

Making stream of production

-1. The meaning of “making stream of production

Before going to the main theme I would respond to the questions regarding the introduction of TPS which I have issued last time.

1) JIT and Lean Concept.

Lean concept was proposed and expanded world widely by James P Womack who investigated the system of Toyota and found the thought of JIT.

JIT

The meaning of JIT is “Necessary thing in necessary timing and necessary quantity” and has 2 sides.

One is “Produce necessary things in necessary timing and quantity required”.

Another one is “Supply or provide the necessary things to customer in the timing required and quantity required by the customer”.

And it is quite true that the thought of JIT was rewritten to the word of “Lean”.

TPS has 2 phases. These are the philosophy of JIT and the supporting system which are the systems of Kanban and Heijunka, Jidoka----

On the other hand Lean (system) is not the system, but just the thought (of JIT).

When I was in Mexico for supporting the NUMI project and teaching Japanese technique to the Mexican factory of Delphi (at that timing Packard Electric. At 1980s), the group of MIT was surveying the competitiveness of Japanese companies including Toyota. And after the investigation, Professor J.P Womack wrote and introduced the thought of Lean (JIT) concept.

Again TPS and Lean are different. TPS has the systems for achieving the thought of JIT. And Lean has no methods to be possible to call system, but just thought. However the great achievement of J.P Womack which was expanded the thought world widely should be praised.

NUMI: New United Motor Manufacturing, Inc. Joint venture company of Toyota and GM. 1984 ~ 2009).

2) Supply or provide the necessary things to customer in the timing required and the quantity required by the customer.

For example the case of buying a car.

The ideal situation of a customer buying a car is that visiting a car dealer and finding his favourite type and colour and possible to buy.

But if there is no favourite car, he needs to choose one way in 2. One is to buy one in the compromise. Another is to make order and wait the LT of delivery.

The case of Toyota the LT after the order to the dealer is very short days. (In Japan and without the condition of new model car which very high demand at once, producing out of the country and the remote place like as North Pole).

When getting the customer order, the car dealer deals with this with unique ordering number in the same day and sending this on the direct line to Toyota. And the Toyota factory plans the production in the production schedule of Heijunka of next day. And the car production is made with the order number. Therefore if you visit the factory and wish to chase and follow your car with the ordering number, you can see it next day (from the order) in the assembly line even though very unique colour pink. Then you can understand that Toyota starts the production after getting order.

Now here we have one doubt that does Toyota start the production after receiving order in all processes (Manufacturing after receiving order)?

If it is possible to take the style of “Manufacturing start after receiving client’s order” completely, it is ideal.

However the answer is No.

In the first place the Toyota production system also not the style of “manufacturing after receiving order”, but one kind of “make to stock” system.

And it is possible to say that Toyota system uses “make to stock” with modifying the production order (First order First production: first customer demand and first production start.).

Let’s look the case by case.

-The case of export.

As you know the case of export is the complete “make to stock” production.

-The case of new product introduction.

The stock in the car dealer also is possible to be regarded as a stock.

When the new model introduction, it is necessary to manufacture the stock which have no customer demand.

-The case of normal production.

As I wrote last time, TPS never deny MRP, but uses for

Informing the demand to each process (Press, Welding, Coating,
Plastic moulding, Forging, Casting, Machining, Suppliers and Assembly.

For

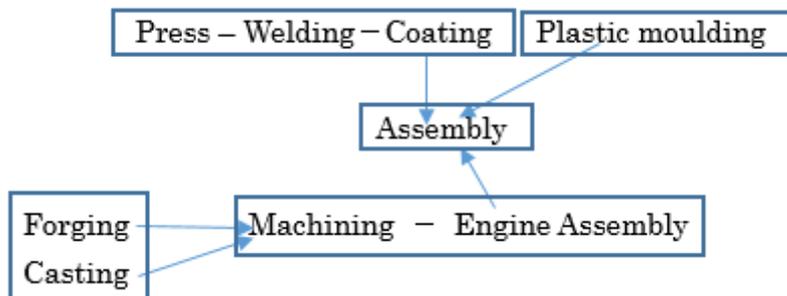
Material preparation, Headcount preparation and

Kanban calculation and preparation.

Now here the important thing is that the MRP information is not the production order to the processes and suppliers. The actual production order is made just by Kanban and is given to just the final process (assembly). Then as you know begins the “pull system”.

Normal production of Toyota also is not the complete “Make-to-order manufacturing”.

