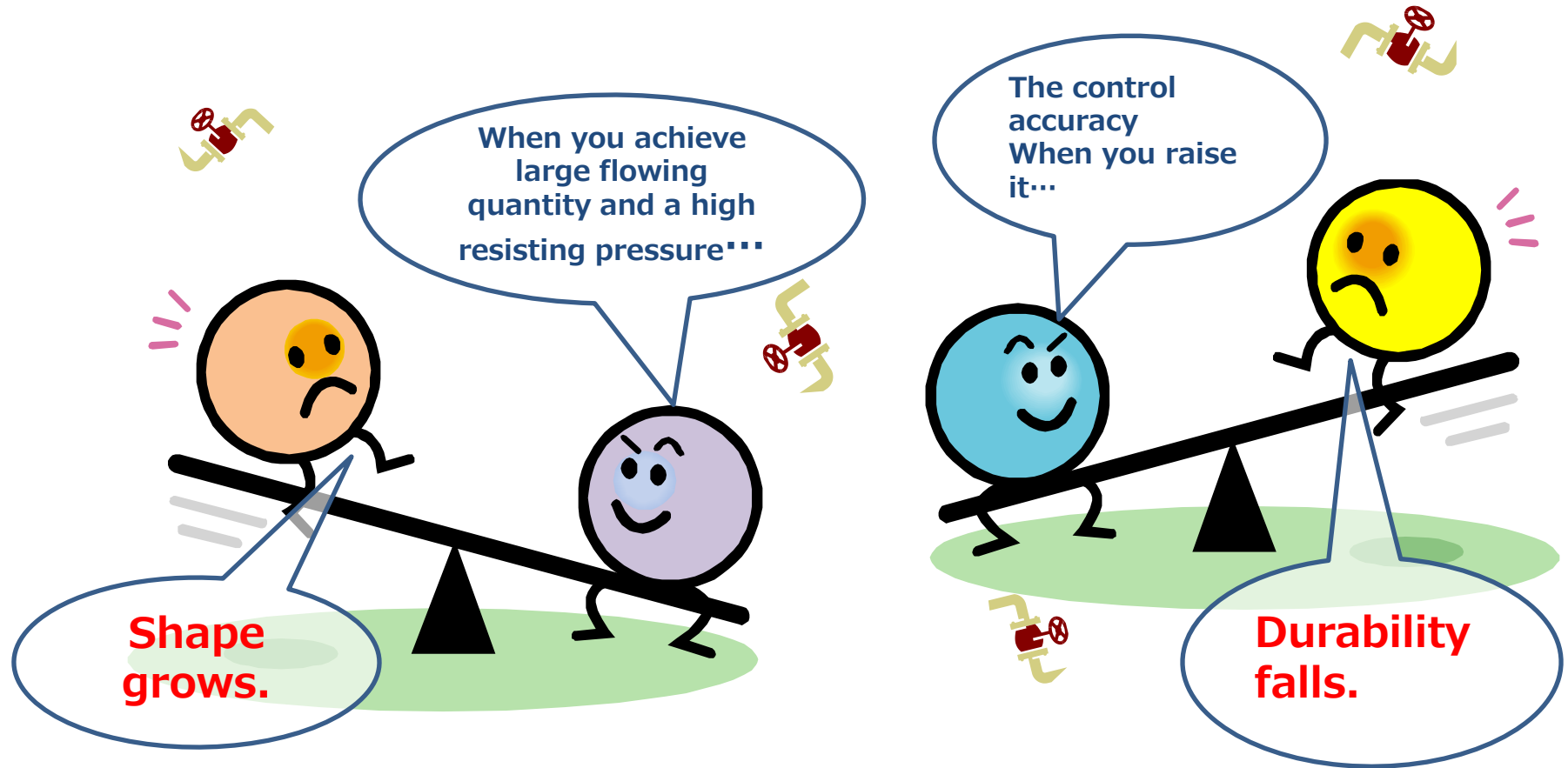
The equipment designer also participates in the device project.

**TRIZ that succeeds in the device business is developed with the equipment business (valve).**





Two developments that use TRIZ progresses in the field of the solenoid-controlled valve and the motorized valve.



