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Toyota Production Preparation based on Total TPS (Toyota Production System)

1. Background

I have worked for Toyota Motor Corporation for 30years implementing factory and production line designs, and more broadly in process design and development, not only in Japan but in the Toyota's overseas factories. I provided advisory supports to overseas automobile components factories concerning local purchasing.

I established my own company after retired Toyota Motor Corp. The new business environment gave me a lot of opportunities to visit factories worldwide that have no business relationship with Toyota. I visited factories, diagnosed, provided advisory service, and came to know how different the factories of Toyota and the rest.

We have to seek for quality, productivity, and cost to build factories to win global business competition. My mission is to help you to build a factory that is capable of competing globalization. I strongly believe, what we have to do is to build production lines and shop floor grounded in the ideas of Total Toyota Production System.

I spent so much time and huge effort to introduce and stabilize Total TPS to non-affiliate company of Toyota before and after leaving Toyota. The latest Total TPS is what I have elaborated through my business experience, and I will explain the latest Total TPS to you here.

Productivity and quality of overseas factories is not good, and production cost is high. US are not the exception. There are many factories in the same situation. Integrated engineering of factory and production lines is not sufficient. I did not understand why they made such production lines at the beginning.

First of all, the production lines are entrusted to outside engineering companies without a deep consideration of the manufacturer's internal needs and resources. In other words, factories are not capable of build engineering internally. The outside engineering company does not necessarily consider product quality, cost and productivity requirements--instead, these outside

suppliers may seek to maximize the size of their order. They may feel that if they designed an efficient, short production line, they would receive a smaller total order.

On the other hands, capital investment of manufacturing company increases as well as cost. It conflicts with profit. In this circumstance, the company cannot ensure quality of product, production cost, and productivity.

The company producing products has to take into account product quality, production cost, and productivity in its own. There is implementation of Total TPS remaining after pursuing quality, production cost, and productivity. That is, we need to build production lines and shop floor that have essence of Total TPS incorporated.

Making shop floor of Total TPS is to make shop floor active. We have to build the shop floor possessing the ideas of Total TPS, that is, the education and training of workers and cultivation of active workers. Before mass production starts, building production lines and shop floor based on the ideas of Total TPS. This is the idea of Toyota Production Preparation.

There are companies applying Toyota Production System (TPS) and Lean Production concepts in North America or other countries, but they are only for the improvement activities of shop floor, so-called Genba Kaizen TPS, after mass production started. Of course, this is very important improvement activities. However, the effect of improvement activities is limited since constrained conditions on equipment or facility occur once production lines are activated. Also, there is no activity to make a shop floor of Total TPS production, such as active shop floor, education and training of worker and cultivation of active worker. I learned that TPS or Lead production is used in the very narrow sense.

TPS improvement activity is important at the production phase, but in the preparation phase there is greater opportunity to implement TPS concepts—and it's easier to implement critical TPS elements before start-of-production (SOP). I could say, it is MUDA (waste) to improve after SOP.

There are many books about TPS published, but none of them explain the current TPS-Toyota Production Preparation sufficient enough. I strongly feel the need to explain Toyota Production Preparation this time.

2. Target, goal, and concept of current Total TPS

Factory planning determines quality, production volume, and cost. This is the management. Therefore, it is necessary to build the production lines and the workshop by ourselves, which determines quality, production volume, and cost.

Starting from Production Concept first, then moves to plan the major and significant issues.

In Toyota Production Preparation, the plan for production lines and the workshop is proceed as follows.

<STEP>

(A) Production Concept
(B) Quality management
(C) Process design
(D) Production design
(E) Production and TPS *1
(F) Quickening factory

<Mission and target of each step>

① SE activity (SE activity at the level of TDS)
② Quality
③ Production volume and productivity
④ Cost
⑤ Shorten and assure lead time
⑥ Education and training of human recourse

*[1] TDS: Toyota Development System is development and design of products

From the point of Total-TPS, setting up Production Concept is necessary for the plans of production line and workshop.

(A) Production Concept

The following table is helpful to establish <STEP> and <Mission and target of each step>.

	① Simultaneous engineering	②Quality	③Production volume and Productivity	④Cost	⑤Lead-time	⑥Education and training
(A): Production concept	a-1	a-2	a-3	a-4	a-5	a-6
(B): Quality management	b-1	b-2	b-3	b-4	b-5	b-6
(C): Process design	c-1	c-2	c-3	c-4	c-5	c-6
(D): Production design	d-1	d-2	d-3	d-4	d-5	d-6
(E): Production and TPS	e-1	e-2	e-3	e-4	e-5	e-6
(F): Active working environment	f-1	f-2	f-3	f-4	f-5	f-6

As a consequence of completing the above table, the following things will be achieved.