The example of car manufacturing process



The customer can chose (for instance) body colour, engine type, auto window, sunroof etc. However the processes of common parts are progressed with no relation to the actual order. (For instance press, welding, forging, casting and other common parts.) And the order of production are arranged in order of the actual receiving order in visual control and kanban as “First order First production”.

How about the supplier who implements TPS.

For instance Sumitomo who supplies the wiring harness to Toyota.

He needs to have the warehouse and minimum stock near the Toyota factory.

The Kanban system also is kept in having stock (but minimized). For instance Toyota also has the process of large press and make the activity of SMED. However the large press process is never the one by one production, but has stock in the Kanban system.

And the style of Make-to-order manufacturing is made in just one piece flow production in the line (assembly line).

3) Chihiro Nakao of Shingijutu?

I was questioned the activity of the consulting firm “Shingijutu”

I know just name because of the “Heroic story” which he made drastic and dramatic demonstration which they changed the lay-out for making the flowing production (stream of production) line by themselves. And yells at the managers if they hesitate

to obey them.

This manner is the tradition since Taiichi Ohno who was insolent and arrogant.

I was educated by Kikuo Suzumura who contributed to the establishment of TPS and first disciple of Taiichi Ohno. And C. Nakao, Y. Iwata etc. were the disciples of K. Suzumura in the Production Research Division in Toyota.

Kikuo Suzumura. My impression was that he was very scary person. He and his group taught us TPS in my company. And one day when visiting the production line with me he found excess work-in-progress which we call “subassembly” and should be 5 but 7 beside of the line. Then he yelled me in anger “Connect these!!” and threw these on the floor.

“Sub assembly” is the cables cut and terminated and assembled in connectors. “Connect these cables cut in its original form” is of course impossible. After yelled at me, he went to the executive room and yelled at my boss (director).

His point is quite right. When introducing the Kanban system which needs to have minimum stock calculated and planned, 5S and 4R are seriously important for visual control and controlling stock. And it was wrong that I had excess work-in-progress. I love TPS.

However I hated and never like the manner of Mr. K. Suzumura and Toyota.

Demonstration in Shingijutsu style.

I heard the heroic story of Shingijutsu style that change the lay-out in not to say whether or not for making one piece production flow (stream of production).

(I heard, but I haven't seen. Therefore following comment is based on the reputation and assumption.)

One piece flow production or small lot production and stream of production are very useful to reduce LT, inventory and work-in-progress and also space dramatically.

-1. It is recommendable if--.

It is recommendable to take the style to show how it is possible to reduce space, stock and LT as a dramatic demonstration if the company has sufficient number of machines (spare machines) to use these in the flowing production line.

-2. It is not recommendable if--.

It is not recommendable to take his style if the company hasn't spare machines, but just high speed (for instance) CNC which is multiplex functions and batch style machine.

I wrote that Toyota makes his own handmade machines which are not full and

multi-functional automatic machine but “cheap”.

Toyota doesn't like to fix machines to use [these](#) effectively. But on the other hand he sacrifices the machine performance for individual flowing production line and cellular line. Therefore the machine should be “cheap”.

On the other hand the general company is accustomed to the batch production with high speed and multi-functional machine. Also he hasn't the experience of the SMED and 100% inspection & guarantee of quality in individual process. In this situation it is impossible to make the style and is very high risk in following 2 reasons.

One is to give up or abandon the introduction of TPS on the way.

Another is more serious and that he has problems of production. In extreme cases, if the machine which is used for the production of many kinds of parts is installed in a cellular line as the exclusive use, he must have troubles for other necessary production.

In fact the situation of most of the companies are in batch and job-shop style production with high speed and automatic & multiple functions machine.

Also most of the companies has no sufficient base of the “Factory Management”. For instance there are cases which they have no even Standard Time system. The companies require us to introduce TPS, but they don't have even policy control, TPM, TQM. This is the actual situation of our clients. (Your clients may be much higher level. But in general--). Of course if the client has no sufficient base, and even though making brilliant demonstration, it is impossible to stabilize the system in the company. I don't know Shingijutu, but I think he teaches TPS for much higher level company which has sufficient capacity of factory management and allowance of machine only.

Now we need to understand that the particular techniques of TPS (for instance Kanban with pull system) are not useful to everything.

TPS was/is not improved for everything cases, but for just the car manufacturing.

And TPS is never almighty.

As a consultant most important capacity and attitude is to identify the most useful method and to recommend to meet to the client's demand and manufacturing condition.

Right now the circumstances of manufacturing industry is not “mass production”, but “high-mix low volume”.

Car manufacturing? Of course this is “mass production”, even though there are many variations in a car model.

Making Stream of Production.

