Making stream of production
-5. Toyota style “Standardization”.

Before going to the main theme, I would introduce a question which is about the CS (Customers Satisfaction) and my answer as usual.

What is CS (Customer’s Satisfaction)?
For getting CS and evaluating the level, I teach the seeking of QCD which are Quality, Cost and Delivery and the beneficial position of the customer.
1) Quality.
-The case of parts supplier.
As you understand the quality assurance is a base of CS. However what is Quality?
Quality is the degree of the characteristics which satisfy the customer’s requirement.
Generally the customer requirement is identified in the specification.
Now the quality in CS.
If you say that the quality is one of essential condition for CS, just to be satisfied the specification is never sufficient and required more active mind.
Even though the specification is OK, but it is necessary to seek what is the true customer’s requirement and what is the function required.
Therefore it is necessary to have the attitude which investigate the required function and suggest the Kaizen ideas for contributing the quality improvement of the customer’s product.
-The case of the finished product.
If you are a finished product company following items are required.
-1. Quick response when occurred the claim.
-2. Compensation.
-3. Polite instruction.
-4. Quick information to the customer when quality problems were found.
(These are essential for the parts supplier as well.)
2) Cost.
-The case of parts supplier.
It is not better ideas to sacrifice your own profit. But it is required to contribute to the cost of the customer.
Therefore based on the analysis of “Deployment of the function” of finished product, and the parts, making VA/VE activity and suggestion is recommendable.
Proposal capacity.
Now here let’s think the capacity to propose (to the customer).
-The case of parts supplier.
Proposal capacity also one of important theme for CS.
In the case of quality and cost, it is important to have the proposal capacity. Then for getting the customer’s satisfaction, the active activity (active proposal) is essential.
-The case of the finished product.
Your customer (guest) expects the function of the product against the price.
And if the function is not sufficient against the price, the customer takes one in 2 actions which to reconcile or to make a claim.

And both of the case worsen the reputation. Therefore from the point of view of CS, it is recommendable to seek the way of collection of customer's voice. (Direct call in free dial, free mail, questionnaire.)

3) Delivery.

Now I'm writing TPS from the point of view of "Making stream of production". And in the description, I presented the case which the customer requires to deliver the 1.000 products at once. But it was identified that the true wish was to have the product (parts) 50/day to meet his assembly line speed.

For realising the wish of customer it is necessary to improve the LT (reduction of LT: lead time).

Reduction of LT is the point of view from the supplier. On the other hand as a customer, following 2 things are expected.

-1. Possibility to negotiate the advantageous LT and batch size.

-2. The promise is kept in no concern.

A little more I share my hours to describe the theme of CS.

What is the purpose of the improvement of CS? Why does a company seek CS?

The purpose of seeking or improving CS is for seeking the company's goal. So what is a company's goal?

The goal is the continuity and the continuous growth based on the proper profit.

I present the example of a company which continues his business more than 400 years. 400 years he continues and expands his business. There are many great company like as TOYOTA, GM, Ford, Google----. But I don't know other example who continues more than 400 years.

The name of this company is SUMITOMO. Now SUMITOMO is a grand conglomerate. And SUMITOMO has his family precepts as follow.

1. "Furi wo owazu" (in Japanese).
   The meaning is that no seeking the flippant and immediate profit.
2. "Jiri and Rita. Koushi Ichijo"
   Jiri: The company benefits himself.
   Rita; The company benefits others (customers, employees; CS, ES)
   Kousi Ichijo; And the business contributes to the profit of nation and society (SS).

Again the goal of a company is to gain the proper profit continuously.

For this goal "Jiri" is essential, but never sufficient and necessary the concept of Rita.

(Ji; myself, himself, itself. Ri; benefit. Ta; others, customers, employees.)

Several years ago I visited the travel agency which I use for the schedule of visiting several European companies.

However one occasion, the agency hadn't suitable and economical plan of air flight. Then the staff introduced the brochure which was his competitor agency deals and said

"Unfortunately at present our agency doesn't deal in the suitable plan for your schedule. But xxx has better plan. Please try to use this for your travel".

The staff of this agency considered the customer's benefit first and recommended the plan of the competitor. I temporarily used the agency introduced. And I use this kind agency even now.

CS
For seeking the company's goal, CS is important. However it is never sufficient. And I teach the importance of CS, SS, ES (3S).
CS; yes customer's satisfaction. SS; Society's satisfaction.
ES; Employee's satisfaction.

