

Improvement of Productivity in Factory

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What is productivity?

Productivity are one of the concept that come from human idea.
Our wish are getting much value(output) with small manpower
and investment thing.

Relationship of a resource and return.

① Productivity = Output/Input

= value-added amount / (the number of laborers
x working hours)

② Capital productivity = outcome *1 / capital

③ Labor productivity = accomplishment/labor

*1 Outcome : Production volume , Net sales Profit Additional value

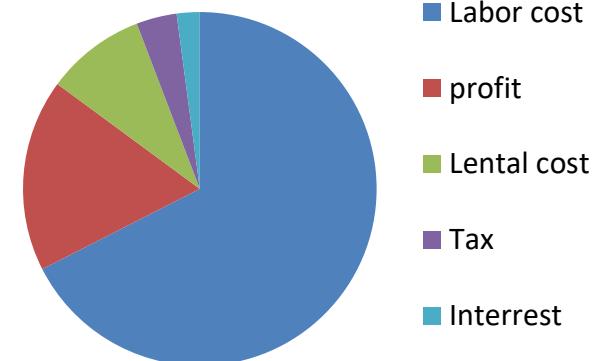
Labor: The number of employees, working hours, the personnel expenses
or equipment number

Value-added labor productivity = Value-added amount / Labor input

Additional value amount = net sales - (the material cost + stocking production cost + cost of fuel + outside order expenses)
= The profit + personnel expenses + production cost
service cost + Tax

We can know that transition of laborer's effort and development of ability, and operational efficiency by comparison with an other company.

Composition value-added frame

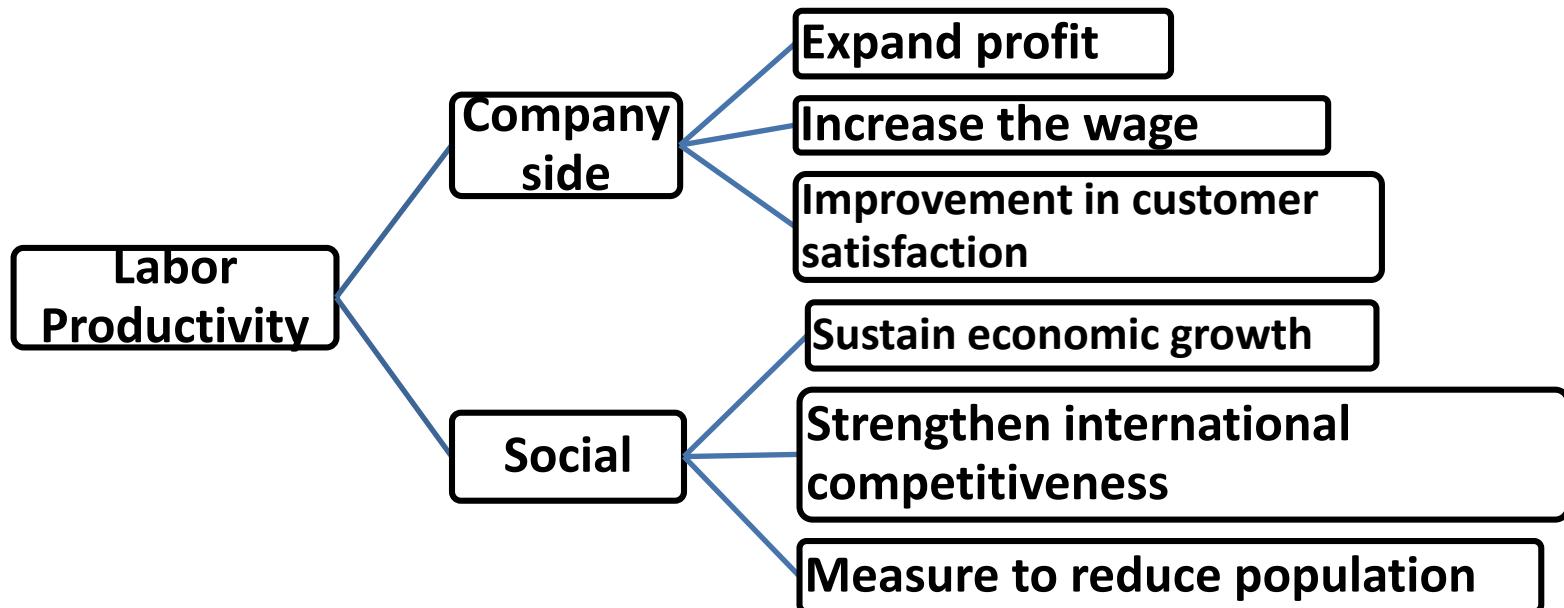


Why is productivity improvement done?

The improvement in labor productivity leads to the expansion of corporate profits and Increase the wages of employees.

It leads to an improvement in customer satisfaction.

Driving force to sustain economic growth and Strengthen international competitiveness and In the case of Japan, it contributes to a decrease in the labor force.



How is productivity improvement done?

$$\textcircled{1} \text{ Productivity } \uparrow = \text{Output} \rightarrow / \text{Input} \downarrow$$

Investment resources decrease (Reduce muda loss)

$$\textcircled{2} \text{ Productivity } \uparrow = \text{Output} \uparrow / \text{Input} \rightarrow$$

Outcome Up (Laborer's development of ability, concentration improvement and rise in price)

$$\textcircled{3} \text{ Productivity } \uparrow = \text{Output} \downarrow / \text{Input} \downarrow$$

Scale reduction (Unprofitable Department Sale、Employment adjustment)

$$\textcircled{4} \text{ Productivity } \uparrow = \text{Output} \uparrow / \text{Input} \uparrow$$

Scale expand (Strengthen profitable Department, Investment for technology)

Specific productivity of the manufacturing

Labor Productivity = GDP ÷ (Number of workers × Working Hour)

We can replace GDP to sales amount in companies.

To find the labor productivity.

A way using standard time is also capable of calculation and is a correct index. It can be done and used.