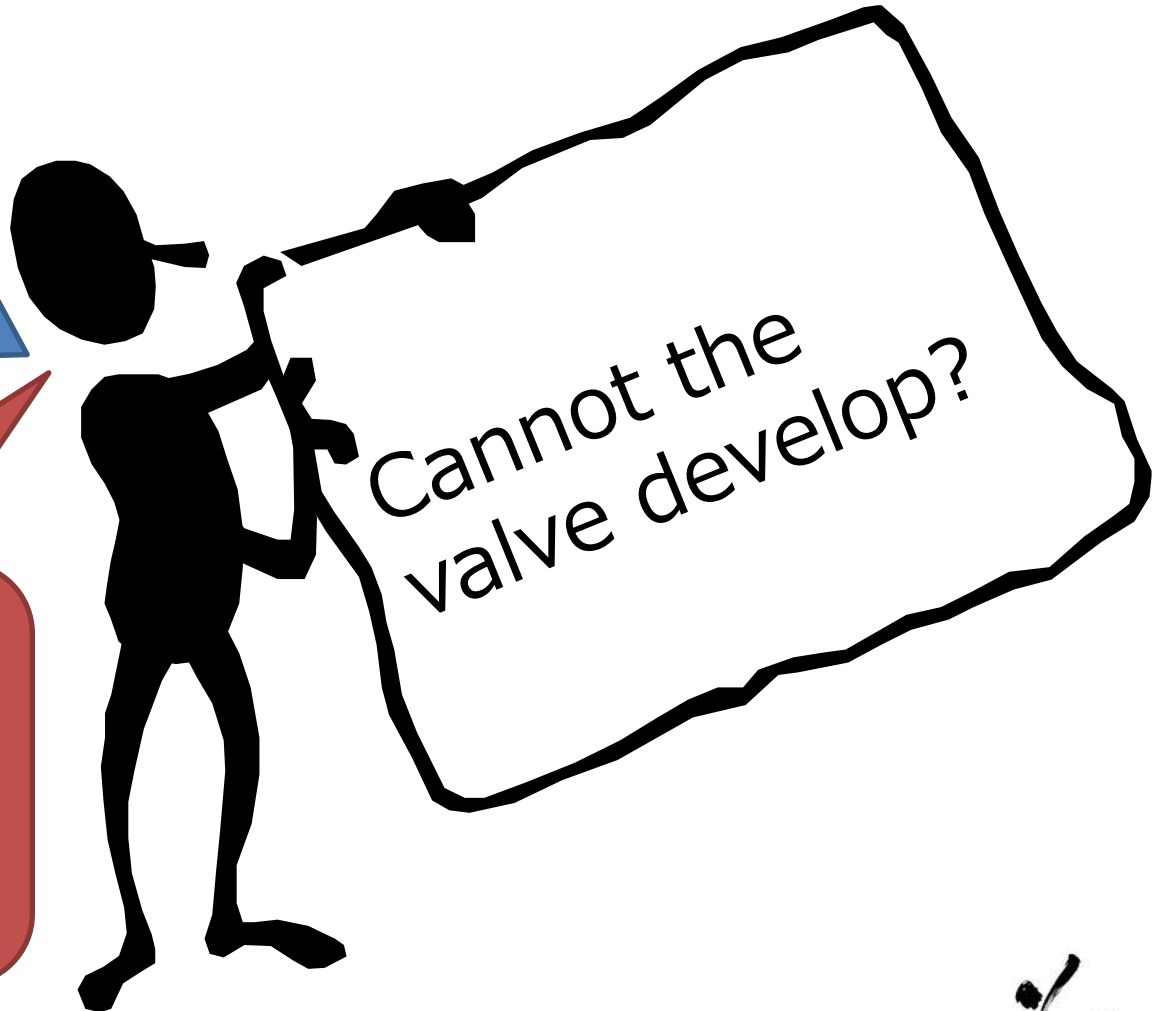
Upgrade of valve product



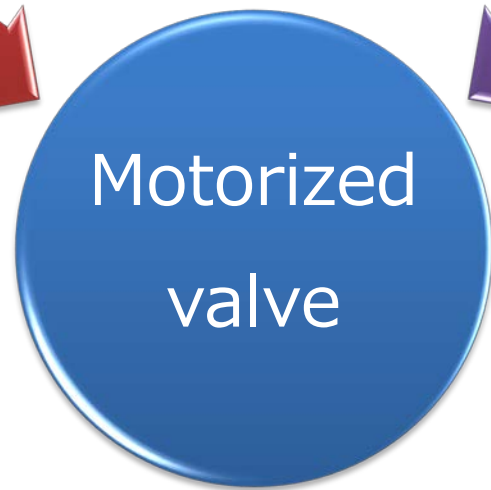
The matter that unifies the progressing development is generated.