Now main theme.
I need to write a little more regarding the model line introduction the product "7".
The introduction processes are

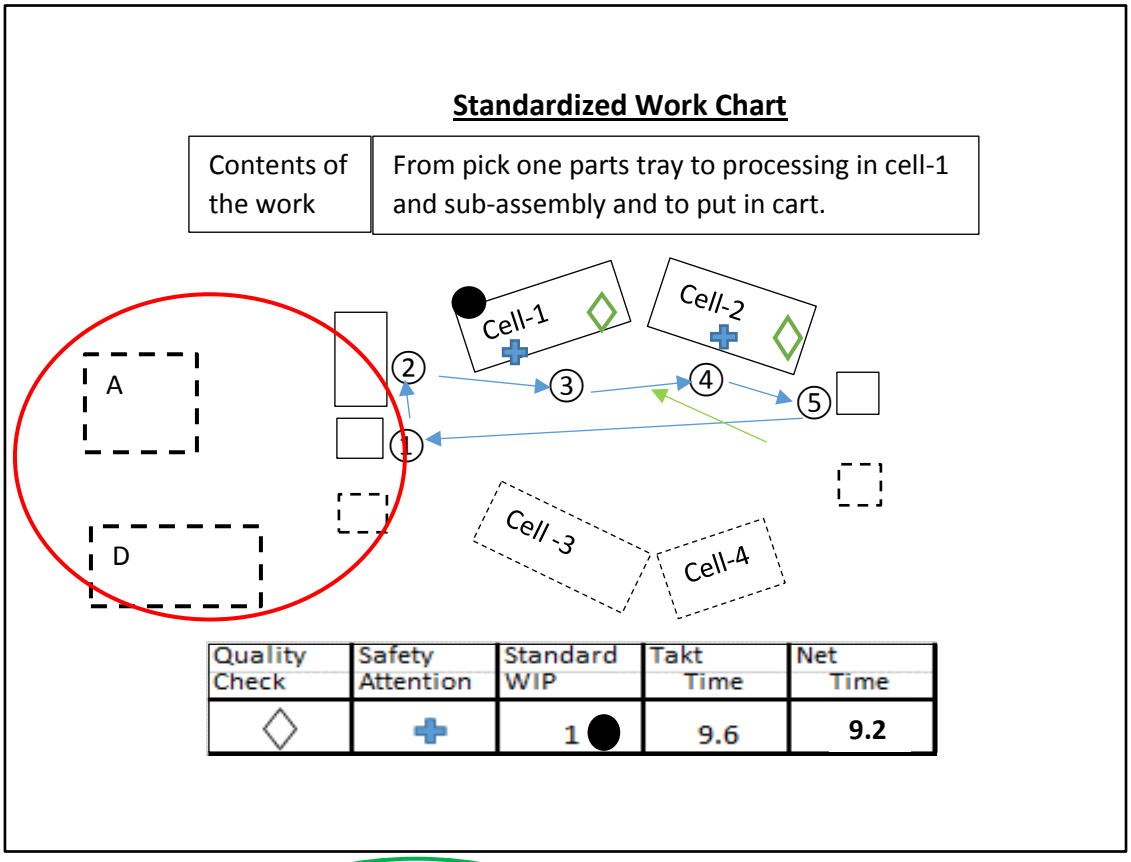
-1. Takt Time. I emphasized the importance of work in the Takt Time.
Takt Time = Planned working hours/day ÷ necessary production/day
-2. Time study and the confirmation of minimum net-time.
-3. Calculation of necessary head account of line worker in individual process.
Head account = Minimum net-time ÷ Takt Time.
-4. Making standard tables and chart.
Process Capability Table. Standardized Work Combination Table.
Standardized Work Chart.
-5. Layout consideration and move & install machines and cells.
-6. Training and start the line.

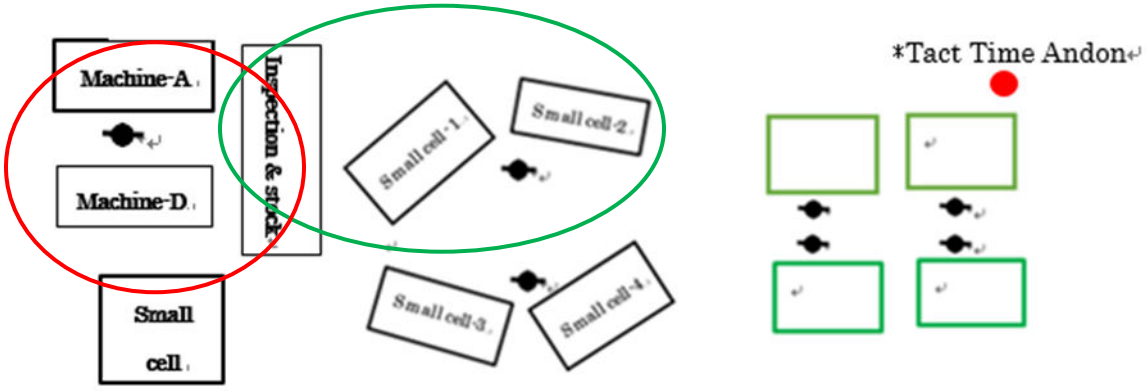
Then from -1 to -3 are already finished.
Then I need to write the Process Capability Table, Standardized Work Combination Table and Standardized Work Chart of the machine cell (machine-A and D).
Machinery process.
It is quite natural that the processing speed of machinery and manual assembly are different. Machinery process is faster speed than manual, but has the changeover. Therefore (more or less) machinery process is the batch production with proper WIP (If the production order is expected in future.). The large press process which the real production time is very short (for instance some seconds), but has very long change over (for instance several dozen minutes) also is same. For absorbing this differences, proper batch size and stock are inevitable.
Now we look these points in this model line.
<u>Process Capability Table.</u>
Machine-A produces 8 parts which are KE-0025, DU-F20, DU-F53, KJ-00, RG-91, KE-005, DV-F25 and KL-30.
Of course for one of each, it is necessary to provide the Process Capability Table.