Now we go back to the main theme which is to think the meaning of “making stream of production.

It is quite important and useful for lean which the meaning is to be no managerial MUDA.

Why making the stream of production is important? What is the purpose of making flowing production?

In TPS, Taiichi Ohno taught us that if there is a stagnation, the courses of problem lurk. Another words, a stagnation which are inventory and work-in-progress (from the point of view of materials), waiting (from the point of view of the labour) and information causes serious Muda and the flab in the management.

Also he taught us that “Make the flow of production and lower the water level then it is possible to find more problems”.

For resolving this situation, one of useful method is to make the stream of production with small lot. The visual effects in making the stream of production are

- a) Reduce space, b) Quality improvement, c) LT (Lead Time,
- d) Reduce WIP (Work-in-progress and e) Cash-flow improvement.

a) Reduce space (improve space efficiency).

When looking general factory, the space efficiency is quite low.

A factory uses the space for real production, passage and stockyard (excluding toilet, rest area, compressor room, maintenance room, meeting room---).

Then the space efficiency which is the ratio of production space to total is less than 40% and the real production area is buried in materials and other unnecessary things. We need to recognize that such phenomenon is unusual.

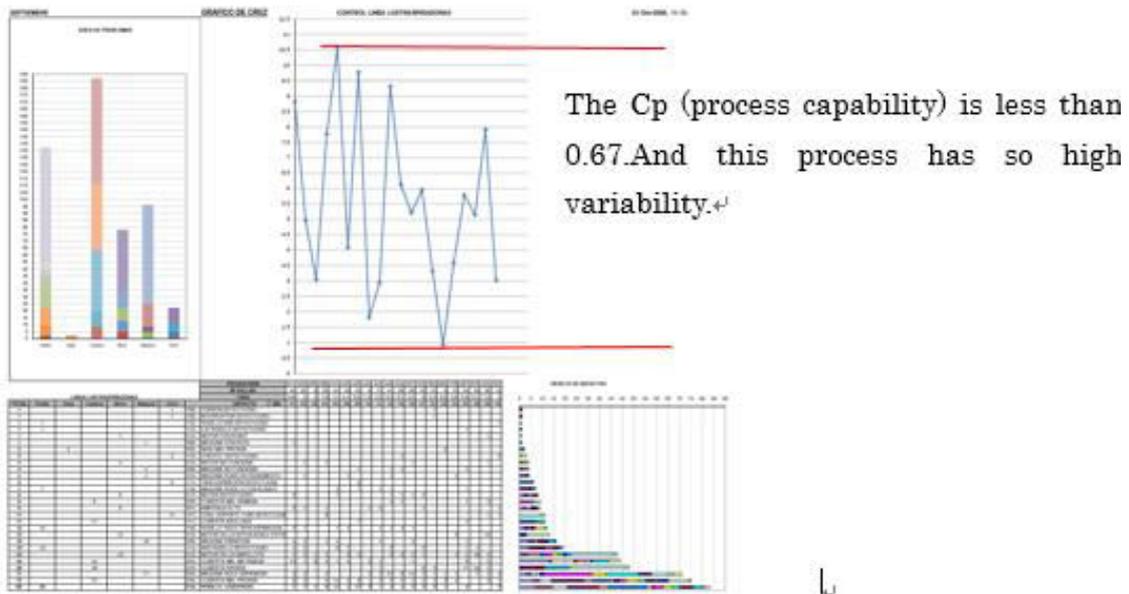
In the column of 5S, which I already shared to you, the first S (Seiri) requires the treatment of unnecessary articles in making the “standard (what’s article and how many should be in the location)”. And with the combination activity of 5S and making flow of production, it is possible to reduce unnecessary things and (as a result) is possible to reduce space dramatically.

The space cost is not the major problem in (for instance) USA in which the land cost is very cheap. But the stagnation like as stock causes other serious problem which is to obstruct the “visual control” and to paralyze the consciousness of risk and kaizen. And it is possible to improve space efficiency in making flow of production dramatically.

b) Quality improvement.

Batch production is easy to become the causes of high defect ratio because the inspection and the feedback also is under batch style. And if we could establish the flowing production system including the inspection with one by one or very small lot production, it is possible to improve the quality because “The quality is in proportion to the speed of the feedback” (QRQC; Quick Response Quality Control). By the way it is possible to reduce space in just making flowing production (and 5S activity). However the effect is never sufficient, but restrict.

Please look at following quality control graph (QC Cross Diagram).



And even though introduce the flowing production system in the line which is so low process capability, the effect of reduction of space is restrictive because the process needs to have the stock to cover the low process capability.

