

Touch! MPRO Plus

Introduction of the TRIZ Technique to a Productive Process Change Framework

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Turbine global manufacturing
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- Necessity of production process revolution framework
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- Result of "Technical contradiction" use and effect
- Possibility of "Trend of technological evolution" use
- Future tasks

Mitsubishi Heavy Industries group

Enterprise that keeps strengthening technology without slack, both study by experience and knowledge accumulated by history of manufacturing of 140 years, contributing to world development by reformation of management, change, and application to diversity, and growing up



Thermal power system



Environmental equipment



Traffic system



Airlines and space appliance

Animation

Necessity of production process revolution framework

From the-making white paper of the passing production ministry issue of 2018 year

第2節 「現場力」を再構築する「経営力」の重要性

人手不足・デジタル革新が進む中で、「現場力」を再構築する「経営力」の重要性

- ・ 現場の人材不足が深刻化する中、これまで技能人材等が属人的に有してきた知見を、**組織の共有知として活用できる仕組みづくりが鍵**。そのため、デジタル時代の「現場力」には、現場から得られる**質の高いデータ**や、技能人材等の**属人的な知見**を**デジタル化・体系化**して、**組織として資産化する力**等が求められている。
- ・ その際、個別現場が主導する部分最適化を目指すのではなく、**重要な経営課題**と捉えて経営側がコミットし、バリューチェーン全体での全体最適化を図った構築が重要。その実現には的確な**「経営力」**の発揮が鍵。

デジタル時代の「現場力」

従来の「現場力」(※)

- 「暗黙知や職人技」をも駆使しながら、問題を「発見」し、企業や部門を超えて「連携・協力」しながら課題「解決」のための「道筋を見いだせる」力と仮定。「カイゼン」や「すり合わせ」にも通じる力。

- 質の高い現場データを取得し、デジタルデータとして資産化する力
- 職人技(技能)を技術化・体系化、暗黙知を形式知化し、デジタルデータとして資産化する力 等

資料：経済産業省作成

デジタル時代の「現場力」の再構築を実現する「経営力」

人手不足・デジタル革新が進む中で解決すべき“経営課題”

付加価値の獲得

省人化

技能承継の実現

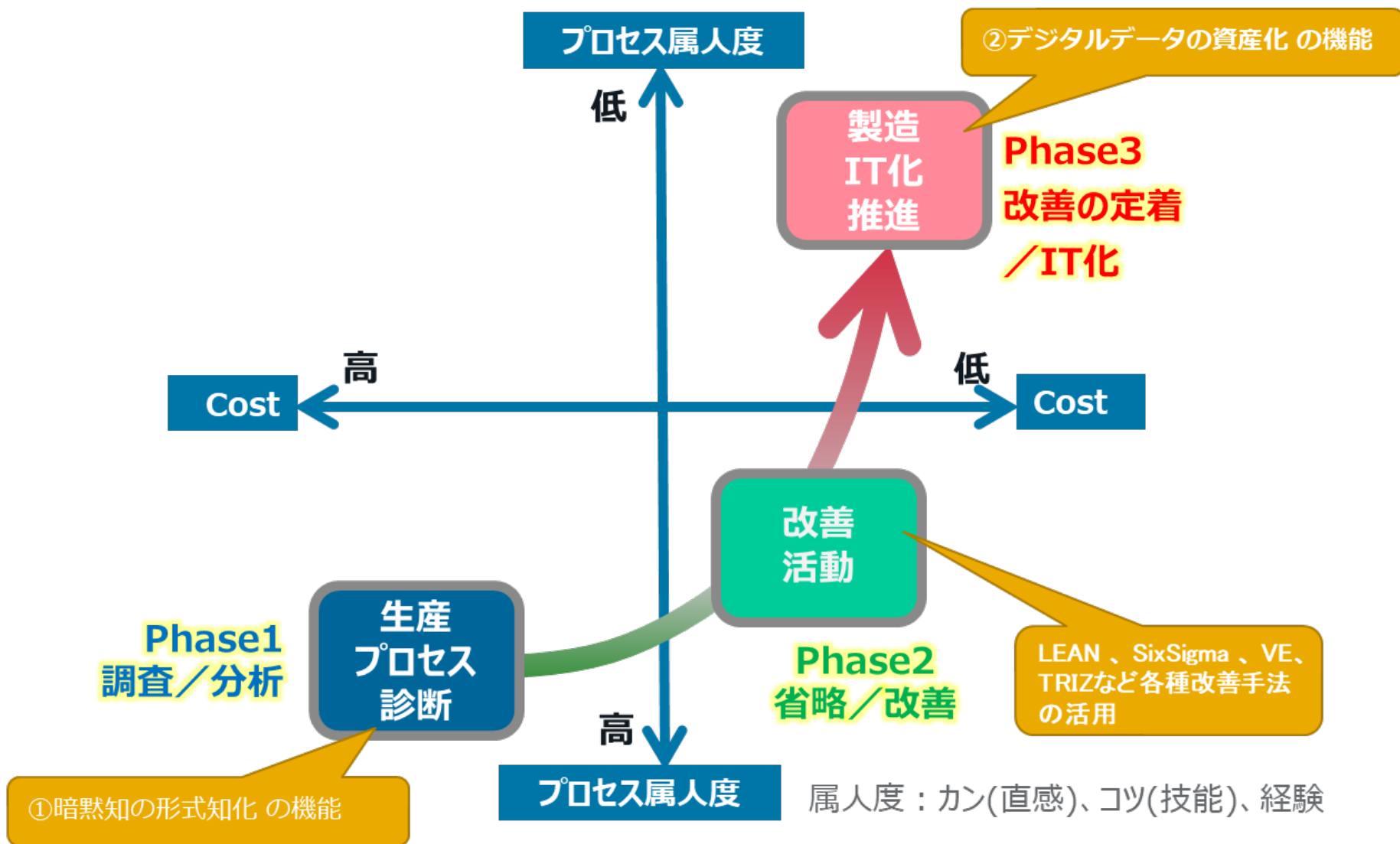
※昨年の白書における「現場力として重視するもの」に関するアンケート結果等を基に作成。なお、人が介在して活動が行われる全てが現場になりえ「現場力」は生産現場に限定されないため、企業活動の中で幅広く捉える必要がある。従って、一義的に定義することは困難であることに留意。