① Factory plan and production plan become clear.
② Navigation marks of management target are covered.
③ Targets of related parties or departments become clear, then the next activities or practices are cleared.

By implementation of each activity, factory and production lines will have been fully improved before mass production starts and minimize the necessary improvement once the mass production starts.

Next, an actual example of “Toyota Production Preparation: Total TPS “is explained by using the project that Toyota implemented

3. Target

The following targets are set up at the phase of Production Concept.

1) Quality management: Error of accuracy is the half of the previous accuracy. That is to improve the quality double.

2) Production cost in the model cycle: Reduce 30%

3) Production volume: Target is 95% at operation ratio. Responding production of many models, more than 100 kinds, is required.

4) Schedule of production preparation: Make 30% shorter lead time than previous schedule.

4. Procedure

The following is how to implement a certain project at Toyota by Toyota Production Preparation.

More detail procedure is explained below.

<STEP>

(A) Production Concept
(B) Quality management
(C) Process design
(D) Production design
(E) Production and TPS *1
(F) Quickening factory

(A) Production Concept

Production Engineering Div is responsible, but Production Div. needs to support.

①Activity of SE is important at TDS.
Production concept needs to be reflected to the design at the phase of production development.

②Study the existing factories to compare, find causes, and develop measures for the following issues.
1) Quality issues
2) Analysis of production cost or adoption of Total Cost System for total model cycle.
3) Analysis of causal factor to limit operation ratio on production volume.

. 4) Analysis and measures of long pass on production preparation schedule.
5) Improve the weakness of production lines at the existing factories.
6) Feed back the items already improved by Total TPS.

③Quality assurance :
Quality is built in the process. The aim is to develop production lines that can assure quality
④Production cost (in the model cycle) : Calculation and reduction
Reduce amount of capital investment, labor cost, material cost. Consequently, reduce the total production cost of the factory.
⑤Achievement of productivity : Examine and verify at the phase of production design.
⑥Compare production design schedule with the existing factories for the shorter lead time.
The schedule is determined considering the result.

(B) Quality management

Process engineering Dev. is responsible.

Quality is not made by Process engineering div since quality must be built in process in TPS. Process engineering div. builds the process that can assure the quality.

①Quality assurance: The aim is to build the process that assures the quality.
②Quality standard:
Set the quality standard in the each process. The quality check needs to be completed in the each process to assure the quality.

(C) Process design

Process engineering Dev. is responsible.

①Process plan
②Facility/equipment plan
③Facility/equipment maintenance plan
④Quality standard :
Set the quality standard in the each process. The quality needs to be checked and assured in the process.
⑤Equipment to direct production :
Equipment to direct the production needs to be developed since many and various kinds of products, more than 100 kinds, are produced in a single line.

(D) Production design

Production Div. is responsible, but Process engineering Div. needs to support.

①Issues set at the phase of Production design is important.
②Production preparation worked cooperatively by both production Div. and Production engineering Div. is important as well.
③Examine, clear problems, and measures
The phase of production design provides the time for examining, making problems clear, and taking measures before the mass production.
④Goal of Total TPS:

Mass production used to start in the condition that equipment, mold, and jig suppliers just delivered. However, the gold of Total TPS is not achievable in this way.

⑤Test, check, and measures

It is necessary to test, check, and measure if the goal of production concept has been achieved. There are many unexpected problems occurs once mass production starts.

⑥Establish significant issues on TPS:

1) Implement of pilot production (Check quality and measures)
2) Improve workability for placement of parts and for equipment and tools.
3) Plan, measures, and implement of logistics
4) Establish standard work
5) Quality instruction sheet
6) Training and mastering of work
7) Durability test of equipment, check maintainability, and improvement

(E) Production and TPS

Production Div. is responsible.

①Development at this phase is the general TPS or , so called, Lena production.

②Improvement activities after the production starts:

The activity of TPS at this phase is important, and leads to the next step of Quickening factory.

③Feedback to new product

The results of improvement activities are fed back to next new products.

(F) Quickening factory

Education and development of human resource is important, and activity of quickening factory plays an important role for it.

①Activities of quickening factory:

1) QC circle
2) 5S
3) Creativity
4) Small improvement
5) Autonomous study called “Jisyuken”
6) Many skilled workers
7) Technical skill system

The company is quickened by effective use of human resources, that is, improving of human resource and quickening members and workshop.