Approval					Part number: KE-0025			Type: XT-5		Plant: Model line
Manager	Supervisor	**Process Capability Table**			Part name: RMJT-assy			Articles	1	Process: Parts process
R.B	M.E				Machine	A			By	Project
Process	Process name	Machine			Basic Time		Cutting Tool		Prod.	Remarks
		No.	Manual T		Auto Feed T	Complete T	N of Change	Change T	Capacity	
1	KE-0025	M-A	(5") 1"		12"	13"	2000	7'00"	2214	Manual T: 5"/5pieces.
						The working hour is 480 min / day				
		total	(5") l"							

This case is very simple and not interesting at all because this part is just one

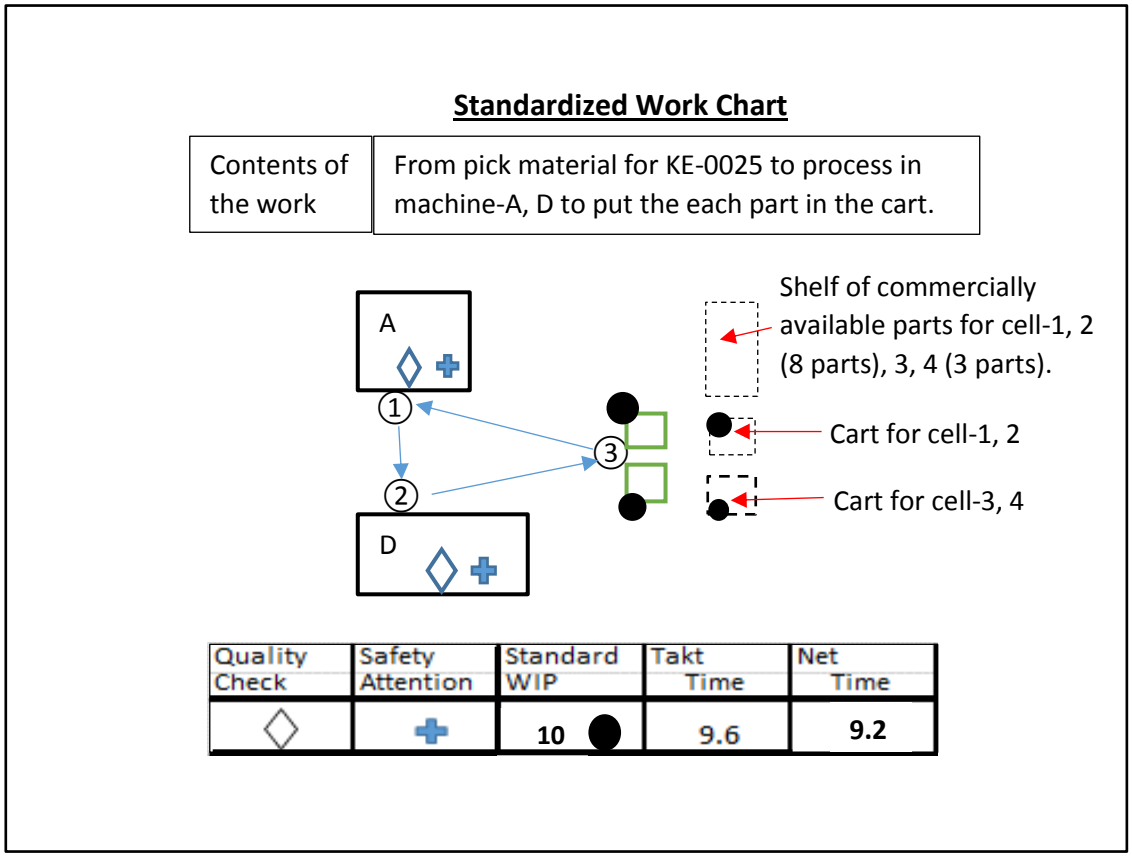
production process and not like as the example of the training with the nabour company. However this table is important as the basic ledger of machine capacity in individual parts for improvement.
Other 7 parts for machine-A and 4 parts of machine-D also are same. (But omit.)
Standardized Work Chart
You remember following Standardized Work Chart of Cell-1,2.