14

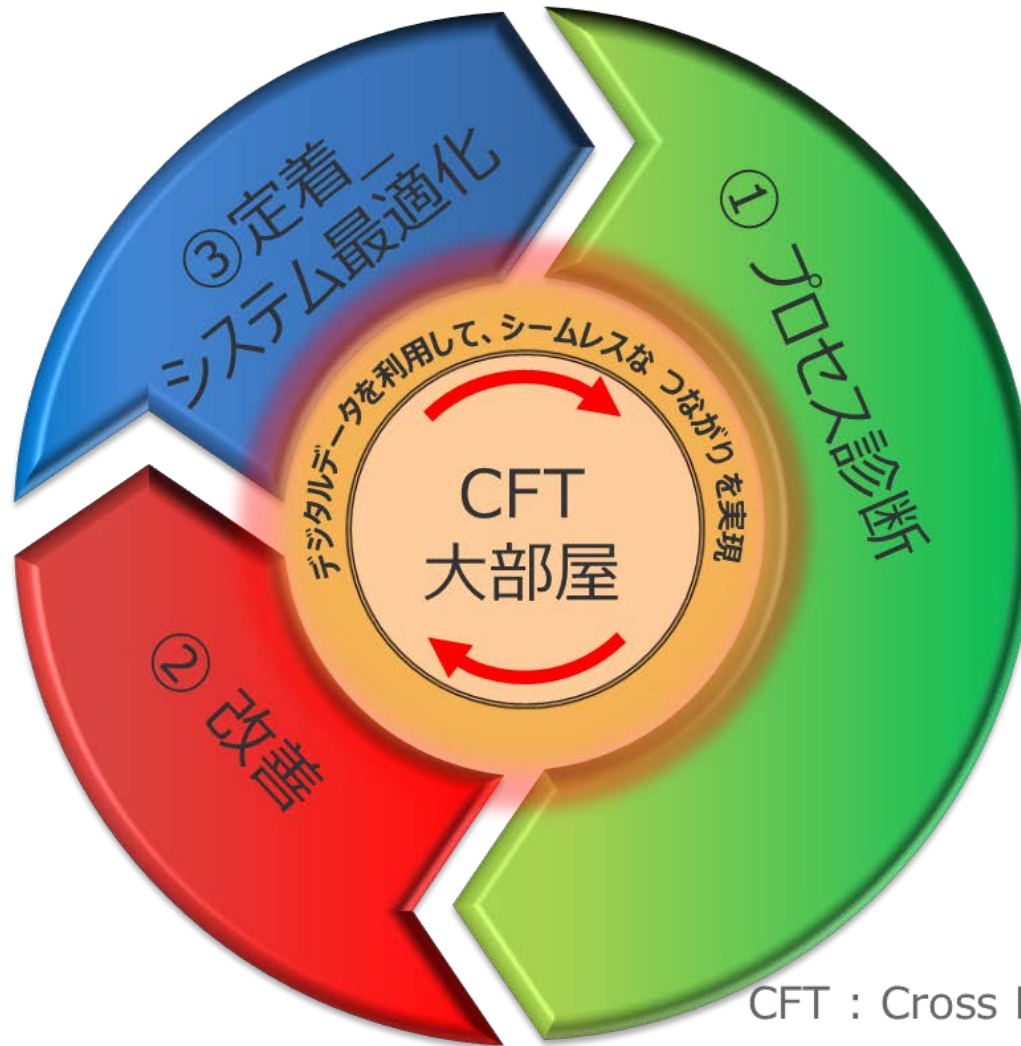
出展：「2018年度版ものづくり白書」(METI/経済産業省)

Whole image of production process revolution

The quality and cost competitiveness are improved, and a mechanism established of the flow to be improved.



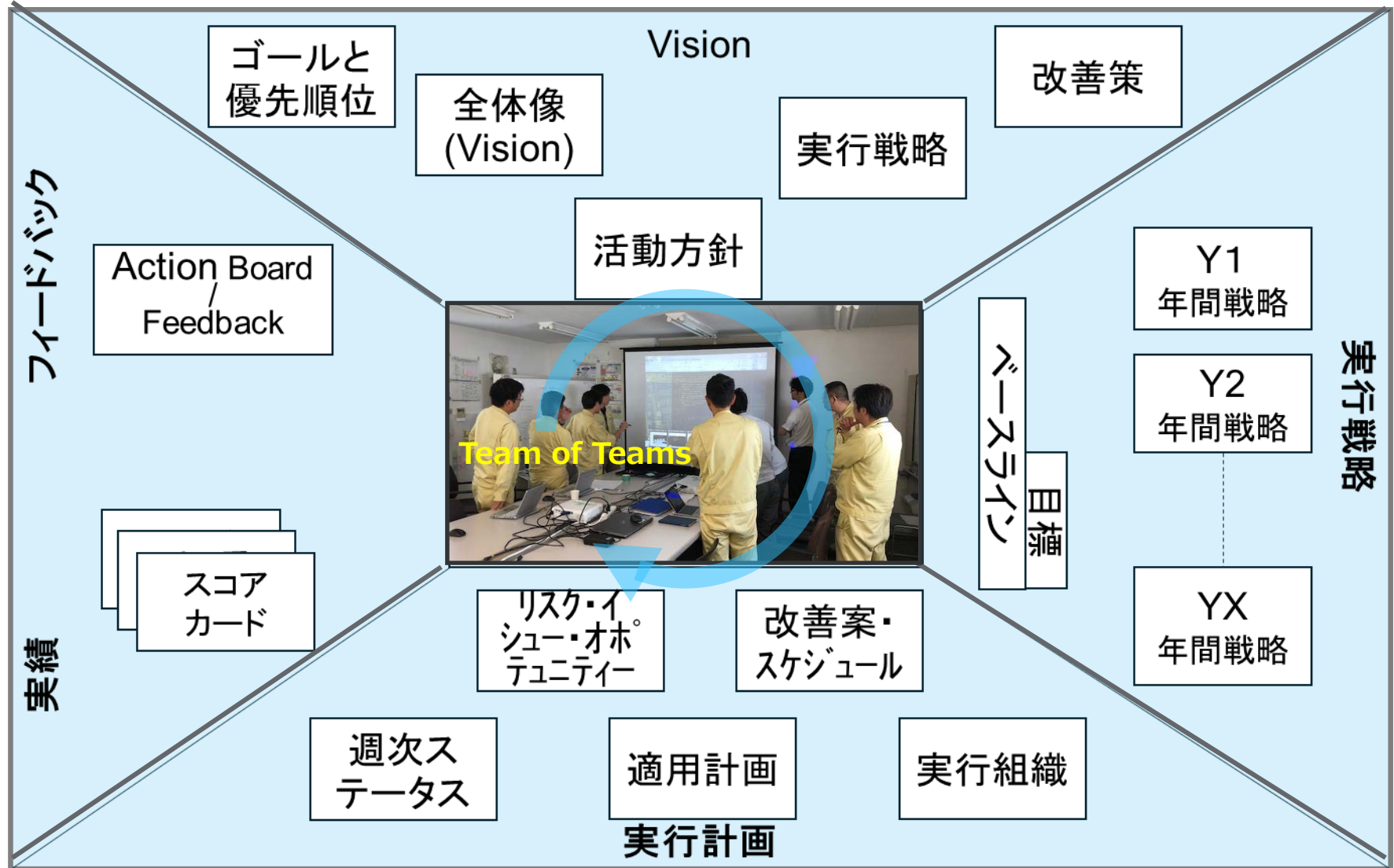
Five blocks of production process revolution "MPRO Plus"