②Toyota Production System

Previously shown, all the activity below constitutes the Toyota Production Preparation.

(A) Production Concept
(B) Quality management
(C) Process design
(D) Production design
(E) Production and TPS *1
(F) Quickening factory

5. Output

In the project, the result shown below is achieved by developing Toyota Production Preparation.

1) Quality management: Error of accuracy is the half of the previous accuracy, Quality improvement is double.

2) Production cost in the model cycle: Reduce 30%

3) Production volume: Operation ratio is 95% as target.

4) Schedule of production preparation: It made 30% shorter lead time than previous schedule.

5) Equipment to direct production: It became capable that a single line produces more than 100 kinds of various products,

6. Case study

This is the production system that TOYOTA applies at present. Many projects result to show how useful and effective the Total TPS is.

<Summary>

Make factory plan and production line plan by Toyota Production Preparation.

→ Achieve quality and productivity improvement and cost reduction.

<STEP>

(A) Production Concept
(B) Quality management
(C) Process design
(D) Production design
(E) Production and TPS *1
(F) Quickening factory

<Mission and target of each step>

① SE activity (SE activity at the level of TDS)
② Quality
③ Production volume and productivity
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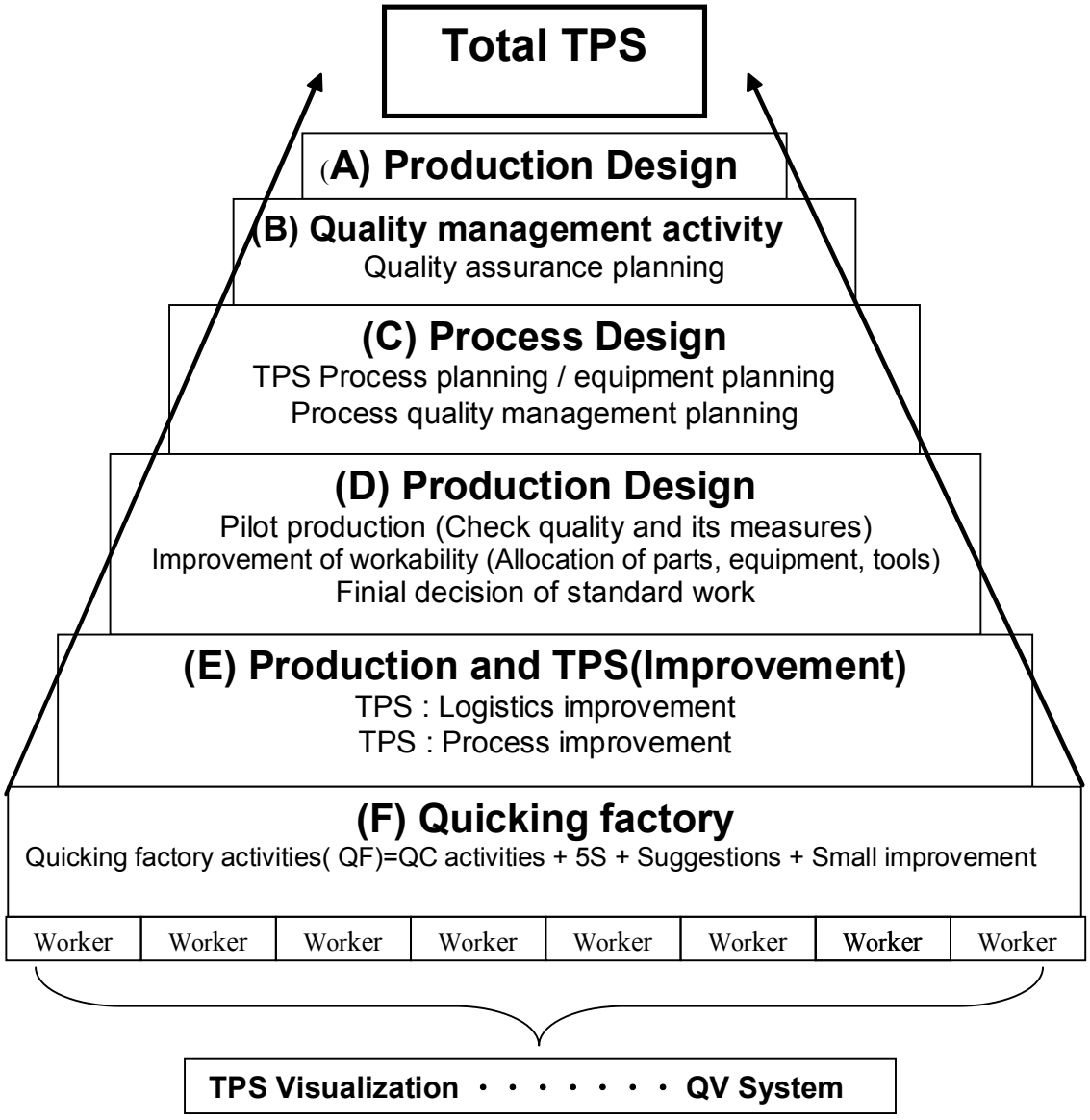
The below is a diagram of Toyota Production Preparation.