I want to upgrade the device function. . . .

The valve becomes a bottleneck.



## Valve development "Three key words"



Resolution several thousand or more

It is a continuous work for ten years.  
It is 3,650 days for 24 hours.  
It keeps operating.

Resistivity  $18\text{M}\Omega \cdot \text{cm}$   
Electric conductivity  
 $0.055\mu\text{S}/\text{cm}$  at  $25^\circ\text{C}$

- Comparative example of electric conductivity (at  $25^\circ\text{C}$ )
- Tap water : Some.  $100\sim 200\mu\text{S}/\text{cm}$
  - Seawater : Some.  $50,000\mu\text{S}/\text{cm}$



## Feature of general motorized valve

| Product | Feature                        | Merit  | Weak point  |
|---------|--------------------------------|--|---|
| A       | The flow coefficient is large. | <b>The driving performance is strong.</b>    | <b>Control unsuitability of slight flowing quantity</b> |
| B       | Resolution is good.            | <b>The reliability of the motor is good.</b> | <b>There are a lot of movable components.</b>           |
| C       | Cheapness                      | <b>The moving part is few.</b>               | <b>Resolution is bad.</b>                               |

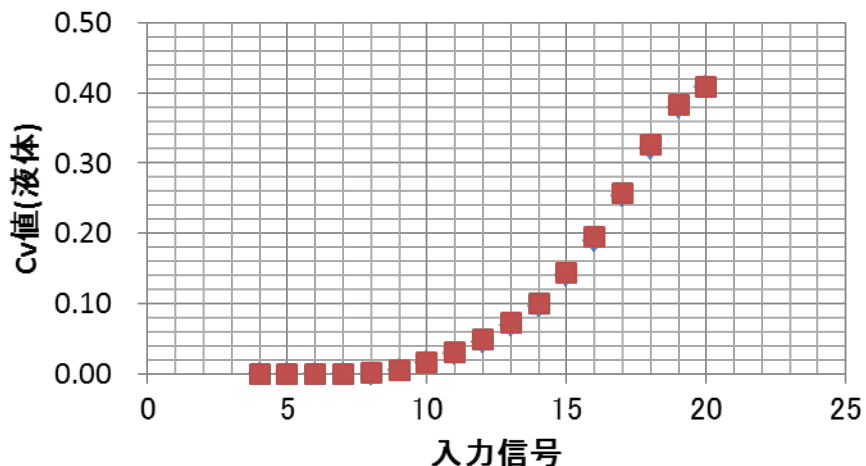
## It's hard to please everybody

It is low longevity though is efficient.  
It is a low performance though it is high longevity.