For example) Standard Time = 8H

Some day this work was finished in 5H Productivity = $8 \div 5 = 1.6$ (160%)

Next day this work is finished in 10H Productivity = $8 \div 10 = 0.8$ (80%)

Labor productivity = Standard time ÷ Actual time (%)

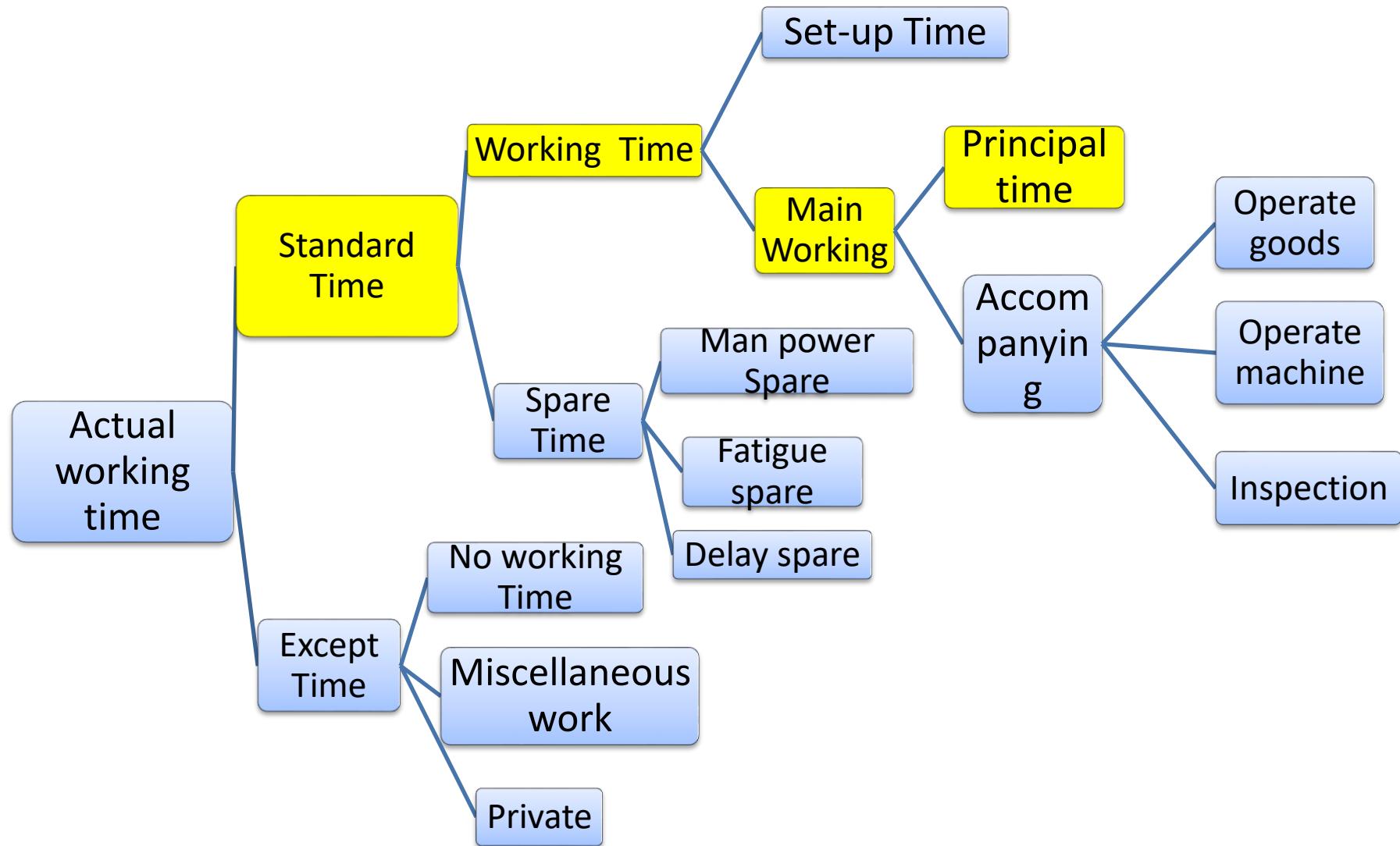
When we want to compare hard work during section and before and after improvement, in case of using standard time , it's possible to find the fair value.

Definition of Standard Time

<Definition>

- ① Using decided way and equipment . and Under decided work condition ⇒ **Standard work method and the operational condition**
- ② Worker have degree of the skillfulness requested of work (the skill and experience)⇒**Average worker**
- ③ The condition you train about the work and it starts to suit physically, and that the work can be executed sufficiently
- ④ working by standard speed.⇒**Standard speed**
- ⑤ Time necessary to complete a unit of work rate
- ⑥ Additional spare time

The structure of the standard time



How is Standard Time born?

For the experiment of Taylor's scientific management method, transportation of iron ore, lime, etc. So, How much is the amount of scooping shovel, the maximum amount of scooping in a day?

- i Thickness, length, holding way of shovel's handle
- ii Angle, force when inserting shovel
- iii Distance to throw scooped items, height
- iv Influence of floor materials and conditions



8kinds of shovels(large for light items small for heavy items)
The scooping amount 21 pounds/shovel unified. ←make working instruction.



The number of working tons was 4times from 17 ton/person·day to 59ton.

Need for standard time①

Case 1

A-1 line produces product A with 100 workers,
100 million yen sales.

A-2 line product B is 100 workers, 200 million yen.

Question : Which line works best?

Because sales include purchased items.

When the percentage of purchased good is included in product B. Although the amount of work is small, sales may be large . \Rightarrow In sales, you can't evaluate your work.

Need for standard time②

Case2

Three years ago casting factory cast 1000 tons of product C, We cast 2000 tons this year.

Question : Is this work done twice as much as this year since three years ago?

If casting weight reduction is progressing, It may have been working more then twice for first time.