CFT : Cross Functional Team

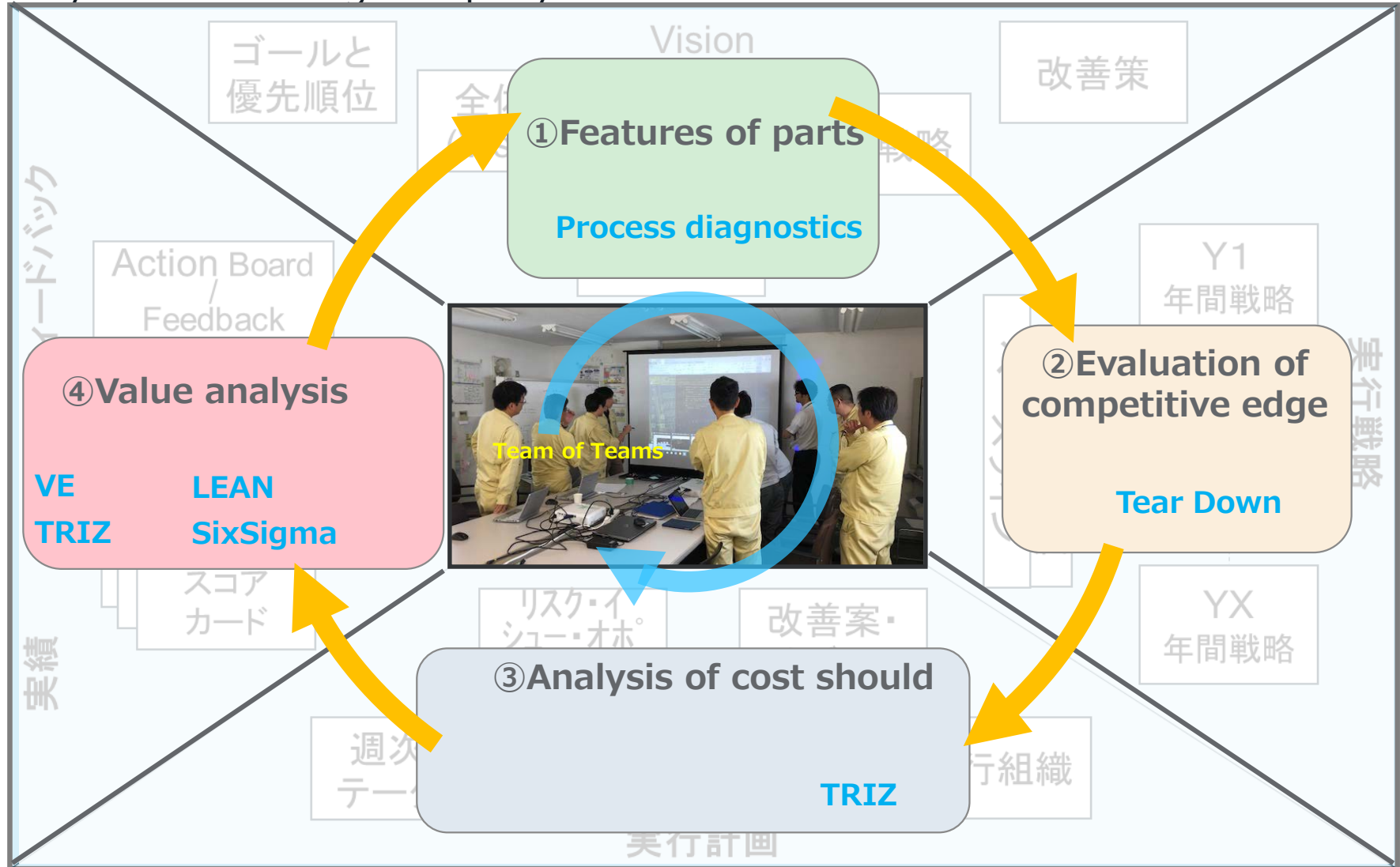
Organization of production process revolution - 2/3

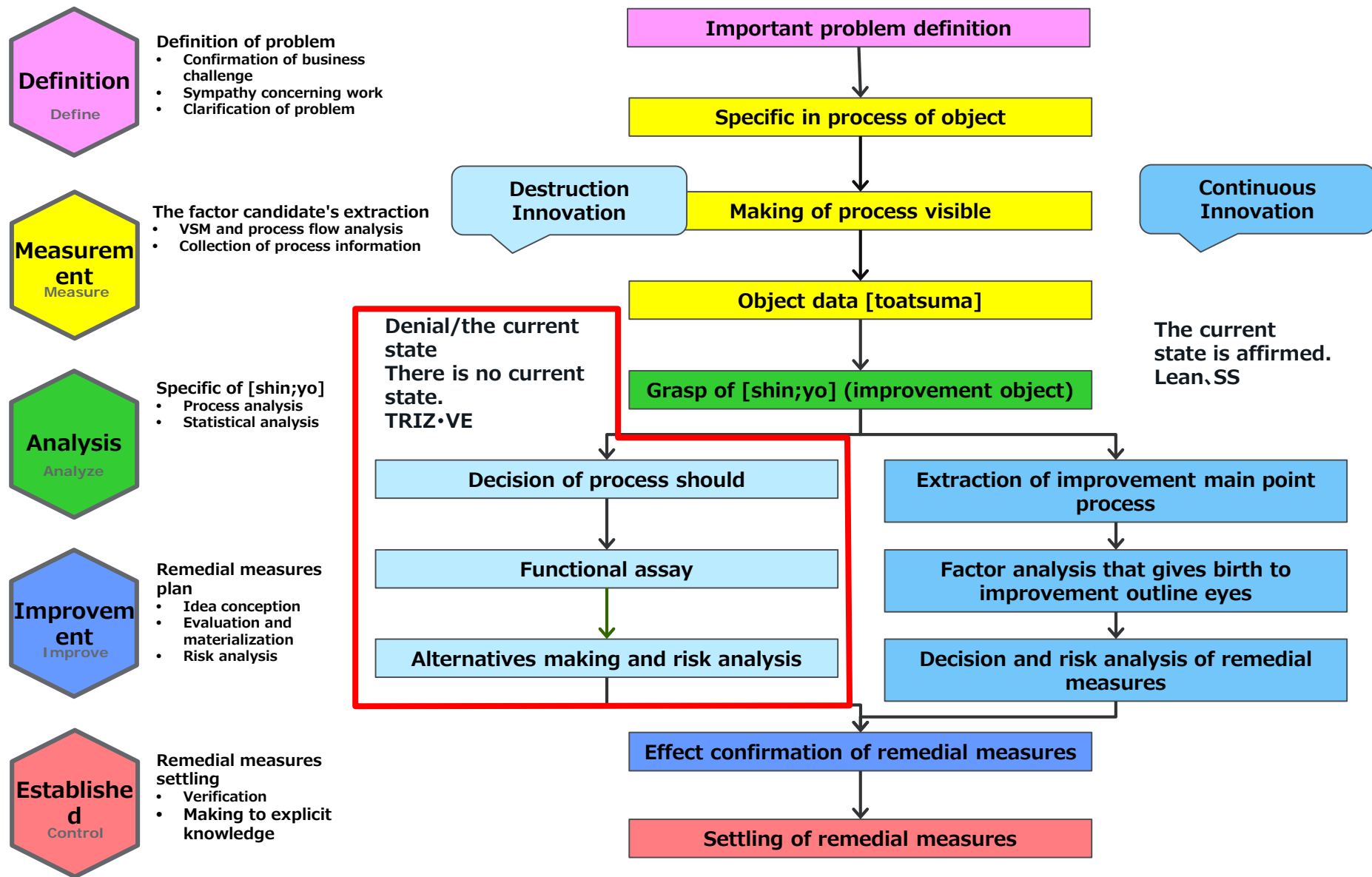
Mechanism of "Large room of CFT" that concluded successfully in Toyota and Boeing Company



Organization of production process revolution - 3/3

Mechanism of "Large room of CFT" that concluded successfully in Toyota and Boeing Company

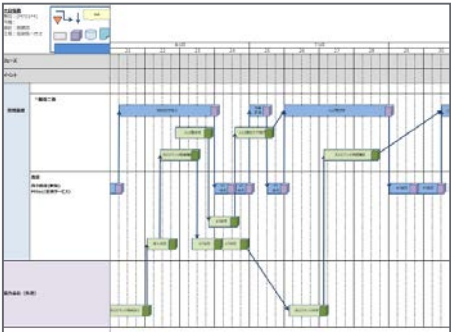




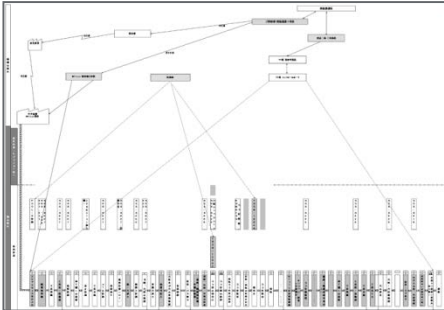
Process diagnostics

The video shooting and hearing of work and the business process are executed. The problem that has been buried is extracted by a detailed analysis and the fixed quantity evaluation.