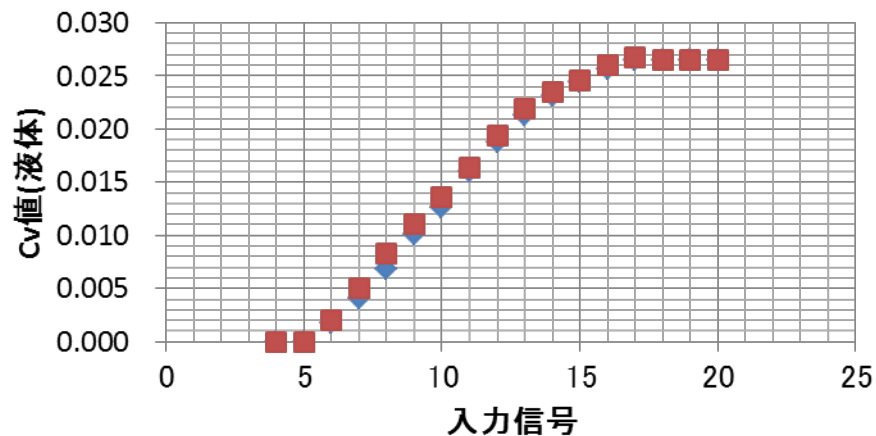


## Example of flowing quantity characteristic of general motorized valve

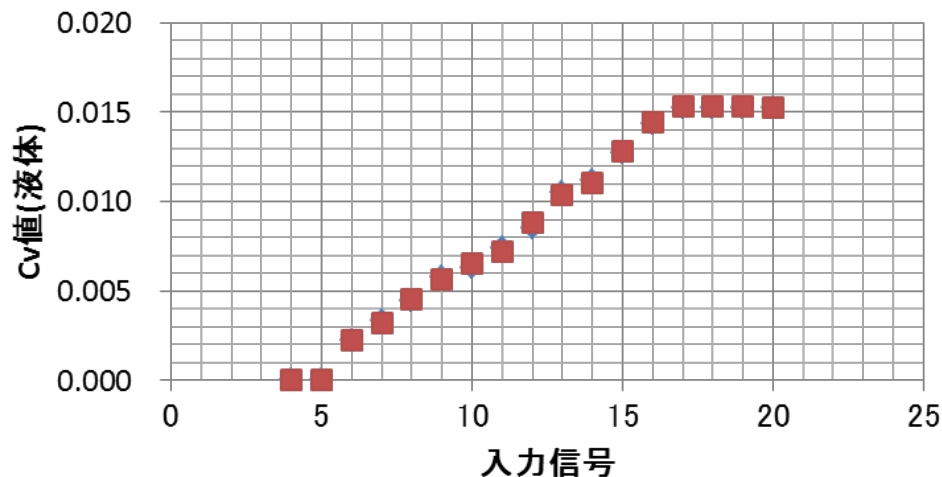
製品A



製品B



製品C



◆ 入力信号: 4→20mA

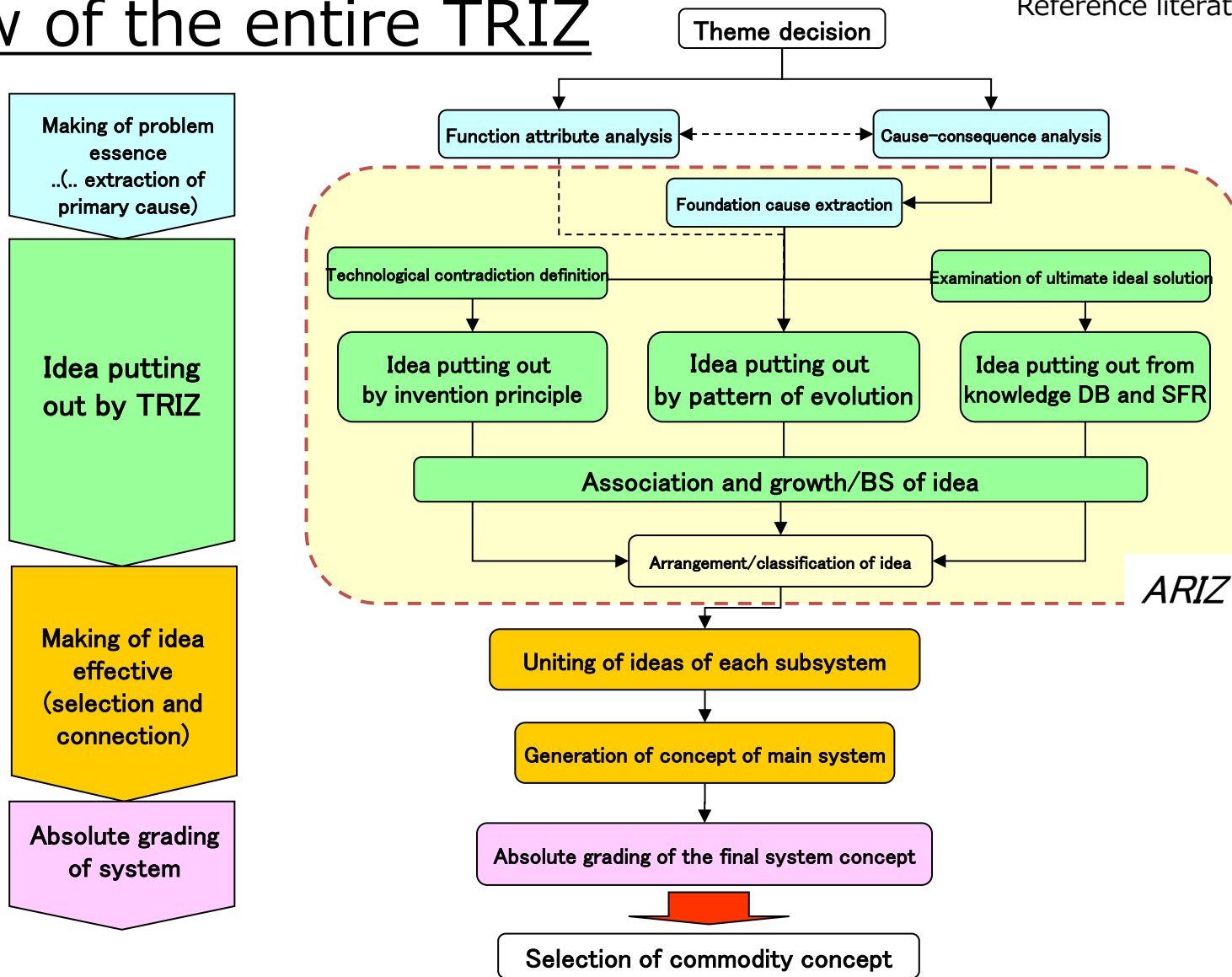
■ 入力信号: 20→4mA

The range that can be divided is few.



## Flow of the entire TRIZ

Reference literature: Idea Ltd.