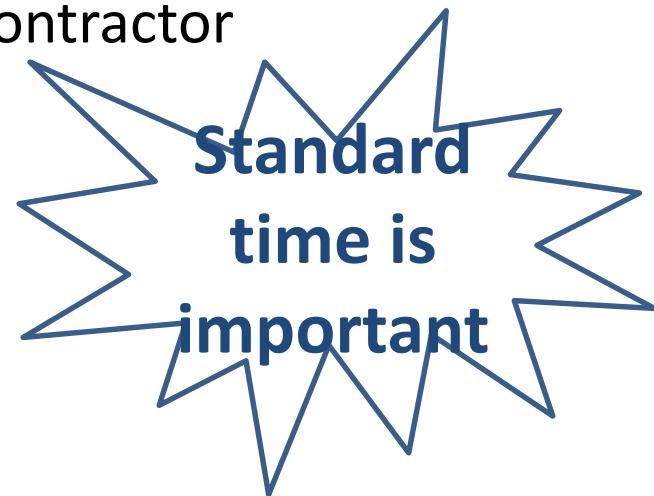
⇒It can't compare with working of worker by measuring unit ton.

Time is optimal for the unit of measure of work volume Unit per time OO(OO/H)

Need for standard time③

<Where is standard time used?>

- i Estimate of processing cost in production cost
- ii Basics of production planning such as schedule planning and production load planning
- iii Determine number of workers and machine equipment
- iv Basics of cost control / inventory control
- v Basics of order placement to subcontractor
- vi Basics of wage system



Standard speed①

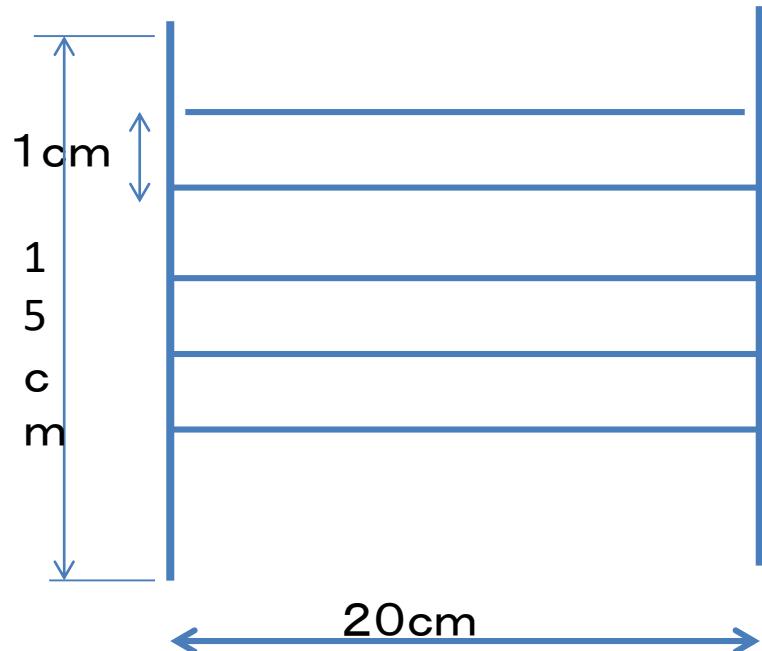
< Experiment of working speed >

Draw three pairs of two vertical lines at a distance of 20 cm with a pencil. Length is 15 cm in vertical

Next, with a free hand between the vertical lines at pitch of 1 cm Draw 10 lines as parallel as possible.

1st set is A = normal speed, 2nd set B = as soon as possible

3rd set is C = as late as possible



Work speed ; B>A>C

Quality characteristic ;

- i Parallel • Spacing is uniform
- ii Match starting and ending point with vertical lines.
- iii Thickness of line is constant.
- iv Lines are straight

Standard speed②

- Watch result B that is as soon as possible.
 1. We make shift at starting and finishing point.
 2. We make shape of key at finishing point.
 3. The line is curved as a whole.
 4. The parallel and the interval become irregular.
 5. The thickness gradually becomes thick.

Work has an appropriate speed to satisfy its work quality.

How to make standard time

< How to set standard time >

i Experience estimation method

 Estimation by a specific experienced person

ii Actual time method

 Method using average past actual time in the past

iii Work sampling method

 At a randomly selected time within a certain period of time, workers and machines

 , And estimates the occurrence ratio by using the statistical method.

iv **WF method (Work Factor method)**

 Make a standard table and accumulate for each body part (fingers, hands, arms, torso, legs) to be used by the operator, working distance, object weight, and artificial adjustment.

v **MTM method (Method-Time Measurement)**

 Classify work as “10 basic actions”, create a standard table, and accumulate.

No improvement

Where there is no standard

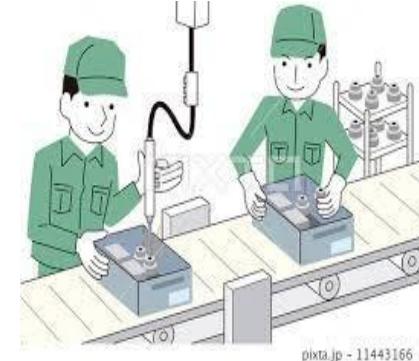
< Revision of standard >

1. Operation standard is made by group leader at site.
2. Group leader was veteran former skilled worker.
3. Group leaders are labor union members.
4. The group leader actually does before
the confirmation of the new work standard.
5. New operation standards are documented (standard
operation sheet, work instruction sheet).
6. Always revise the standard.

Movement and work

Value-added work in assembly process (screw tightening)

- i Pick-up parts · · · Accessory work
- ii Pick-up screw · · · Accessory work
- iii Take the tool. · · · Accessory work
- iv Tighten screws on parts · · · **Value added work**
- v Pass next process · · · Accessory work



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Consider the case where you continued the work one day.
「Even if you take the tool all day long, added value does not increase.」
Accessory work is movement, Value added work is work.

Muda ▪ Mura ▪ Muri

3M(ムダ=Muda ムラ=Mura ムリ=Muri)

Muda: Things that do not produce added value

(Those who can not pay for the customer. Things that are not affected even if lost)

Mura : 4M+ The amount of work has variations.