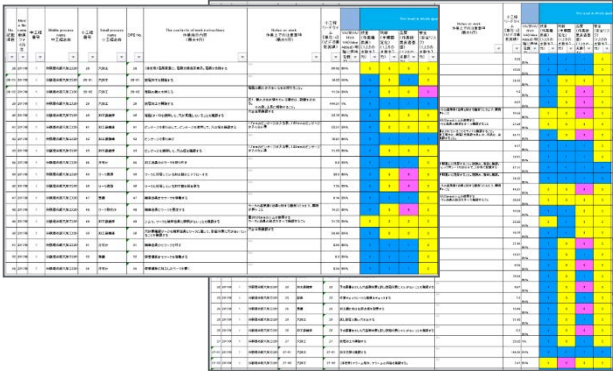
Business flow



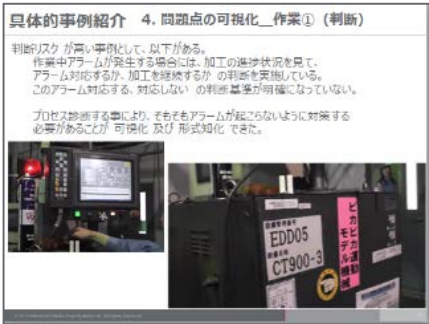
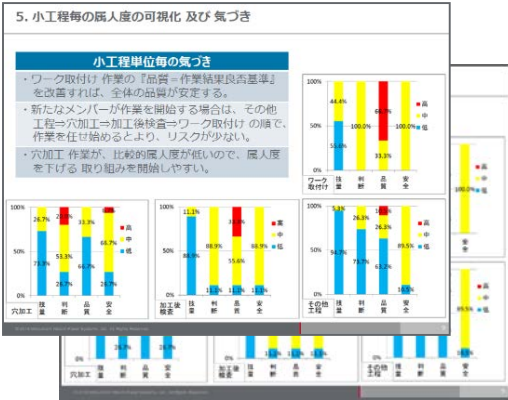
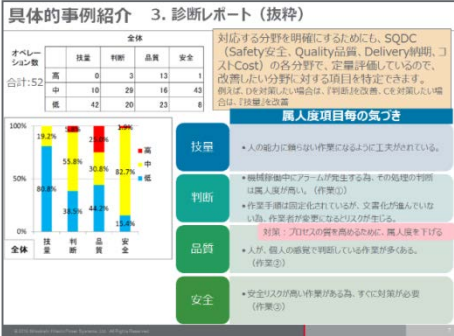
Value stream map



Small and medium-sized work schedule



Report



Process diagnostics – Small and medium-sized work schedule –

No. 記載 項目	Movie file name 動画 ファイル名	中工程 番号	Middle process name 中工程名称	小工程 番号	Small process name 小工程名称	OPE No.	The contents of work instructions 作業指示内容 (最大4行)	Notes on work 作業上での注意事項 (最大5行)	小工程 リードタイム 【単位:s】 (ビデオ撮 影実績)	The level in which qual				
										VA/BVA/ NVA VA(Value Added): 明 確に価値 を創造し ている工程	作業 (作業難易 度) (1,3,5の点 数を入力)	判断 (手順固定 化) (1,3,5の点 数を入力)	品質 (作業結果 良否基準) (1,3,5の点 数を入力)	安全 (安全リス ク) (1,3,5の点 数を入力)
5	201706	1	分割研磨冷却穴加工(20-	5	ワーク取付け	5	検査治具のワーク当たり部に異物、傷がないことを確認する	NA	6.07	BVA	1	3	5	3
6	201706	1	分割研磨冷却穴加工(20-	6	ワーク取付け	6	検査治具にワークを固定する	ワークの基準面(治具と接する箇所)に力エリ、異物が無いこと	10.64	BVA	3	3	5	3
7	201706	1	分割研磨冷却穴加工(20-	7	ワーク取付け	7	シムで、ワークと検査治具に隙間がないことを確認する	厚さ0.03mmのシムを使用する ワークと治具の接点をすべて確認すること	21.95	BVA	3	3	3	3
8	201706	1	分割研磨冷却穴加工(20-	8	ワーク取付け	8	研磨道具で、穴基準位置を研磨する	研磨されていることをライトで確認すること。 量産工程では、両端2点確認で良いが、初回は、全穴 確認すること。	44.71	BVA	1	3	5	3
9	201706	1	分割研磨冷却穴加工(20-	9	片付け	9	検査治具からワークを外す	NA	4.67	BVA	1	1	1	3
10	201706	1	分割研磨冷却穴加工(20-	10	準備	10	検査記録用紙記入場所までワークを移動する	NA	12.41	BVA	1	1	1	3

Inside process

Small process

Work (operation)

Working
hours

VA/BVA/NVA evaluation

"Dependency to an individual ability" is evaluated.
(capability, judgment, quality, and safety)

- VA(Value Added) : Step where value is clearly created
- BVA(Business Value Added) : An not omissible step in a present technological level and the ability though value is not created.
- NVA(Non Value Added) : Step where value is not created at all

Criterion of "Dependancy to individual ability"

It relates with the work efficiency and the quality rose to 'Dependancy of person's ability' that executes the process, and the process where 'Dependancy of person's ability' is high can be caught as a problem.

Capability Work difficulty		Judgment Procedure fixation making		Quality Work result quality standard		Safety risk	
Those who belong degree	Criterion	Those who belong degree	Criterion	Those who belong degree	Criterion	Those who belong degree	Criterion
Height	<ul style="list-style-type: none"> Enough knowledge by special training and the experience is needed. 	Height	<ul style="list-style-type: none"> The work procedure is not fixed, and it judges it from worker's experience and intuition according to the changing situation. 	Height	<ul style="list-style-type: none"> There is no clear standard in the quality confirmation of work. 	Height	<ul style="list-style-type: none"> There is no safety rule for the risk. The risk is not recognized.
Inside	<ul style="list-style-type: none"> Special training is necessary. 	Inside	<ul style="list-style-type: none"> It is not put into writing though the work procedure is fixed. 	Inside	<ul style="list-style-type: none"> There is a clear standard in the quality confirmation of work, and the person is judging. 	Inside	<ul style="list-style-type: none"> It is defensive though there is a safety rule for the risk the worker considered it.
[Hiku]	<ul style="list-style-type: none"> It is possible by a general training in fundamentals. If the point instruction is received, it is possible. 	[Hiku]	<ul style="list-style-type: none"> The work procedure is made fixed, and the work procedure is put into writing. It is not necessary to provide for the work procedure. 	[Hiku]	<ul style="list-style-type: none"> There is a clear standard in the quality confirmation of work, and the judgment is automated. The work result doesn't influence the post-processing and the product quality. 	[Hiku]	<ul style="list-style-type: none"> A material pair is planned to the risk. There is no generation risk of the disaster and the accident. (businesslike work etc.)