As you understand the subassembly-1 process in above Standardized Work Chart is the area mark in the line. And the Standardized Work Chart of Machine-A & D is the area mark.

And the Standardized Work Chart of machine process is as follow.



The job contents of Machine-A & D operator.
(The necessary materials, tools and jigs are prepared by the supervisor.)

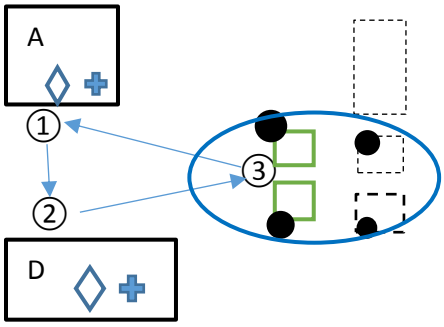
1) Set-up the jigs in the machine-A and D.
   Take and insert the material in the machine and start button.
   (Total changeover time; 7 minutes.)
2) Parts inspection; 5seconds.
3) Take out the parts and move in the bucket.
   Carry the bucket and put the parts in the tray.
   (Supply service for 12 parts. One part supply service; 15seconds.)

Necessary walking are between the machines; 2 seconds, between machine and cart is 10 seconds.
The operator repeats this process for 8 parts (machine-A) and 4 parts (machine-D).
The parts supply of machine process are as following matrix.

	Cell-1,2	Cell-3,4	total
Machine-A	5	3	8
Machine-D	2	2	4
total	7	5	12

And the operator needs to make the tray service for the subassembly workers. And the trays are as follow.

The operator makes the supply service of machine-A parts (1,2,3,4,5 and 1,2,3) and the parts of machine-D (1.2 and 1,2).
(Other parts; 1,2,3,4,5,6,7,8 and 1,2,3 should be served by the workers of subassembly-1,2 by themselves.)
Now
The trays are prepared 20 each of cell-1,2 and cell-3,4).



The supply carts have 10 trays each. Therefore for cell-1,2 there are 2 carts and 20 trays which means 20 sets of subassembly-1 (or subassembly-2) (as maximum stock). The requirement of the parts production is used the Double-Bin System which is one kind of primitive Kanban system. The rule is quite simple.

When the subassembly worker finished one cart (10 trays), she push back the empty cart to the machine area and pull another cart which should be finished necessary 10 trays of above picture.
Then the machine operator starts the production just for the empty cart.
(About the Double-Bin system, I touch this a little in the chapter of Kanban System.)

Now the Takt Time of the machine process.
The assembly and subassembly processes are “One by One production flow”. However the machine process is batch (lot) production flow and the batch size is 10/lot.
When making the “Stream of Production” this problem which is different speed between the processes is never avoidable.
This company also has the press process and furnace which are required batch production. Toyota also is same. He has assembly process which is “one by one production” and press and furnace processes which are batch production.
The case of this company’s model line, the subassembly and assembly takt time is 9.6 (480min/day ÷ 50). But the takt time of machine process is 96min (9.6 x 10/lot).
And the Standardized Work Combination Table (Man-Machine Diagram) is as follow.