- An adequate problem definition is indispensable to show an excellent idea.
- Do to grip the true nature of the problem?
- The system whole image is obtained and a down shot and new awareness are obtained.

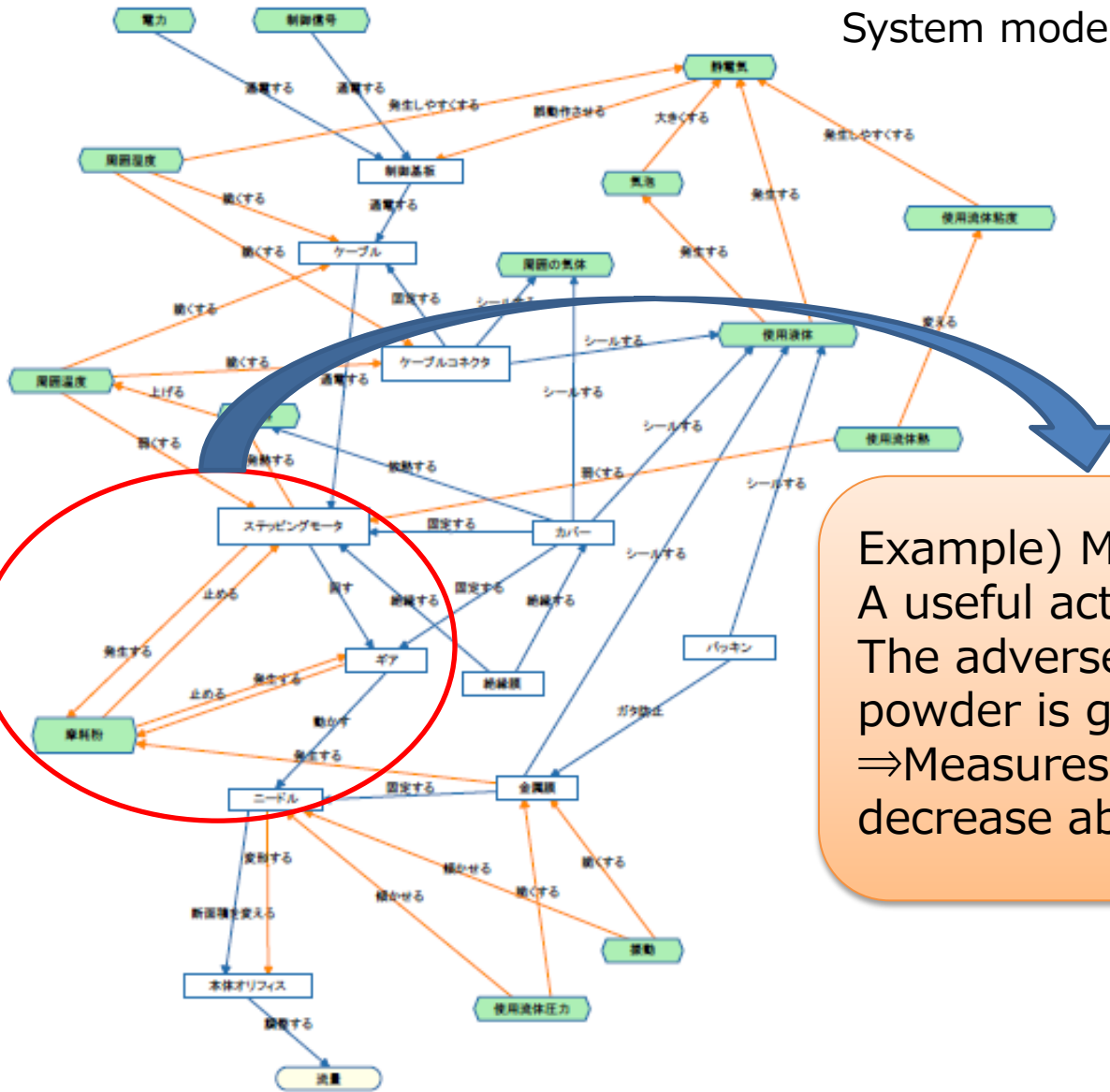
The function attribute  
analysis is executed.