Skill variations(Man)

Material variation(Material)

Equipment variation(Machine)

Procedure variation(Method)

Work load variation(Environment)

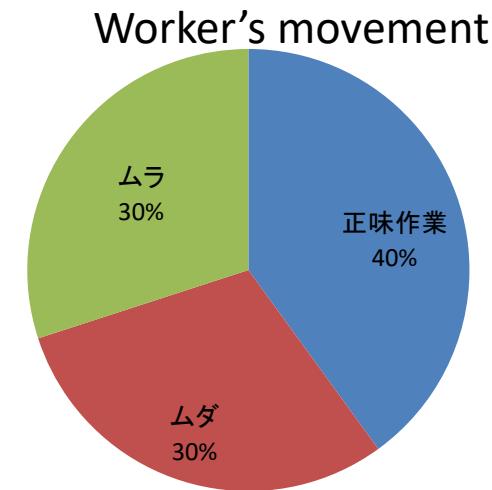
Muri: Things that can not be done

It can not be done too early.

I can not do it because it's too heavy.

I can not do it because it is too much.

I can not do it because it is too high.



Toyota's seven waste

1. Waste of making too much

- To make extra what you do not need at that time.
- It is the worst waste, and it arises from the badness of setting and management of tact .
- Waste of making too much make waste of inventory · waste of operation · waste of transportation.



It generates and apparently hides waste of waiting.

2. Waste of Waiting

- Waiting for parts and materials from the previous process can not work.
- The worker easily hides it by adjusting the work speed.
- It is important to make standard work firmly, and first to make actualized wait.



3. Waste of transportation

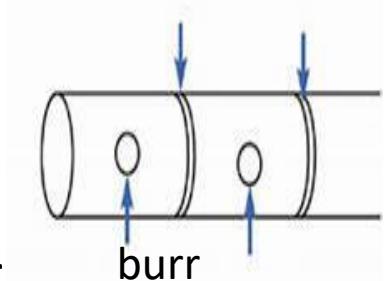
- Move more than necessary, temporary placement, transshipment
- It is generated from waste of making too much.
- It occurs when the flow of goods is not decided.



Toyota's seven waste

4. Waste of processing

- More than necessary finishing work due to the fact that the standard is not decided.
Unnecessary inspection etc. originally applicable.
- Continuing the traditional approach, do not consider whether it is really necessary, and do processes and work that are not essential.



5. Waste of inventory

- Inventory is all stocks such as materials, parts, work-in-progress, finished goods.
- Inventories are costly, they are deteriorated with aging and can not be used when stocking.
- Inventory is inventory that can not be explained because the purpose that exists is wasteful.
- Inventory hides the problem.



Toyota's seven waste

6. Waste of movement

- Actions such as searching, squatting, switching, checking are movements that do not produce added value.
- It happens with lack of training if standard work is not the same for everyone.



7. Waste of Defective item / rework

- To discard defective products, rework and reproduce.
- Occurs from not complying with the standards and not being decided
- It is also caused by insufficient condition management



Procedure of waste detection and waste elimination

1. Just stand on the genba . . . Deny the current situation and watch
2. Discovery of waste

We divide detailed actions such as actions / procedures actually performed by workers into elements.

It is classified as value work / non-value work.

Stagnation of waste (pay attention to the movement of objects)

Unnecessary movement / transportation (pay attention to movement of people / machines) ⇒ If people are moving, think as wasteful.

3. Eliminate waste

ECRS

E : Eliminate = Can we abolish work?

C : Combine = Can you do more than one work together?

R : Rearrange = Can not swap work procedure?

S : Simple = Can you work easily?

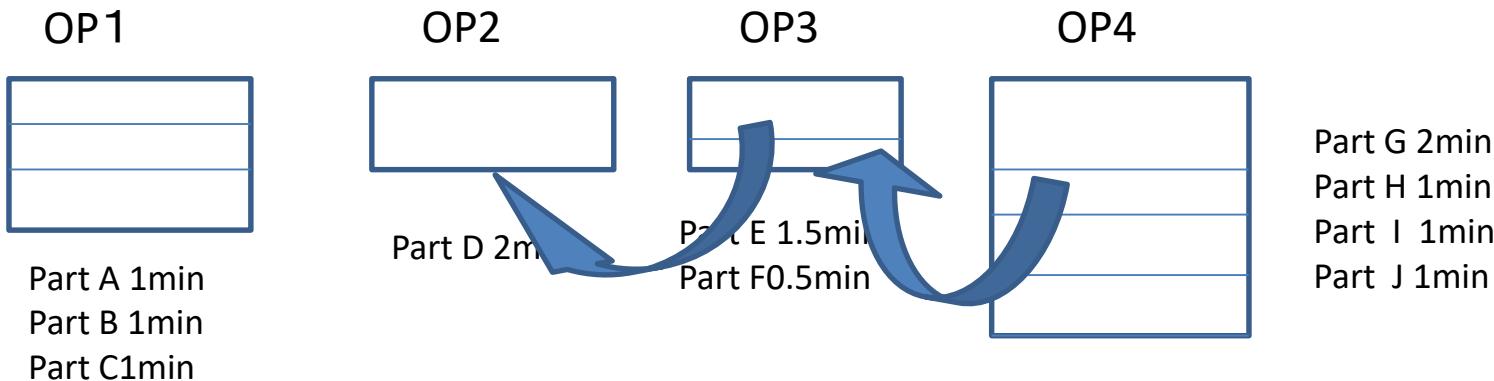
Su , dou , kyo , raku

Su : Reduce times Dou ; Work same time Kyo : Reduce distance

Raku : Comfortable working

Examples of specific productivity improvements

1. Line balance



< To balance the line >

- i Make an assembly order plan with leveling work amount.
- ii Do not make a small island, help each other.
- iii It is necessary to have multi skill training according to the variation of the sharing.
- iv Make waiting easier from outside the line.