Use stage and advantage of TRIZ technique

Three stages of TRIZ technique use

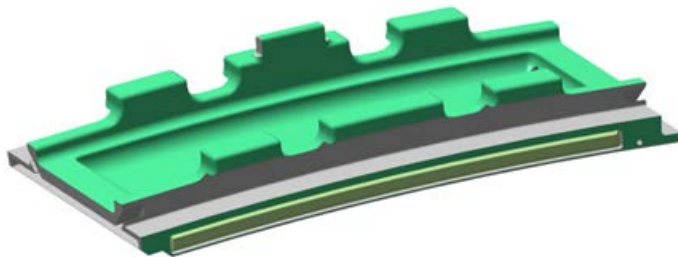
- ① **Alternatives will be effectively made by using the solution approach of "Technical contradiction" at the stage of the improvement in a short time.**
- ② **The trend of the main technological evolution at the stage of the improvement is used. As a result, destroyed process is developed.**
- ③ **It can propose a reformative system by using the trend of technological evolution in the stage of the system optimization (settling of the improvement idea).**

Result of technical contradiction use and effect - 1/7

Case where solution approach of technical contradiction is used at stage of improvement

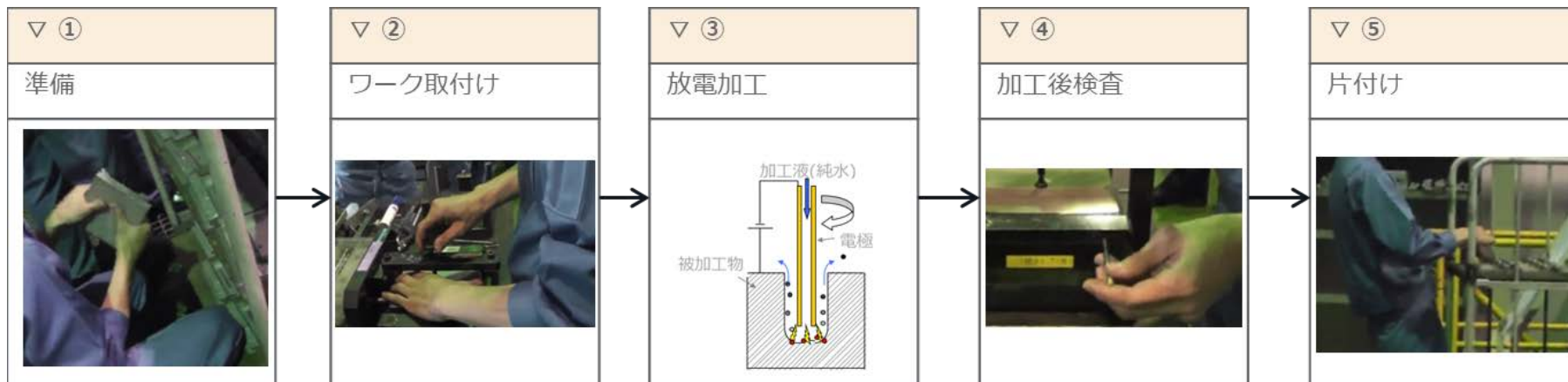
【Object commodity】

Parts of thermo power plant (160mm×100mm×20mm)



【Process of object】

Holing the open work by electric discharge machining is selected as a process of the object.



【Measurement and analysis】

The improvement point is specific according to the process analysis.

No. 記号 項目	Model name 動機 ファイル 名	中工程 番号	Middle process name 中工程名称	小工程 番号	Small process name 小工程名称	OPE No.	The contents of work instructions 作業指示内容 (最大4行)	Notes on work 作業上の注意事項 (最大5行)	小工程 リードタイム 【単位:分 (ビデオ 計測値)】	The level in which qual				
										VA/EVA NVA VA/Value Added) 研 究に準拠 数を入力)	作業 (作業難易 (1.25の点 数を入力)	判断 (手順固定 (1.25の点 数を入力)	品質 (作業結果 (1.25の点 数を入力)	安全 (安全リス (1.25の点 数を入力)
1	201708	1	分装作業準備加工(30)	5	ワーク取付	5	検査器具のワーク面に汚れを拭き、傷がないことを確認する		8.87	0.5/A	1	1	5	3
2	201708	1	分装作業準備加工(30)	6	ワーク取付	6	検査器具とワークを確認する	ワークの検査面が汚染する箇所には、異物が 無いこと	10.64	0.5/A	3	1	5	3
3	201708	1	分装作業準備加工(30)	7	ワーク取付	7	シム、ワークと検査器具の接触がないことを確認する	検査器具のシムを使用する ワークの検査面をすべて確認すること	21.95	0.5/A	3	1	5	3
4	201708	1	分装作業準備加工(30)	8	ワーク取付	8	検査器具で、穴を正確に貫通させる	貫通していないことをライトで確認すること。 検査器具は、汚染を防止するために、毎回、金穴 を確認すること。	44.71	0.5/A	1	1	5	3
5	201708	1	分装作業準備加工(30)	9	片付け	9	検査器具からワークを取り外す		4.63	0.5/A	1	1	1	3
10	201708	1	分装作業準備加工(30)	10	準備	10	検査器具の部品を正確に入力してワークを移動する		12.41	0.5/A	1	1	1	3

分析対象の工程
= 中工程

作業の種類を定義
= 小工程

目的が変わる単位で作業を分解
= 作業 (オペレーション)