It is a down shot as for the function  
relation of each element of the entire  
system.

The relation of each element of the motorized valve is arranged.



System model chart (Excerpt from Goldfire)



→ Useful action  
→ Adverse effect

Example) Motor  
 A useful action: The gear is turned.  
 The adverse effect: The abrasion powder is generated.  
 ⇒ Measures indispensability to decrease abrasion powder





After the relation of each element is arranged, a potential risk and remedial measures of each element are examined.

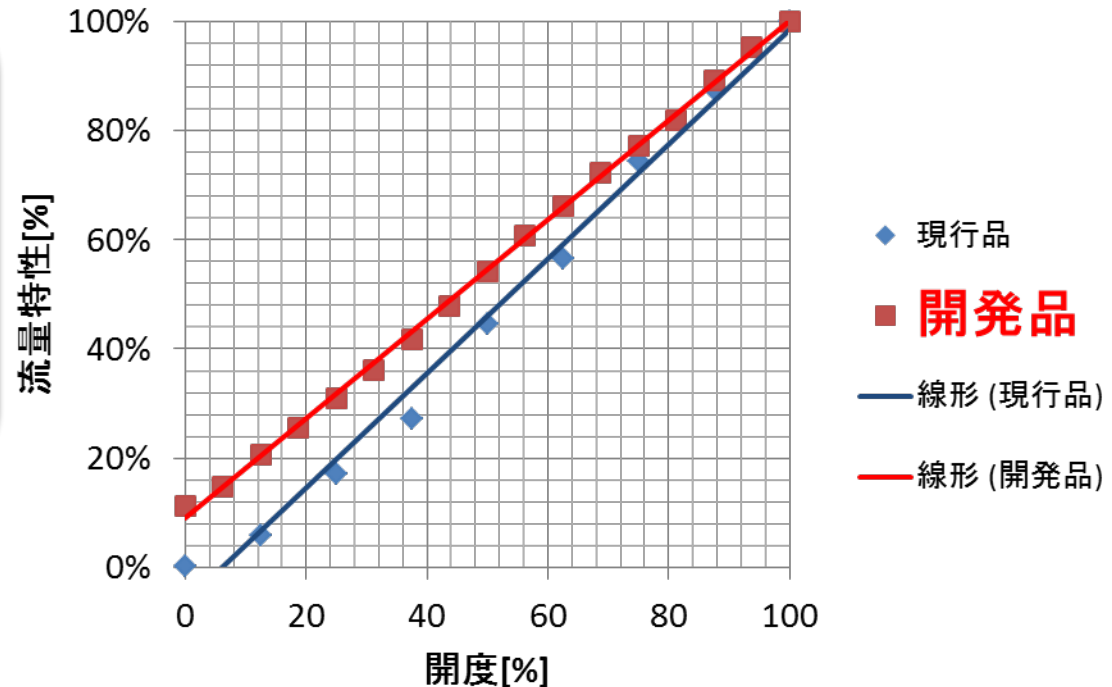
## Design FMEA table

| No. | 部品      | 機能内容 | 潜在的リスク     |            |     |      |    | 回避策 |  |
|-----|---------|------|------------|------------|-----|------|----|-----|--|
|     |         |      | 不具合モード(故障) | 不具合モード(機能) | 発生度 | 発生原因 | 検出 | 合計  |  |
| 1   | 弁本体     |      |            |            |     |      |    |     |  |
| 2   | 弁本体     |      |            |            |     |      |    |     |  |
| 3   | 弁本体     |      |            |            |     |      |    |     |  |
| 4   | 弁本体     |      |            |            |     |      |    |     |  |
| 5   | 弁本体     |      |            |            |     |      |    |     |  |
| 6   | 弁本体     |      |            |            |     |      |    |     |  |
| 8   | 弁本体     |      |            |            |     |      |    |     |  |
| 9   | 弁本体     |      |            |            |     |      |    |     |  |
| 10  | 弁種      |      |            |            |     |      |    |     |  |
| 11  | 弁種      |      |            |            |     |      |    |     |  |
| 12  | 弁種      |      |            |            |     |      |    |     |  |
| 13  | 弁種      |      |            |            |     |      |    |     |  |
| 14  | 弁種      |      |            |            |     |      |    |     |  |
| 15  | 弁種      |      |            |            |     |      |    |     |  |
| 18  | 弁種      |      |            |            |     |      |    |     |  |
| 17  | ベアリング   |      |            |            |     |      |    |     |  |
| 18  | ベアリング   |      |            |            |     |      |    |     |  |
| 19  | ベアリング   |      |            |            |     |      |    |     |  |
| 20  | ベアリング   |      |            |            |     |      |    |     |  |
| 21  | スライダガイド |      |            |            |     |      |    |     |  |
| 22  | スライダガイド |      |            |            |     |      |    |     |  |
| 23  | スライダガイド |      |            |            |     |      |    |     |  |
| 24  | スライダガイド |      |            |            |     |      |    |     |  |