2-1.Shorten setup

Set-up time = External setup time + Internal setup time
+ Adjusting time

Time to see the first time after setup

Work that can be done without stopping the machine

Work that can not be done without stopping the machine

<Step of improvement setup>

- i Measurement of current time (video shooting)
- ii Analysis of setup work (We will standardize for variations among workers according to workers who work earlier.)
- iii It is divided into internal setup and external setup. (External setup as much as possible)
- iv Improve setup work (shorten adjustment time)

2-2 Idea for shortening setup

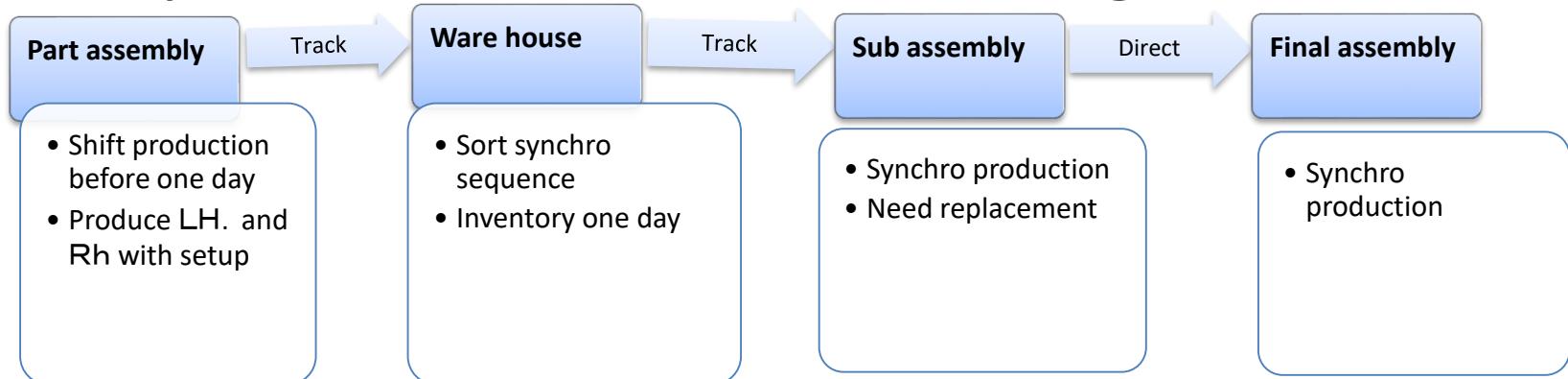
<Machining>

- One touch of attachment of processing jig and boltless.
- Limited gauge from general purpose measuring instruments (micrometer etc.)
- Done by Multiple people.
- A layout that places the tool near the machine.
- Specialization cutting tool
- Cutting tool preset is external setup.

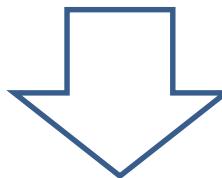
< Molding >

- Seri Seton mold placement (clearly indicating the place)
- Place the tool near the machine, not in the cabinet.
- The mold heating is preheated. (External setup)