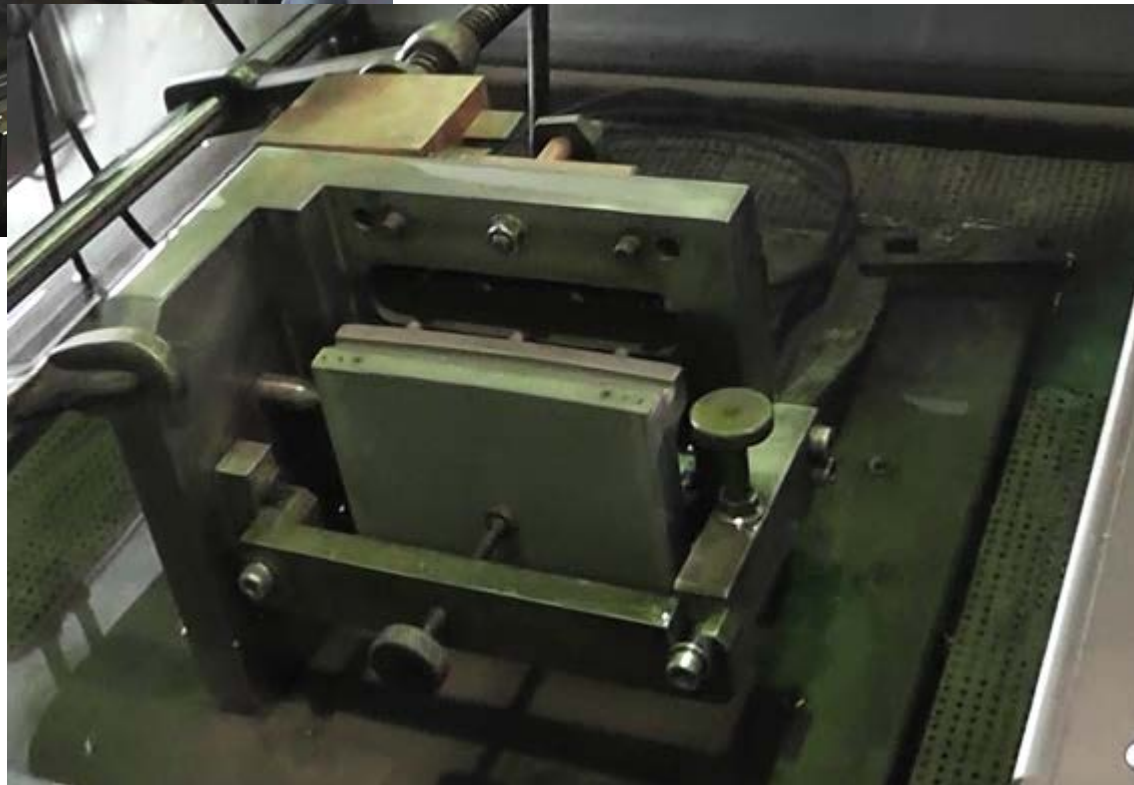
実際の作業時間

オペ単位で“個人の
力量の依存度”
を定量評価

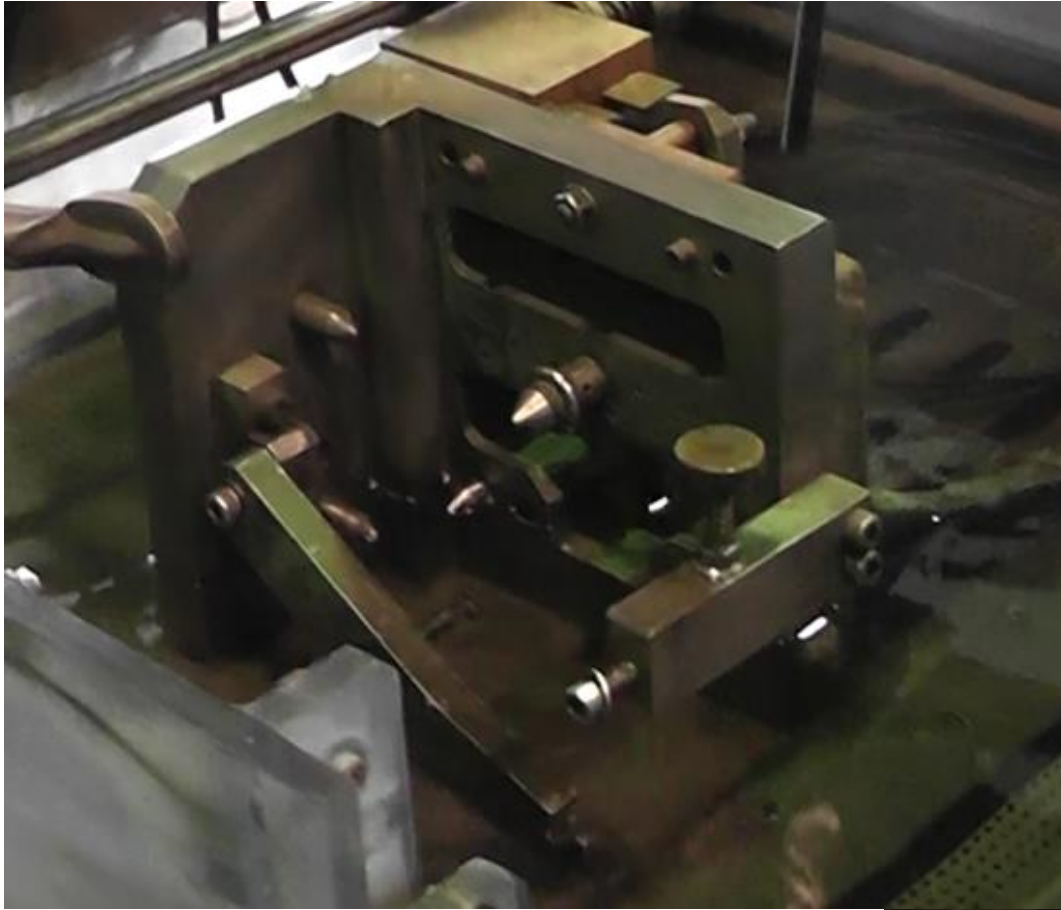


- ✓ In the installation of work on the treatment device, it should be a zipper doing, and the installation is a difficult structure. support work by one hand
- ✓ When the quality record was investigated, several defective processings had been generated in year though the worker did not consider the difficulty.

Result of technical contradiction use and effect - 3/7



Result of technical contradiction use and effect - 4/7



【Setting of technical contradiction】

(cause that cannot be set in treatment device well)The parameter is selected from the analysis result of the image, and the invention principle is specified.

The first improvement idea

The evil that comes not to process it easily as a result occurs so that the self-respect of work is supported as the first improvement idea though it thought the treatment device is inclined.

Selected parameter

Parameter to be improved: "34: Easiness of operation"

Deteriorating parameter: "41: Manufacturing""44: Productivity"

Specified invention principle

29:Use of air pressure and
hydraulic pressure

36:Phase change

5:Annexation

1:Division

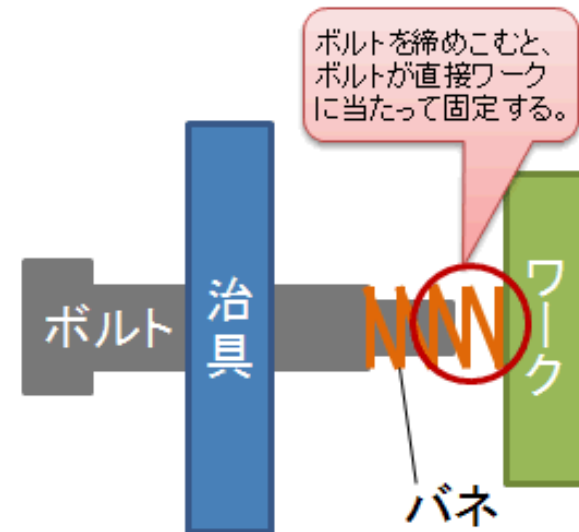
28:Substitution of mechanism

15:Making to dynamic

25:Self-service

【Idea① (Principle of annexation)】

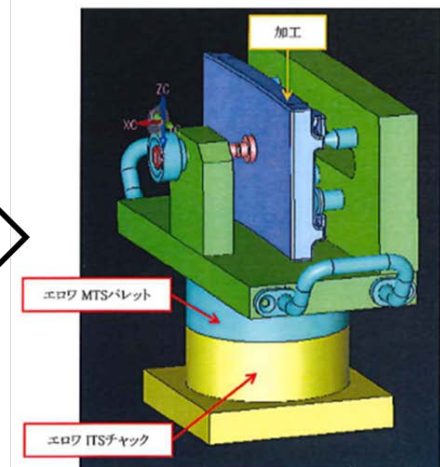
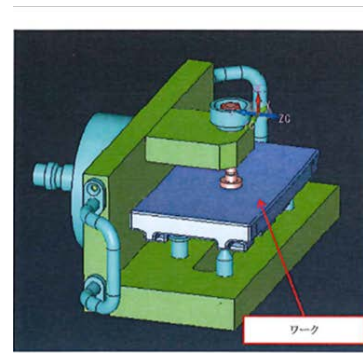
With the function to support the self-respect of work
The function to fix work is annexed.



【Idea② (Principle of division)】

With the function to fix work
The function to define the attitude of work is divided.