| 25  | Oリング    |      |            |            |     |      |    |     |  |
| 26  | Oリング    |      |            |            |     |      |    |     |  |
| 27  | Oリング    |      |            |            |     |      |    |     |  |
| 28  | Oリング    |      |            |            |     |      |    |     |  |
| 29  | Oリング    |      |            |            |     |      |    |     |  |
| 30  | Oリング    |      |            |            |     |      |    |     |  |
| 31  | Oリング    |      |            |            |     |      |    |     |  |
| 32  | Oリング    |      |            |            |     |      |    |     |  |
| 33  | Oリング    |      |            |            |     |      |    |     |  |
| 34  | Oリング    |      |            |            |     |      |    |     |  |
| 35  | アダプタース  |      |            |            |     |      |    |     |  |
| 36  | アダプタース  |      |            |            |     |      |    |     |  |
| 37  | アダプタース  |      |            |            |     |      |    |     |  |
| 38  | 出力種     |      |            |            |     |      |    |     |  |
| 39  | 出力種     |      |            |            |     |      |    |     |  |



Electric valve demand for quality

- There shall be operation durability.
- The flowing quantity characteristic shall be a linear characteristic (linearity).
- The purified water should be able to be used.



The maximum error margin with linear approximation : 1/3 of present goods

- The operation durability is being evaluated now.
- Correspondence to the purified water uses the material with the tolerance through the material evaluation.

- The experience of succeeding in the device business was able to be developed with the equipment business.
- The beginning of the solution was able to be gripped by arranging the problem (problem) to difficult development.
- The experience that the conception of the idea changes was able to be done by putting a new view in the act of development that had been done up to now.



## Our corporate principles

- An excellent product and the technology that wins the customer's strong support are offered.  
It becomes the proposal type corporate.
  - It wishes employee's happiness, and the employee is pleased by the prosperity of the enterprise.  
It becomes a company that works by one's best.
  - Symbiosis with the region is aimed at, and it becomes corporate that contributes to the development of an economic culture of the regional society.
- This project is promoted, and development is ended.
  - The approach by the development matter is increased, and the value improvement of our product is promoted.



Thank you for listening.



Shinwa

Shinwa Controls Co.