Visualization of Toyota is a management tool applied commonly in these activities.

Visualization is fundamental.

<Example of Production design>

The elements of Toyota Production Preparation should be included as much as possible in advance at the phase of Process design and Production design. As a result, the necessary improvement at the start of producing is minimized.

Total TPS

			Objective of activity and planning					Department in charge
			SE activity	Quality	Production Volume	Cost	Schedule	
A	Design	Production planning, including personnel	○	○	○	○	○	Production management
		Plan of internal/external manufacture	○	○	○	○	○	Production engineering planning
		Production process・equipment overall plan	○	○	○	○	○	
		Logistics plan	○	○	○	○	○	
B	Quality management	Overall quality management activity of company	○	○	○	○	○	Production assurance
		Quality into process activity	○	○	○	○	○	Quality management
		Quality management	○	○	○	○	○	
C	Process design	Make quality standard sheet	○	○	○	○	○	Production engineering
		Process planning	○	○	○	○	○	
		Equipment, mold, jig planning	○	○	○	○	○	
		Equipment procurement		○	○	○	○	
		Process development of production lines	○	○	○	○	○	
D	Production design	Process development of production line Build parts shelves Make draft of standard work sheet	○	○	○	○	○	Production
		Build quality into process	○	○	○	○	○	
		Work training	○	○	○	○	○	
		Maintenance planning	○	○	○	○	○	
E	Production and TPS	Daily production	○	○	○	○	○	Production
		Make shop floor active(Quicking factory)	○	○	○	○	○	Quality control
		*Work improvement	○	○	○	○	○	
		*Logistics improvement	○	○	○	○	○	
		Quality improvement	○	○	○	○	○	
		* Existing TPS						

7. Conclusion

①Quality of product improves. Productivity improves. Cost increases.

②Overseas factories of Toyota apply this implementation, which works effectively worldwide.

③Visualization by Oobeya system makes possible clear understanding overall.

This is brief summary of Toyota Production Preparation. There are many books about Total TPS published, but they do not explain the current production system, that is, Toyota Production Preparation, sufficiently. Therefore, I explained what the existing TPS does not cover.

8. TMS

As I explained previously, we start to take an idea of Total TPS from the planning of factory and production line since we should build the factory and production line that minimize or need not improvement once production starts. We need to work on Total TPS wider and more profound from higher perspective. This is the essence of Total TPS I bring forward.

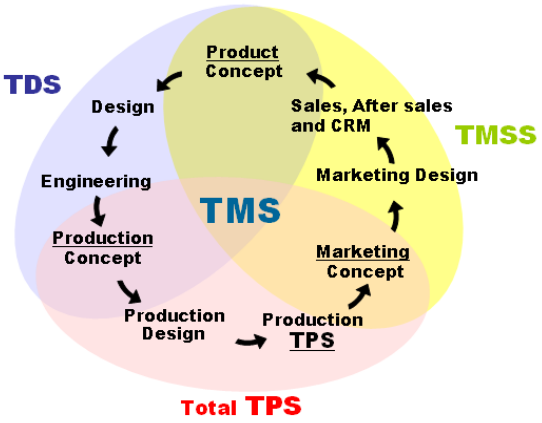
In Toyota, Total TPS becomes widespread not only in production but also in other company's activities. The activities become the management of Toyota in itself.

TMS is a total system of company, and Toyota has developed the management so-called Toyota Management System.

<Overview>

Toyota manages companies in the following way, that is, TMS(Total Management System)

TMS consists of three systems.
(1) TDS: Toyota Development System:
Production development and design
(2) TPS: Toyota Production System:
(3) TMSS: Toyota Marketing and Sales System



MIERUKA is the management tool commonly used in there three systems. MIERUKA is the fundamental of visualization (QV system).

MIERUKA = VISUALIZATION (QV SYSTEM)

This is the method that underlying problems, issues, and target becomes clear, shared, taken measures, and managed as well.

NOTE: Please feel free to contact Toyota Engineering System for further inquiries on TDS and TMSS.