**This idea is
adopted.**



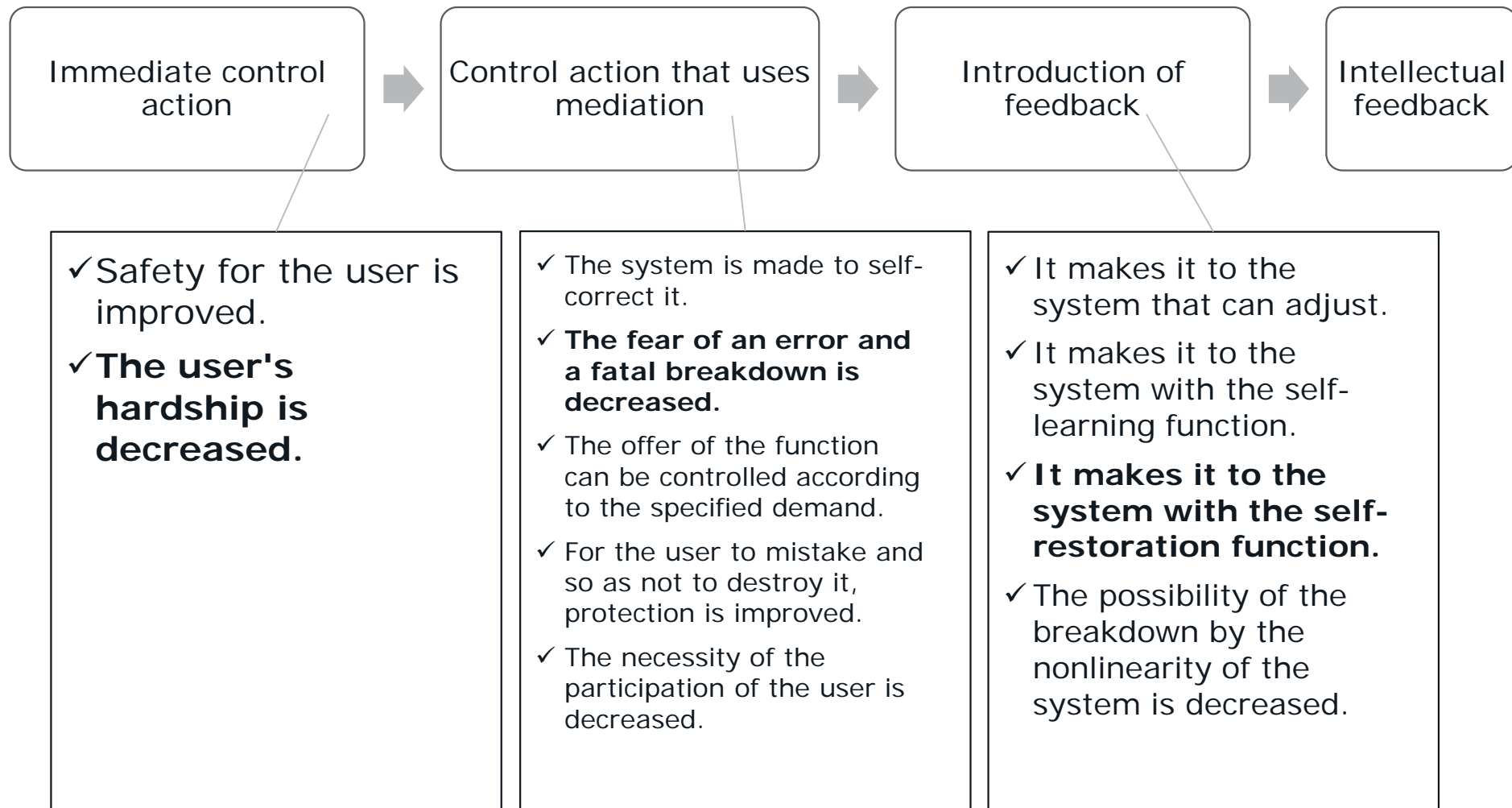
Technical contradiction is used.

- ✓ **Alternatives were able to be made effectively by using the solution approach of technical contradiction in a short time.**
- ✓ **The solution approach of technical contradiction was able to be applied smoothly by pinpointing problems by the process diagnostics, and having understood the problem event in detail.**

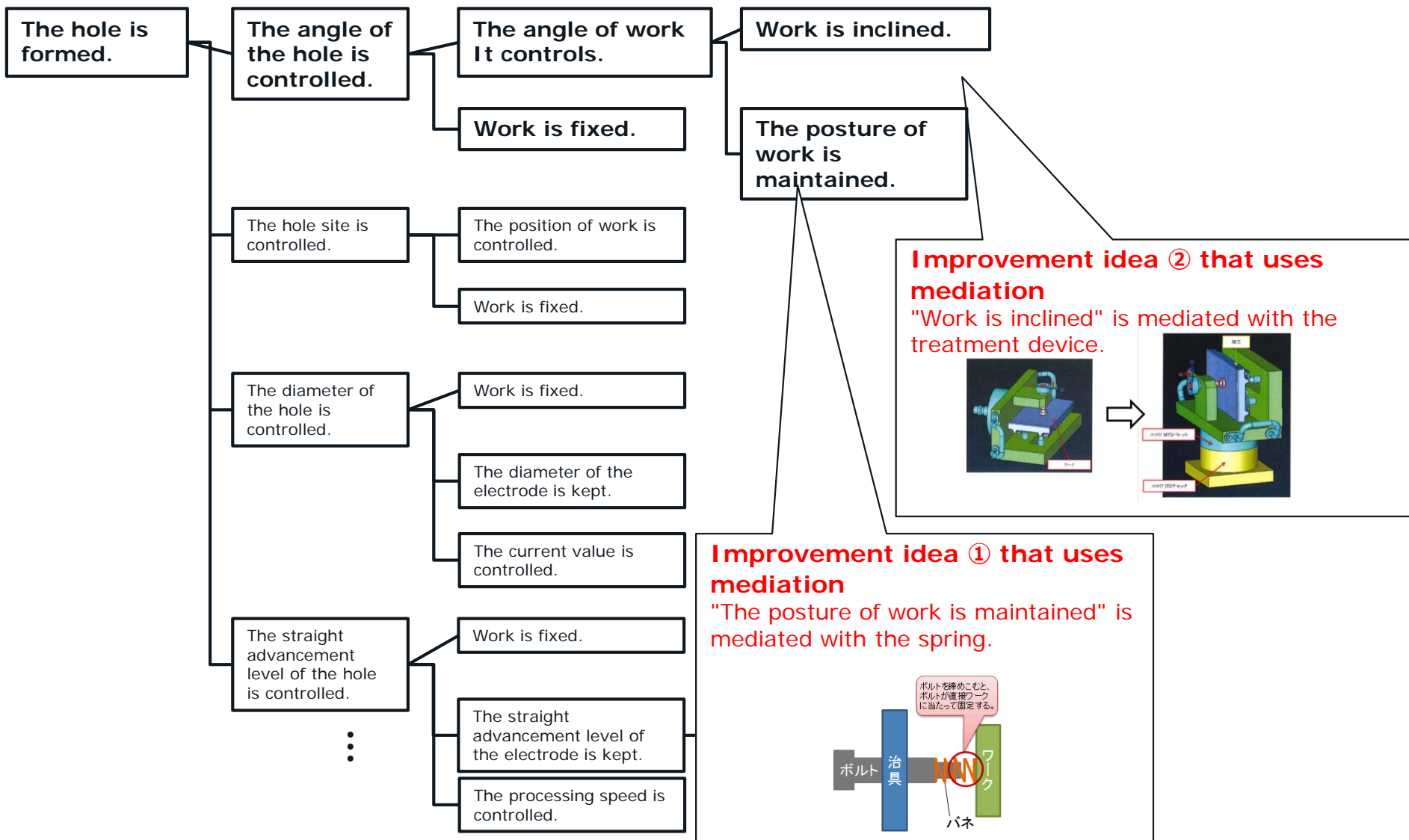
Three stages of TRIZ technique use

- ① **Alternatives will be effectively made by using the solution approach of technical contradiction at the stage of the improvement in a short time.**
- ② **Destroyed more process is developed by using the trend of the main technological evolution at the stage of the improvement.**
- ③ **It can propose a reformative system by using the trend of technological evolution in the stage of the system optimization (settling of the improvement idea).**