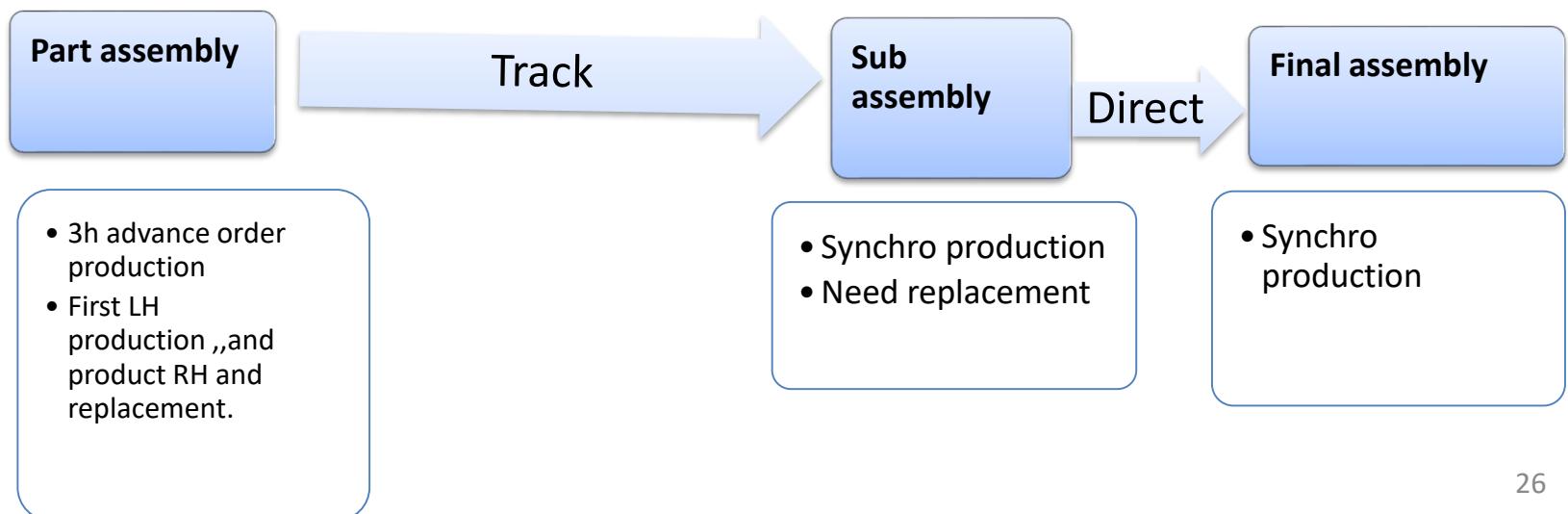
3. Improvement Material Handling



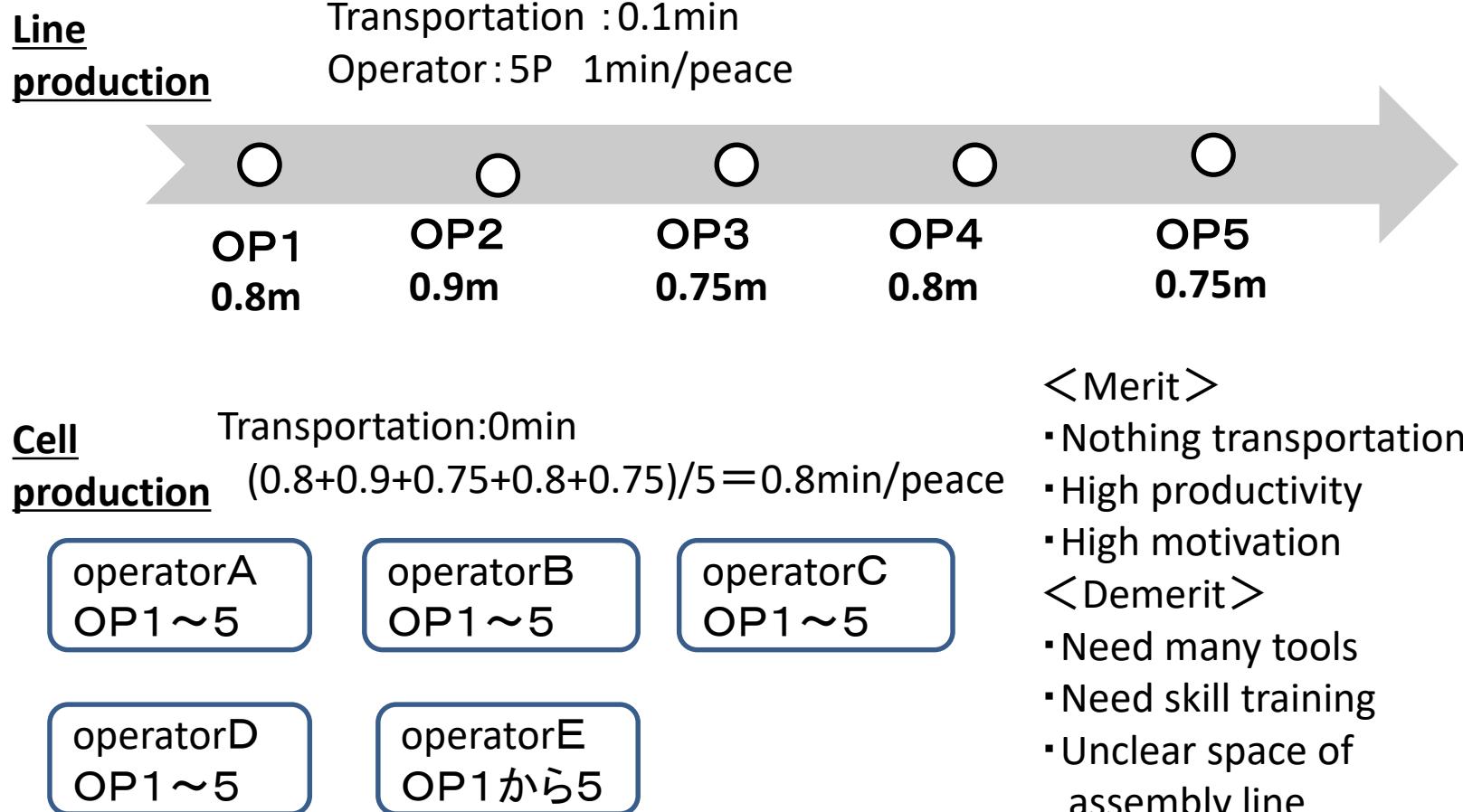
Discontinued sorting in warehouse by actual production