Part No	12345-678910	Standardized Work Combination Table					Production Date	Ago. 14 06'	Quantity: 50 set (10/lot x 5)
Process name; Machining							Dep.	Parts Production	Takt Time: 96min
Pro. No	Work Name; Assembly parts production	Time				Minutes			
		Manu	Auto	Walk	Cum	5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105			
1A	Take out 1material from pallet A and insert.			2"	2"				
	Set-up the tools in M-A and start KE-0025	7'00"	2'00"		7'02"				
	Inspection. Walk to M-D.	5"		2"	7'09"				
1D	Take out 1material from pallet D and insert.								
	Se-up the tool in M-D and start DW-91	7'00"	2'10"		14'09"	Takt Time=96min			
	Inspection. Walk to M-A and pick up KE-0025 and	5"		2"	14'16"				
(1A)	put in Backet and walk put in tray and back M-A.	15"		10"	14'41"				
2A	Set-up the tools in M-A and start KE-005	6'00"	1'30"		20'41"				
(1D)	Inspection. Walk to M-D and pich up DW-91 and	5"		2"	20'48"				
	put in Backet and walk, put in tray and back M-A.	15"		10"	21'13"				
(2A)	Pick up KE-005 and put in Backet and walk, put in tray.	15"		5"	21'33"				
3A	Back to M-A and Take out 1 material from pallet A			5"	21'38"				
	and insert. Set-up the tools in M-A and start DU-F53	7'00"	2'30"		28'38"				
	Inspection. Walk to M-D.	5"		2"	28'45"				
2D	Take out 1 material from pallet D and insert.								
	Set-up the tools in M-D and start DH-52	7'00"	2'30"		35'45"				
(3A)	Inspection. Walk to M-A and pick up DU-F53 and	5"		2"	35'52"				
	put in Backet and walk, put in tray and back M-A.	15"		10"	36'17"				
4A	Take out 1 material from pallet A and insert.								
	Set-up the tool in M-A and start DU-F20	7'00"	1'30"		43'17"				
(2D)	Inspection. Walk to M-D and pick up DH-52 and	5"			43'22"				
	put in Backet and walk, put in tray and back M-A.	15"		10"	43'47"				
(4A)	Pick up DU-20F and put in Backet and walk, put in tray.	15"		5"	44'07"				
5A	Back to M-A and Take out 1 material from pallet A			5"	44'12"				
	and insert. Set-up the tools in M-A and start KJ-00	7'00"	1'00"		51'12"				
	Inspection. Walk to M-D.	5"		2"	51'19"				
3D	Take out 1 material from pallet D and insert.								
	Set-up the tools in M-D and start SK-01	7'00"	3'40"		58'19"				
(5A)	Inspection. Walk to M-A and pich up KJ-00 and	5"		2"	58'26"				
	put in Backet and walk, put in tray and back M-A.	15"		10"	58'51"				
6A	Take out 1 material from pallet A and insert.								
	Set-up the tools in M-A and start RG-91	7'00"	2'40"		65'51"				
(3D)	Inspection. Walk to M-D and pick up SK-1 and	5"		2"	65'58"				
	put in Backet and walk, put in tray and back M-A.	15"		10"	66'23"				
(6A)	Pick up RG-91 and put inBacket and walk, put in tray.	15"		5"	66'43"				
7A	And back to M-A. Take out 1 material from pallet A			5"	66'48"				
	and insert. Set-up the tools in M-A and start DV-F25	7'00"	1'50"		73'48"				
	Inspection. Walk to M-D.	5"		2"	73'55"				
4D	Take out 1 material from pallet D and insert.								
	Set-up the tools in M-D and start FR-50.	7'00"	2'40"		80'55"				
	Inspection. Walk to M-A and pick up RG-91 and	5"		2"	81'02"				
(7A)	put in Backet and walk, put in tray and back M-A.	15"		10"	81'27"				
	Pick up DV-F25 and put in Backet and walk, put in tray.	15"		5"	81'47"				
8A	And back to M-A. Take out 1 material from pallet A			5"	81'52"				
	And set-up the tools in M-A and start KL-30.	7'00"	1'15"		88'52"				
(4D)	Inspection. Walk to M-D and pick up FR-50 and	5"		2"	88'59"				
	put in Backet and walk, put in tray and back M-A.	15"		10"	89'24"				
(8A)	Pick up KL-30 and put in Backet and walk, put in tray.	15"		10"	89'49"				
		87'15"		2'34"			Walking		No machine work
	Net Working Hours/ day: 8hours = 480min						Manual work		
	Takt Time = 480 ÷ 5 (50/10) = 96min						Auto feed		

Takt Time

I wrote the importance of the work with the Takt Time which is

The production rhythm (baton in music). And is the speed how often the product should be produced to meet the customer requirements (the speed of sales). And the calculation form is

Takt Time = Working hours (planned)/day ÷ Necessary (required) production/day.

And I wrote "if" the demand changed.

Please understand if the demand is changed daily or monthly, it is never used the average (for instance monthly average), but should be used the actual demand.

For instance the 3 month forecast is

Next M	2nd	3rd	AV
1000	1200	800	1000

The average is 1.000. And the case of the model line, the demand of next month is 1.000 and the takt time is 9.8 minutes. (1.000 ÷ 20 days = 50/ day. 480 min ÷ 50 = 9.8 min.)

However if the demand is changed to 800, the takt time also is needed to change to 12 minutes.

Of course it is necessary to change the head account of workers.

Subassembly

Net-time; (9.2 + 9.4) 18.6 min. 18.6 ÷ 12 = 1.6 persons.

Assembly

Net-time total assembly; 36.3 min. 36.3 ÷ 12 = 3.0

Therefore 1.6 + 3.0 = 4.6 persons. (There is no exist the 0.6 person. Therefore it is necessary to make Kaizen.)

Conversely if 1.200. Takt time; 1.200 ÷ 20 = 60. 480 ÷ 60 = 8.0 min.

Subassembly; 18.6 ÷ 8.0 = 2.3 persons.

Assembly; 36.3 ÷ 8.0 = 4.5 persons.