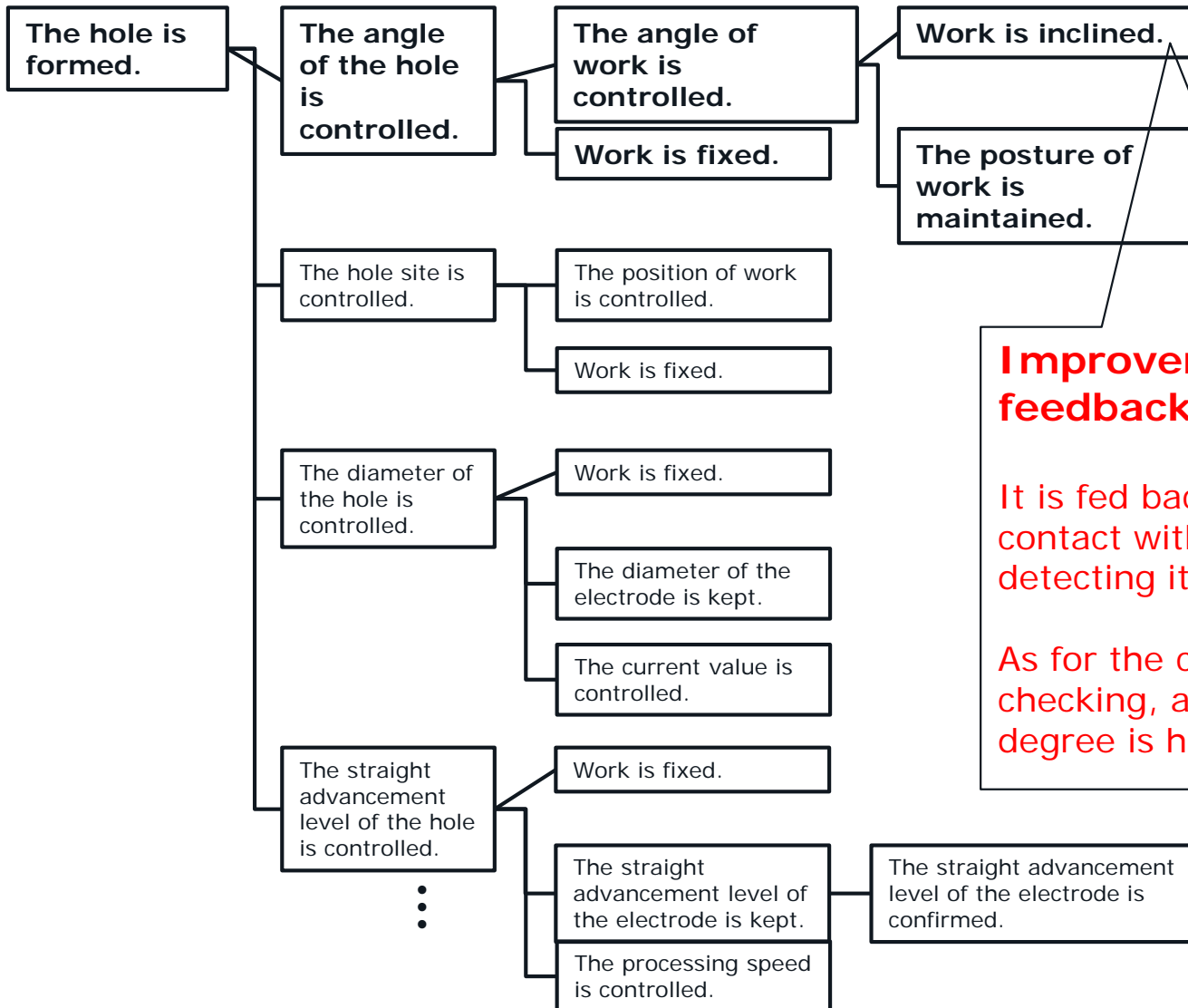
Trend of technological evolution 「Control」



【Function system chart of present process】



【Function system chart of present process】

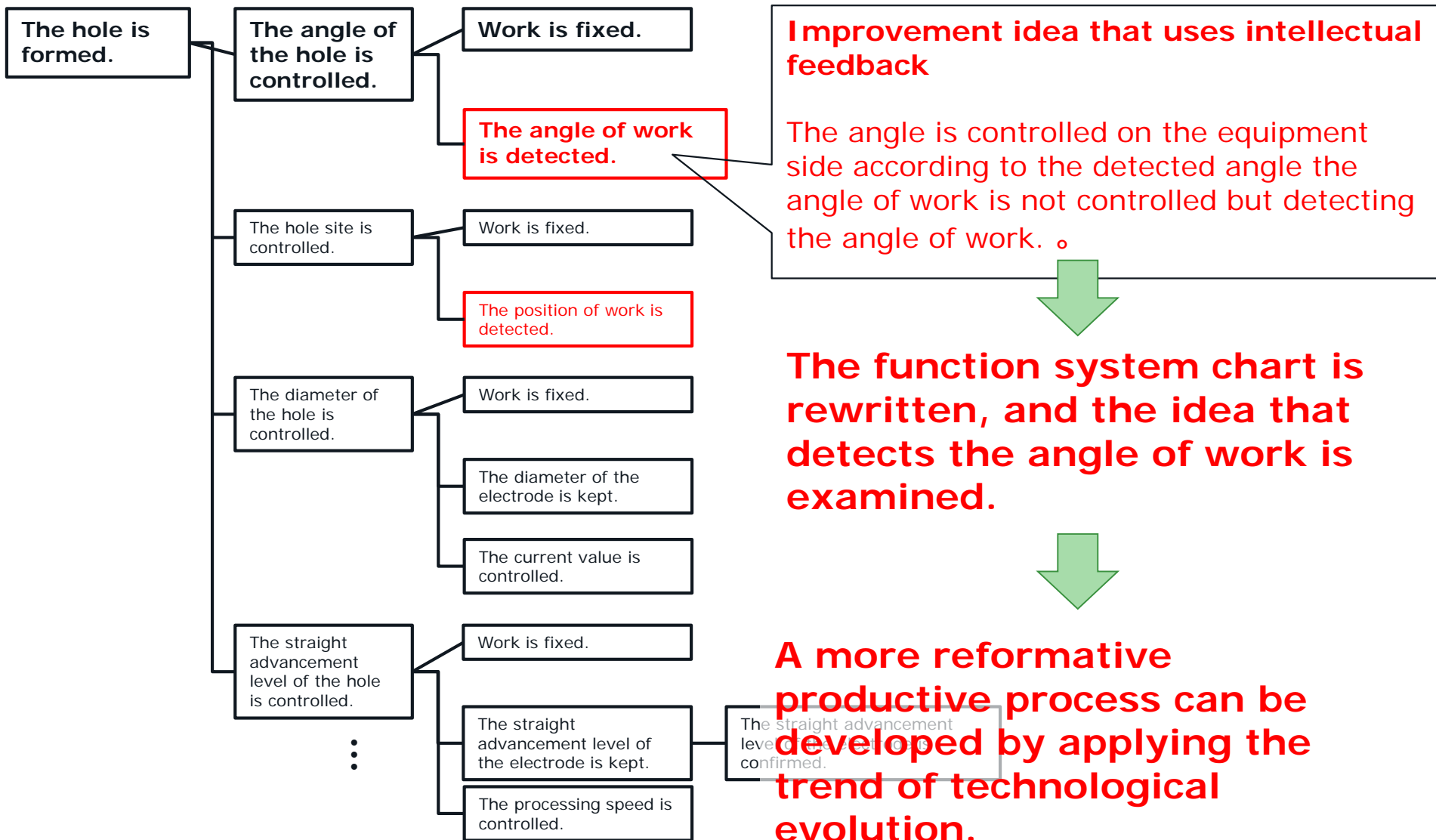


Improvement idea that uses feedback

It is fed back that work has come in contact with all the location points detecting it (Sen Synge).

As for the current state, the person is checking, and the those who belong degree is high.

【Example of function system chart to have adopted intellectual feedback】



Future tasks

- It was possible to improve it efficiently and effectively by the use of TRIZ to the production process revolution framework and showed the embodiment.
- However, it is thought that the effect is improved more by using TRIZ at the following two stages shown at three stages of the TRIZ technique use.
 - ✓ Destroyed more process is developed by using the pattern of the main technological evolution at the stage of the improvement.
 - ✓ Also at the stage of the system optimization (established of the improvement idea), the effect is put out by using the pattern of technological evolution.

ありがとうございました