- Stable quality
- Stable operation of the line
- Improvement of QDC

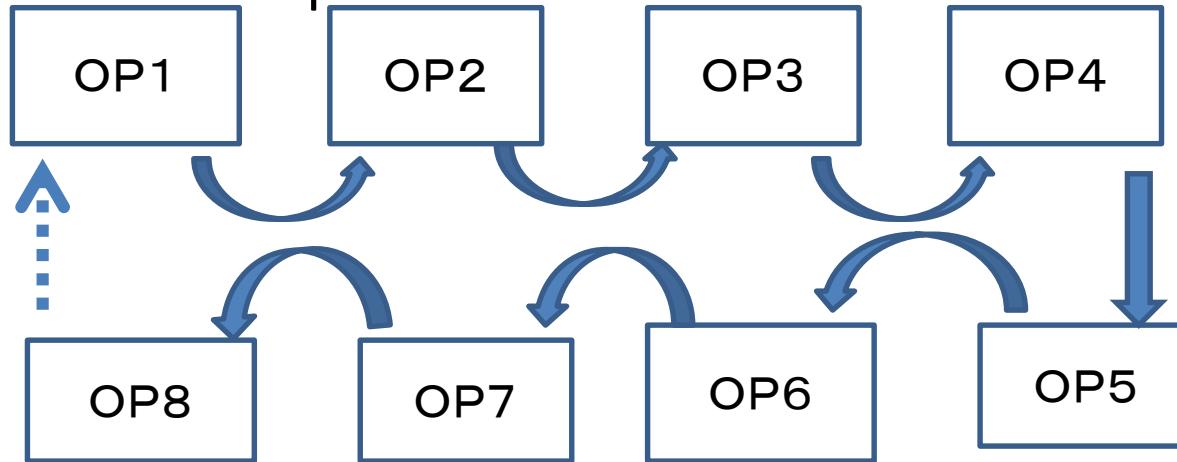


4. Cell production



5. Rotating production

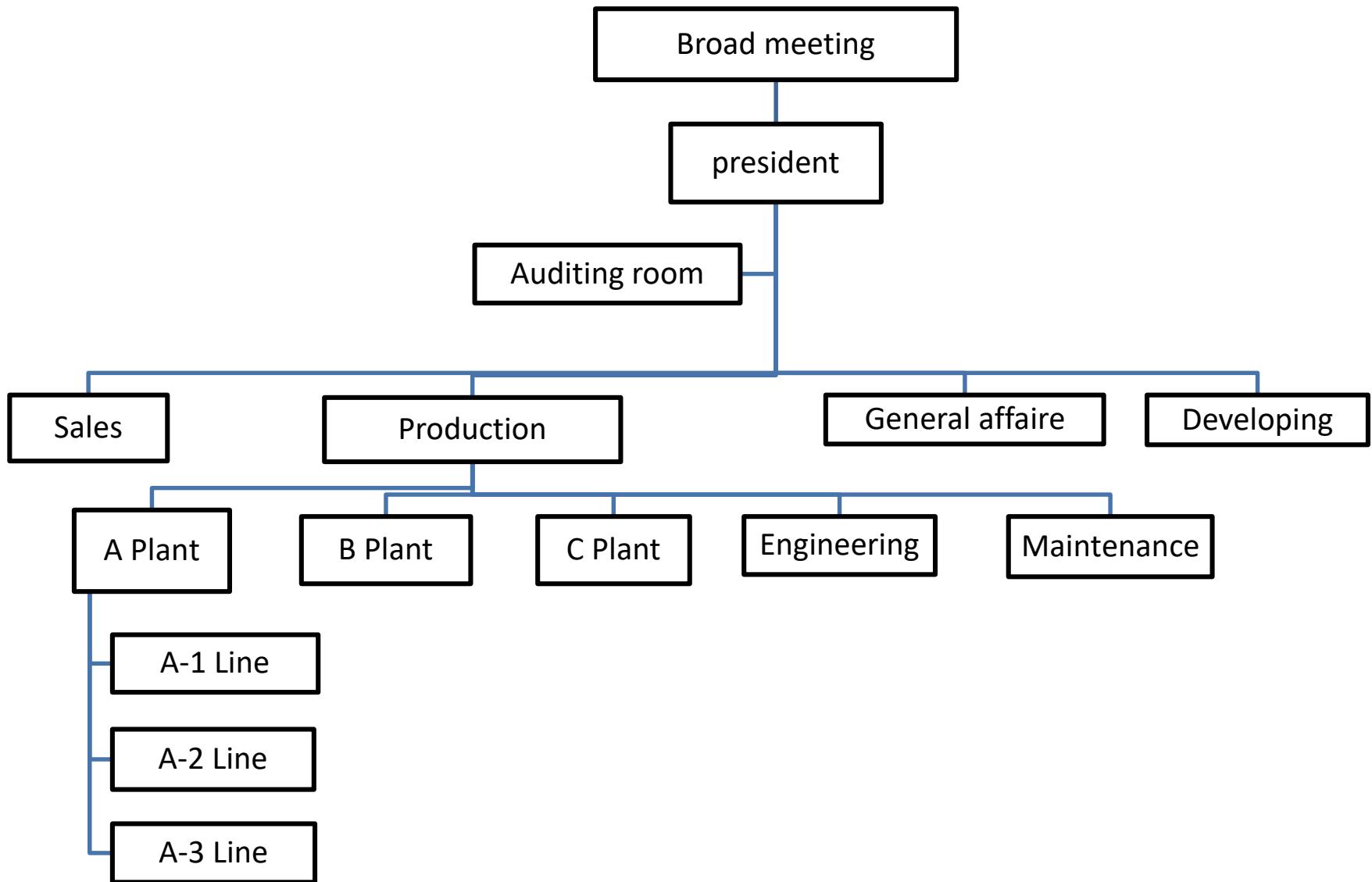
Perform only the manual operation of loading / unloading, and turn the process.



unloading : 0.15min
loading : 0.2min
machining : 1.2min
transportation : 0.05min

<Output>
Worker A1people : 3.2min/piece
Worker AandB2peoples : 1.6min/piece
Worker A.BandC3peoples : 1.2min/piece

Organization of Company



KPI at Manufacturing industry

	KPI(Key Point Indicator)	Management level	Plant manager	Supervisor
S	Number of Accident Accident frequency rate Accident intensity ratio	◎(all) ○ ○	◎(plant) ○ ○	◎(line) ○ ○
Q	Number of claim (number of claim resolved) Claim amount Defect rate	◎(all) ◎(all) ○	◎(plant) ◎(plant) ○	◎(line) ◎(line) ◎(line)
C	Cost of manufacturing Productivity Production amount /H·person OEE(overall Equipment Efficiency)	◎(all) ◎(all) - ◎(all)	◎(plant) ◎(plant) - ◎(plant)	◎(line) ◎(line) ◎(line) ◎(line)
D	Production lead time Inventory amount Inventory days	○ ◎(all) ◎(all)	○ ◎(plant) ◎(plant)	◎(line) ◎(line) ◎(line)
M	Number of Improve suggestions Rate of multi skill	◎(all) ◎(all)	◎(plant) ◎(plant)	◎(line) ◎(line)

All: company wide Plant: Plant wide
Line: Each line

Productivity at Plant

1. Head of the production headquarters decided the policy “to raise labor productivity by 5% in 2018 compared to 2017”. (We set it to 100% in 2017 and 105% in 2018)

In 2018 How do you calculate the productivity of the A, B and C factories throughout the production headquarters?

$$\frac{\sum (\text{Standard Time } St_i \times \text{Production number } N_i)}{\text{2018 Total actual man power}}$$

÷

$$\frac{\sum (\text{Standard time } \times \text{Production number})}{\text{2017 Total actual man power}}$$

Production headquarters is responsible for the whole.