(Also it is necessary to make Kaizen in the line balance.)

The important thing is to have the line-formation pattern (for instance, 1.000, 1.200 and 800). And weekly bases it is required to calculate the takt time and adjust the line formation (for avoiding to have inventories and WIP).

And it is essential to have the monthly production plan based on the forecast, but is never sufficient to control the production and is necessary to have the weekly bases production plan also.

After the consideration and calculation and plan of takt time (-1), head account (and line balance; -2,-3), necessary machine capacity (in Standardized Work Chart, Standardized Work Combination Table and Process Capacity Table; -4), the set-up of the line with moving the machines, cells and carts, jig &tools in each locations is made. -5. Layout consideration and move & install machines and cells.--- Omit.

By the way

I found a book which the title is "Lean Thinking" in a used book store and have read. And found the description of the activity of Japanese consultant who made the quick layout change in midnight. To be honest, I felt strange.

Moving machines and temporal layout change are never difficult. And the true

difficulty things are to make the takt time flow in the minimum condition.
A layout change etc. are mere heavy lifting job.

-6. Training and start the line.
Training and confirming the skill are important. And I describe these in next "Variation".
Then I finish the step of the introduction of model line.
Variation
Let us think variations (process variation; variation in production process).
What is variation?
A process variation is one of serious root cause of the failure of "Making stream of production". And the process variation has the internal factor and external in large classification.
Internal factor has the human causes, material causes, mechanical causes, work environment causes. And I wrote these in "Making stream of production-2" as follow.

Another one classification is the causes of the variable condition of factory.

Human causes: Accident, working in out of standard, excess production, production error, production delay, capacity shortage, skill level, absence, corner-cutting and sabotage.

Material causes: Defective, shortage, mixed, supply delay, supply excess.

Machine causes: Break down, frequent stop, functional error, variation of speed, capacity shortage, defective die or tool.

Work environment causes: Variation of air, temperature, humidity, lux, noise, variation of electricity, variation of pressure, stench, dirtiness, danger.

And here I emphasize the importance of the improvement of process capability.
When starting the introduction of TPS, I teach the basic factory management in parallel to reduce the causes of the variations in factory condition.
Let's look the variation of the internal factor.

-1. Quality variation.
For the introduction of TPS, one of worst condition is quality variation. And the causes are "Working in out of standard, production error (mistake), skill level, working condition (inappropriate jigs, tools, machine condition).
For your good understanding I introduce following true story.
I was invited by a company and visited his factory who was implementing the Lean concept in the techniques of TPS and made following conversation with the general manager. (When we were looking the assembly line which was of his pride)

I said "It seems to be very smooth movement, isn't it?

G. Manager. "Yes Kimura-san we achieved the target labour performance planned".

K.K. Very good. Also you have red containers for the defects in individual process.
But all of them are empty which means 0 defect in the processes.
Is it right? How much is the level of defect ratio?

G. Manager. "At present the customer's claim ratio is 1 per 1.000 (0,1%) and

internal defect ratio in the inspection process is 2,5%.

K.K. What?! 0,1% and 2,5% ?! Does it mean nobody pays attention to the quality?

G. Manager. Of course yes Kimura-san. We pay attention to the quality and finding defects in individual process and the inspection. Then we could achieved current level. In the past we had the quality problem more.

K.K. But the red containers are empty. That means the inspection capacity including the methods is insufficient, isn't it?

1) Why the assembly line doesn't stop?
   Why the assembly line isn't stopped in the quality problems occurred?
2) I can't find the tools of self-check inspection.
   Self-check inspection; individual worker is given 2~3 self-check inspection points.
   Self-check inspection should be made by individual worker. However the inspection time should be minimized with simple and convenient gauge and jigs.
   Check list; to record the result of self-check inspection by each worker.
   Simple inspection standard or visual aid; for self-check.
   Poka-Yoke devise; an inspection job doesn't give a value to the products. Therefore ideally the inspection time is 0.
   ANDON; for help call or stop button to stop line when a problem occurred.
   One of strict rule of TPS is "No making defects and no receiving defects". I know that there is no perfect. But it is necessary to make effort to 0 defect.
3) Your line is too smooth which means that the quality is neglected.
   I can't see the minimum effort for the quality in you line.
4) Also when looking your line strictly, workers have allowance in their working time (nobody delay the work).
   They don't need to stop the line even though occurred the job delay.
5) And when looking the work of each worker, there are variations because of the variation of working method.
   For absorbing these working method variations, do you need to allow such working allowance, don't you?
   Why don't you have any working standard which show
   Working method and process, Quality points, Layout (in working table), Working standard time.
   If there is no working standard, it is quite natural to have "Quality problems and working time variations".

-2. Machine variation (variation of machine process)

And we moved to the machine area. And I stopped at a machine which was stopping and the ANDON was in red.