This situation is possible to say for the case of machine capability too.

c) LT (Lead Time)

Making stream of production effects the dramatic improvement of LT.

And when introducing TPS, it is essential to have the target which are (at least) LT, Cash-flow and the (Labour, Machine and material) performance improvement.

As I wrote, I give the importance to the efficiency of LT. Now what is the LT efficiency (LTE)?

$$LTE = (\sum \text{Standard LT of each process}) \times 100 / \text{Actual LT.}$$

d) Reduce WIP

What is the meaning of “Making Stream of Production”? The meanings are to eliminate the stagnation which is WIP and inventory (and to eliminate the waiting

the next job which is also one of the stagnation, but think in separate). And about the “waiting” I already described in the LT.

e) Improve Cash-flow.

I would write any number of times that for the management of a company the important factor is “cash-flow” rather than the figure of surplus in the income statement.

Even though the surplus in income statement, if the shortages of cash, the company bankruptcy occurs. I therefore when the introduction of TPS is intended, I recommend to have the target figure which are the improvement of LT, Cash-flow and Throughput at least.

LT: the concept and the calculation.

I would write LT a little more.

Once again, why is it important to make the stream of production?

In his book (Toyota Production System), Taiichi Ohno described as follow.

Kanban system is one of important means for realize JIT concept.

And making the stream of production is the fundamental condition for introducing the Kanban system.

And another condition for JIT with Kanban system is the Heijunka.

What is the meaning of “Making stream of production”?

The meaning is to eliminate the stagnations of the production.

And the phenomena of the stagnations are WIP, Inventory,

Information stagnation and the situation of Waiting.

Now how can we identify the level of stagnation?

It is (of course) possible to see visibly in the gemba. On the other hand

It should be managed with the index and which is LT.

LT standard is called TE-BAN in the Toyota word. And LT standard is important factor for the Heijunka.

Soon I shall describe the Heijunka in the example case with using the LT standard (Te-ban).

-1. The method of deciding (Te-ban) LT Standard Time

Making standard in Daily work report: For deciding the standard time of LT I teach to record all processes for all orders received. And when recording the time in individual process,

Net time, Preparation time and Allowance time

should be identified. But the LT standard time of the office procedure (processes of receiving order to production planning and ordering production and shipping) are decided in the analysis of the process flow and in reasonable thinking. And the office procedure also should be identified the Net time, Preparation time.

In the preparation time never include

waiting time, verification, collation.

Anyway as in the following example, LT is not long and summarized in 3 points which are

receiving and processing order process,

production and final inspection and shipping.

When you start LTE calculation newly, I recommend to use the indicator LT standard time which is the case of the benchmark products like as a principal product and the result.

The condition of the LTE calculation is that having sufficient machines to the production plan and is possible to produce necessary parts in parallel. But to be used the LT of the critical path.

-2. Actual LT

Average LT of all products from receiving to shipping.

The standard LT is just one benchmarking product (when starting), but the result LT is all products.

-3. Net time

A standard time is consisted of

Net time, Preparation time and Allowance time.

Then in LTE, just Net time should be used because the preparation time also the target of reduction.

The case of a company.

When calculating LTE you can feel so bad managerial efficiency. I show one example case as follow.

The company received an order. The product is constituted of 50 kinds of parts which are produced internal processes of the large press, baking furnace and some machines and of some commercially available parts and of the parts from suppliers which are stocked in the warehouse. After the work in the processes of press and machines, these parts are sub-assembled and assembled in the line. Again this product has total 6 internal processes which are Press, Baking furnace, Machine work, Sub-assembly, Assembly and the Final inspection. And this company has sufficient machine and facility capacity for producing monthly orders.

First of all the sales department got the order of the product, which already has the design, from a client and transferred the production order to the factory. The factory processed the order and planned the production schedule and responded the delivery date to the sales department. Then at this timing the LT has been spent 2 days already.

The order was planned in the production schedule, but needed to wait the production start 10 days because of the current production schedule. And the production was started from the work of the parts in the machining process. And the total production LT was spent one month (30 days) which the contents are Parts preparation in machining process: 22 days, Sub-assembly: 2 days, assembly & final inspection: 2 days and Repair: 4 day. And again the production LT was one month because of the waiting time of collecting all kinds of parts and waiting in each process and also the time for repair after the final inspection. After the production, the products were put in the warehouse temporarily 1 days for waiting the shipping order.

After the shipping order, the products were put in the shipping yard and shipped. So many days and hours were spent for responding the clients. But when looking the net time in following figure, the net time is only 36.5 hours.