2. How to calculate the productivity A,B,C plant ?

$$\frac{\sum (\text{Standard Time } \times \text{Production number})}{\text{2018 Total actual man power}}$$

÷

$$\frac{\sum (\text{Standard Time } \times \text{Production number})}{\text{2017 Total actual manpower}}$$

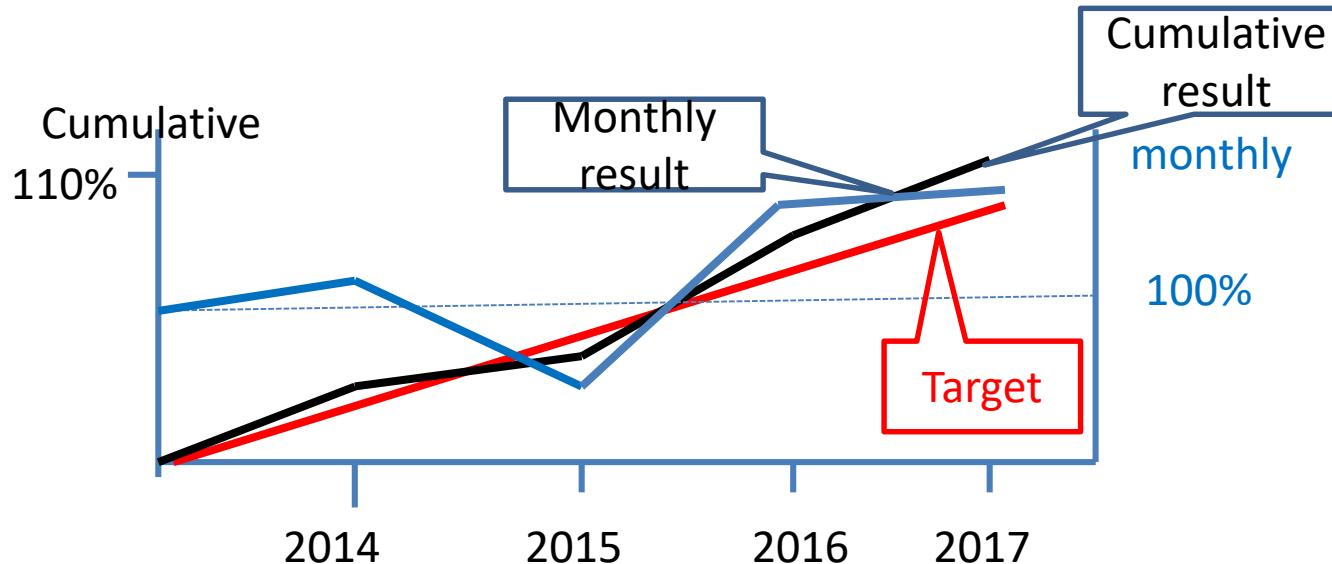
Plant manager is responsible for own plant productivity.

3. How about productivity of each line?

Leader is responsible for productivity of his line.

Indicator for Productivity

1. Improvement of productivity ○ ○% up compared to previous year



- Based on the results of the previous year.
Assign goals to the supervisor. (Considering the results of last year.)
- Make a team of manufacturing, production engineering, conservation and make Implement improvements list items.
- Make a monthly result report. (Next month's plan and support request)
- Which is better reset or continue every fiscal year for improvement of motivation at manufacturing site ?(Will motivation be improved by continuing?)

2. Indicator of Bench mark (DSTR)

In a car company, compact cars (few parts) and large cars .

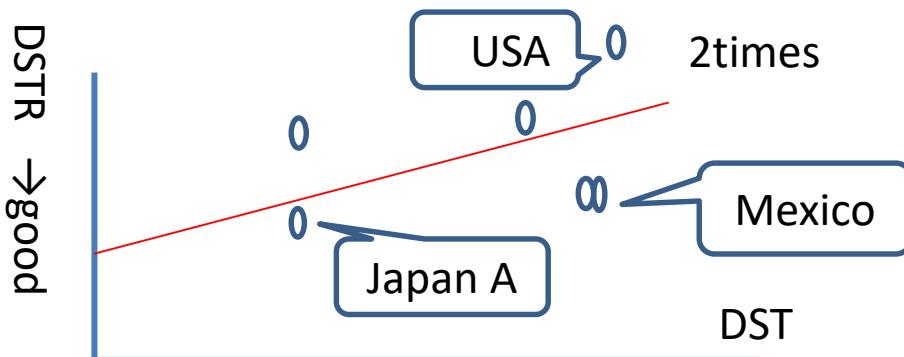
However, productivity improvement is ○ ○% which factory has productivity. We do not know which is higher.
(We understand the degree of effort)

Design Standard Time Ratio = (Actual man power/unit) ÷ (Design Standard time/unit)

Design Standard Time: Main work + minimum accompany work

DST will be decided at the product design stage in activities to reduce DSTR

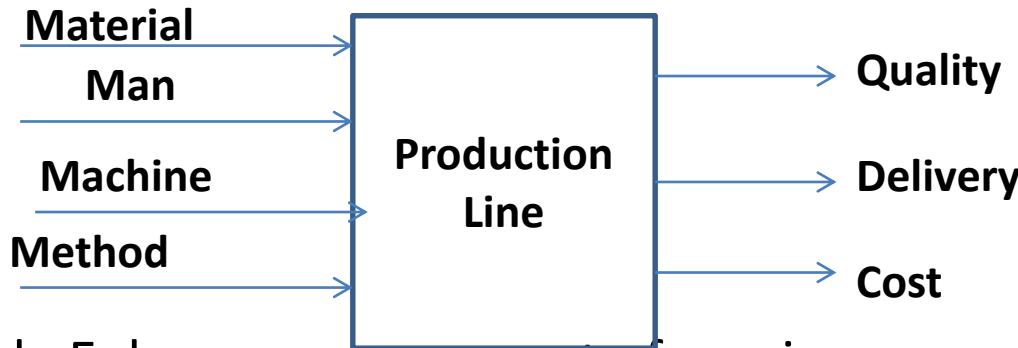
We will reduce the time not included in DST.



- Not include in DST
- Machine stop
 - Transportation
 - Material handling
 - Quality check

The production line is alive

- The production line is a creature and it is changing.
(It will be both forward and reverse)



- Material: Enhance management of previous process.
 Installation of Poka Yoke
- Man: Make multi skill worker (Work skill planning and implementation)
- Machine: TPM (Autonomous maintenance) .Automation
- Method: Procedure manual maintenance and revise
- Production system: Reduce Production lead time

TPM

人材育成

維持改善

自動化設備導入

VAVE

リードタイム短縮