G. Manager "Why are you standing still?

K.K "Why that machine is stopping and what the cause is?"

G. Manager "May be some machine trouble occurred".

K.K "It seems to be yes. Why the maintenance person doesn't come?

Already 3 minutes was past.

And the ANDON shows red sign which means the help call for immediate maintenance, doesn't it?

Please call the maintenance worker to help the operator. And let us stand still until the trouble resolved."

(Eventually the time when the maintenance engineer arrived was 7minutes past after the red light was shown. And ---- minutes were needed to recover the machine furthermore. Why --- ? I couldn't know the exact time spent for recovering the machine.)

1) ANDON; you have ANDON already. But the sensitivity is too dull.
2) TPM (Total Preventive Maintenance) condition; Why don't you implement TPM with operator for preventing machine problems.
   Check list for daily simple maintenance and check by the operator.
   Oiling mark; Identify the daily, weekly monthly oiling by the operator in the machine.
   Sign board for next machine inspection and regular maintenance.
   5S condition; You implement 5S activity, don't you? But the inside of this machine is quite dirt and has many chips.
   Inspection record; Who does set up the tools in machine? Who does inspect the starting quality? Why don't you have the inspection record?

After the plant tour, we made the closing meeting and I questioned.

Please let me know the improvement of Cash-flow, Throughput and LT.

And we confirmed that the labour performance was improved in the factory. But none of Cash-flow, LT and Throughput was improved.

Labour performance was improved in the factory but the Cash-flow, Throughput And LT were not improved. Why?

What is the purpose to seek the Lean manufacturing?

If you like to introduce Lean manufacturing, I recommend you to improve the basic condition which is TQM, TPM and Factory management.

(Soliloquy)

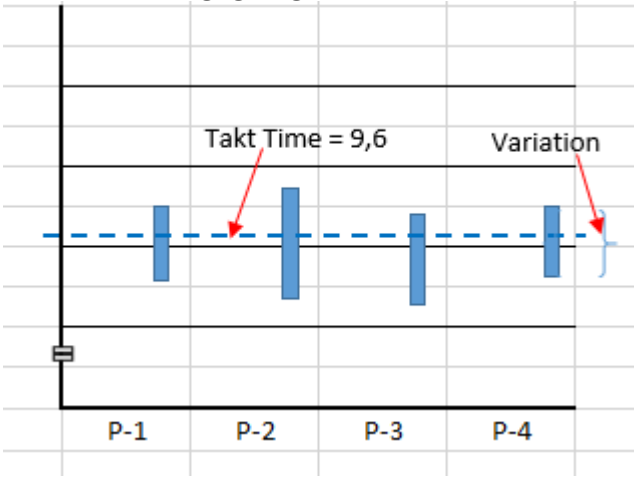
Now Japan is in fall and the season of beautiful singing of insects "lean, lean, lean--- (Imitation sound of singing of insects)."

Saying very easily that "my company seeks lean concept", my company implements

lean, lean, lean. It is never bad thing. But when I look the companies which say that implement lean manufacturing, the thought and the implementation are in half-way. They say Lean very easily like as a fashion.
Lean is one of thought which came from the concept of JIT and hasn't any method.
Then for the implementation of Lean manufacturing, the technique of TPS is used. And TPS requires the basic condition which are TPM (Total Preventive Maintenance), TQM (Total Quality Management. And quality management method like as six sigma whatever.) and Factory Management (including Production Control, 3S concept; CS & ES & SS, Kaizen----.).
General customer is very childlike who says Lean very easily though there is no foundation for the introduction.
The important factor for "Lean" is the flexibility of the company (production line).

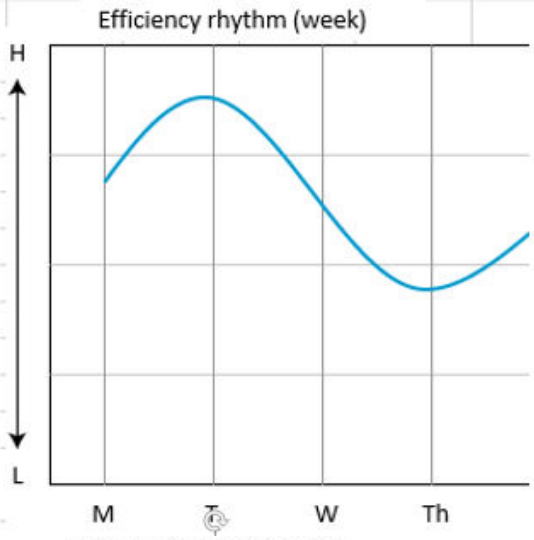
-3. Material variation, work environment variation---- omit.
Anyway it is necessary to minimize the process variation for making stream in sensitive condition.