Article	Net time	Actual time
Receiving and processing order	3 minutes	2 days
Waiting production start in schedule	0	10 days
Total LT of production in 5 processes	4 days y 4 hours	30 days
Stock in warehouse	0	1 day
Preparation and shipping	30 minutes	4 hours
Total	4 days and 4,5 hours	43 days and 4 hours

Critical path of total production (4 days and 4,5 hours).

-Parts preparation (1 day): 0 minutes of press (just net press time and actually less than 1 minutes which not include the time of Change over). Baking furnace 1 day. (And other parts which are used CNC are less than 1 day).

-Sub-Assembly and Assembly & Inspection: 3 days.

Again the critical path of the production process is Receiving- Press – Parts preparation & Baking furnace – Sus-assembly – Assembly & Inspection - Shipping. On the other hand the actual LT was 43 days and 4 hours (348 hours). And most of the LT is the waiting time.

And the LTE = $(36.5 \times 100) \div 348 = 10.5\%$

Now question. How do you think this situation (10.5%)? Is above case rare and

special?

No, this situation is never rare and special and (the case of the company) was the true story.

And the company planned to improve the index from 10% to 50% (9 days LT in all products) with my teaching and the project as the first step target.

Then I taught to make flowing production in minimum batch size (not targeted one by one production in machine work processes from the first.) and 100% inspection in all processes including the inspection for the parts of the suppliers. This company had a bad disease which is the chronic repair (and had the repair line). Then for keeping the flowing production line I introduced the inspection system which is 100% inspection and guarantee the quality in individual process. The watchword was “Never make defects and never send defects”. The contents of the inspection system are Self-Check inspection, Inspection by next process and Poka-Yoke in individual process.

Self-check inspection and Inspection by next process: Giving the very simple and easy inspection task to individual worker with simple visual aids, defect sample, check jigs and recording sheet (just check mark). Sharing the inspection job to individual.

100% guarantee? Of-course it is never possible, but was possible to reduce WIP (work-in-progress) in each processes and also the “repair” drastically.

Jidoka

By the way TPS is constituted of 2 philosophies, which are JIT and this Jidoka.

The meaning of Jidoka (automatic) is that a machine has the automatic device which is automatic stop when occurred the problem or defect. This concept was expanded to the meaning of 100 % guarantee the quality in individual processes and not give the defects to the next. Therefore in TPS, the inspection is 100% inspection by all processes. Then for keeping this 100% inspection system, automatic stop device in machine, self-check inspection, inspection by next process with simple inspection jigs & tools, automatic inspection device and Poka-Yoke should be implemented.

By the way the LTE percentage is possible to achieve?

This company targeted the LTE 50% as the first step in making flowing production style, SMED, 100% inspection system, Kanban, TQM, TPM (Total Preventive Maintenance), QC Circle, 5S & 4R activity (just internal activity and not including the expansion of the activity to the suppliers) and Factory Management.

So is it possible to achieve the index 100%? No (theoretically) because the preparation time and allowance time are never can be 0.

As I wrote LTE uses the Standard Time which is just Net Time of the process. Once again normally the Standard Time is constituted of Net Time, Preparation Time and Allowance Time.

Net Time: For instance the time of machine working, assembly work from set the material in the machine, switch on, inspection during the work, machine work, switch off, takeout and haulage.

Preparation Time: Preparation of materials, die, jig & tools, cart & pallet, container, drawings, workmanship standard. Set-up of jigs, die. Clean-up of machine.

Allowance Time (total of 3 kinds):

- working allowance (put oil or lubricant, correction of defect, care of jigs & tools, handling of remainder material and shaving & chips, change of cutting device).
- work place allowance (power failure, machine trouble and down, waiting materials and others, short meeting & information, Seiso after the job, training).
- physiological allowance (drinking water, toilet, sweat, ---).
- fatigue allowance (rest in the case of handling heavy article, high heat).

And the Standard Time =

$(\text{Net Time} + \text{Preparation Time}) \times (1 + \text{allowance ratio})$

Allowance ratio is from 13% ~ 25% (depending upon the type of industry and process, the individual allowance are different).

Then Net Time and Allowance Time are normally inevitable (without some case of work place allowance like as power failure, machine trouble, waiting material), but the Preparation Time should be targeted to reduce.

Therefore more than 80~87% is available to target. (in the condition of 100% efficiency, allowance ratio 15%)

Next I wish to write the meaning of making flowing production (stream of production) a little more.

Flowing production with Kanban.

One by one production and Heijunka, Monthly and regular demand (like as car manufacturing), Intermittent demand or small lot demand ---.