-4. Working variation.
For considering, going back to the model line of production "7".



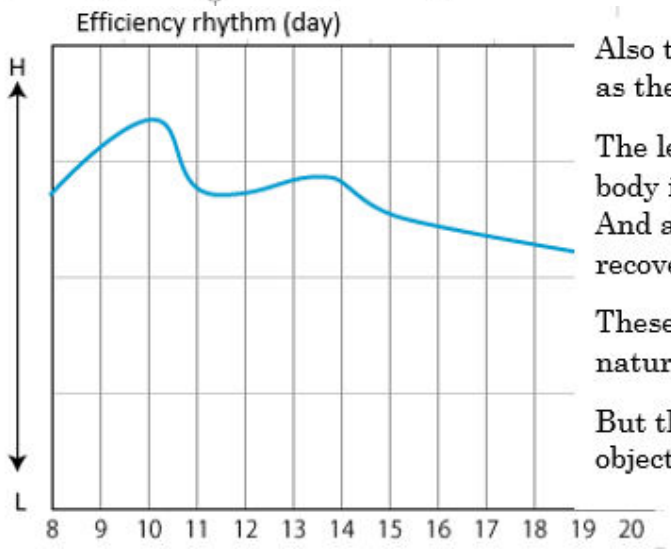
When making the "Time Study, it is necessary to make the graph to understand the variation of each work. The graph on the left is the assembly process in 4 workers cell.

Why does it occur such working time variation? The minimum time of all processes are under the takt time (9,6sec). And if it is possible to reduce the width, it is possible to improve the line efficiency in the proper line balance adjustment. And in this mean, the time variation is one of Kaizen point.
On the other hand if it is difficult to eliminate, it is necessary to have the proper stock (WIP) in the processes as the buffer for the work delay.
Now how can we minimize the working time variation? The working variation has 3 factors. One is work error (in correct procedure). One is physical work delay. And one is no follow the procedure correctly.
For the work error; the countermeasure is training.
Physical work delay; unfortunately there is no countermeasure but.



As you know there is the (physical) efficiency rhythm as follow.

The graph on the left is the image of the work efficiency rhythm in a week.
The level of activities of the mind and body is high in Tuesday and is low in Thursday.
And in Friday a little recover the condition in the expectation of Saturday and Sunday.
There is a physical rhythm in a week.



Also there is the rhythm in a day as the graph on the left.

The level of activities of mind and body is highest in the 10 o'clock.
And after lunch break, a little recover the activity level.

These phenomena are quite natural and never avoidable.

But these also should be the objectives of the line control.

Control the physical phenomena?
No. The meaning of "control" is to consider the phenomena in the line formation. For instance.
When I was the production department manager in SUMITOMO I had very excellent supervisor (woman). She changed and adjusted the line formation which the line had 20~30 assembly workers in the consideration. The contents of adjustment are

Line speed; slow start and 10 o'clock highest speed, at 11 reduce a little
And 14 a little increase. She adjusted the line speed frequently.
(But kept the daily demand)

Change line member (women); if she is in the term of the menses.
It is also quite natural that a woman has additional monthly physical rhythm. And in this term a woman is prone to making work error.
(I hope that this description isn't recognized as a sexual harassment. It is quite true and natural thing as a woman.)

Incidentally this project made the time study at 14 o'clock.

Therefore the net-time (minimum time) was recorded at the medium time zone.

Non follow the work procedure correctly.

For the work variation in work procedure, it is necessary to make 2 things. One is 5S. Another is "Standardization of work" with the "Working Standard". And in the standardization of work, it is possible to minimize.

※And when teaching above minimization of work variation, the supervisor who was a member of this project mentioned his doubt about the possibility of the elimination or minimization of work variation in the model line which the takt time is 9,6min.

I was very glad about his doubt and question.

His thought (or doubt) was

The workers are never robots or machines, but human beings.

Then it is not possible to keep same speed, same movement.

The work of one worker is 9,6min which is too long to describe in one working standard. (Toyota assembly line takt time is about 1min. And it might be possible to describe in one working standard.)

Even though 9,6min working standard is made, who can use this and what is the purpose?

This doubt (and question) is essential to understand the Standardization activity.

And I describe this point in the next description.

External factor of process variation.

The case of defective material or delivery delay which purchase from external supplier

--- omit.

And biggest influence to the process variation is the variation of customer demand which is not avoidable and controllable.

However it is necessary to minimize the influence to the production line.

How can we minimize? And it is necessary to have the method of "Heijunka" which has 2 phases.

One is the Heijunka of necessary capacity for the production.

Another one is the thought of "Heijunka" of the delivery.

I write these detail in the chapter of Heijunka.

Then please understand just the process variation of internal factor in here.

Next I write the product "7" in the model line "8" and Kanban system.