Making stream of production
-8. Making stream of production for “small demand”-2.

Before going to this main theme, I would introduce the question of my students and my answer as usual.
The question was that

If express in short words, what is the activity of “Lean manufacturing”?

And my answer was as below.

The essence of Lean manufacturing is the activity of

Approaching to the customer further on the subjects of
Physical LT and True demand (and reasonable price).

What is JIT concept?

JIT is to make or supply “Necessary things in Necessary timing and in Necessary quantity”. To whom? To the customer.
Who is the main character? The customer is.

Previously I wrote following words

“Kaizen is to approach to the final process.” The final process is the customer.
I was taught this in a conference (I think) of Taiichi Ohno.

And I say that Lean manufacturing is to approach to the customer furthermore.
And as the result of seeking Lean manufacturing, shorter LT, cash-flow and throughput improvement can be gained.
By the way the word of “lean”.

The meaning of “lean” is (as you know) no flab and fat in the body.
And the flab and fat mean the excess inventory and WIP, excess capacity of labour and machine.

As I wrote Lean manufacturing has no system itself, and is just concept. And all of the books of lean quote the system of TPS.
However for seeking lean condition in a company, whether just TPS is the useful system or are there others?
The answer is (of course) “No and there are”.
In the first place TPS is not the multipurpose system or (another word) universal technique, but is able to use just for continuous production (at least to be possible to expect the next demand). And also the companies which implement TPS are very rare and never popular in Japan as well.

Again the system and techniques of TPS are
JIT (Concept), Jidoka (Also concept), Pull system, Making stream, Kanban, Heijunka, One piece or small lot flow, Andon and Visual control, 5Ss & 4R, Takt Time production, Standardization and Standardized work, SMED, Multi-skilled worker, Work in Multi-process by one worker, Cellular production, Full-work system, Mizusumasi, etc.
In above list, the items coloured are unique concept and system as TPS.
(Heijunka system is one of Toyota patent.)

And I teach and help to introduce proper techniques (if the techniques are useful) for the company.
Now I wrote above that to achieve lean manufacturing, TPS is not the only way.

Right then, how the Japanese excellent companies who don't implement TPS do and achieve good performance?
The answer is "Factory Management".
Then I pick up the contents of the factory management as follow.

Policy Control, Target Control, Visual Control, Daily Control, Gemba management, 5Ss &4Rs, Meeting system, Efficiency control, Skill Control, Machine & Equipment management, SMED, Gemba organization, Budget Control, Cost Control, Action plan, KPI, , Production Control (Production, Progress and Shipment, Yamakuzusi & Heijunka), [Purchasing management], Inventory control, Quality control (QC Circle, QC 7 tools, QA-Matrix ,QC Process Chart, QRQC), Kaizen, Breakeven point analysis and throughput, PM, Company magazine, CS &ES & SS, QA (Inspection system, Initial products Quality Control)
Benchmarking, Factory diagnosis, FMEA, Function deployment, ISO, Process designing, Line and Cellular production, Line balance, IE, [MRP, EPR, Subcontract control, Logistic, Sales management].

Above items are the list of my 10 months factory management training course. Excluding [ ] items.

In above list, I position the items **coloured with green** to be the range of "basic factory management".

Again for seeking Lean management, not only TPS, but also Factory management is useful.
So far I explained that "Factory management is the essential base for the establishment of TPS. It is quite true. And if there is no base it is almost impossible to establish the TPS. And Factory management is one of the way to realize the lean situation.
(So far the meaning of lean is to be no flab and fat as a company.)
But "Factory management" is not the tool enough for ultimate lean.
On the other hand it is also true that TPS is not the comprehensive and universal tool which is possible to apply to any type of manufacturing company.
(This point, I already described in the No.-7.)

Now we go back to the main theme.
This project team made 3 ideas for making stream of the product "7". And this was one of key effort for this company. Because this company is a typical "High-mix and Low volume production"
Once again the product "7".

Demand; 13 units and just single order.
Product "7" parts fabrication.
Total 50 kinds of parts.
Commercially available parts; 13 kinds.
Internal manufacturing; 37 kinds.
Large press; 13 kinds. 7 kinds go to Furnace. (And after to inspection.)
6 kinds go to inspection.

After the press process, 7 go to furnace and 6 go to the inspection yard.

Machine A; 11 kinds. 3 kinds to Furnace. (And after to inspection.)
8 kinds (Produce in model line).

3 of 11 are fabricated with the machine A of Parts fabrication area, and go to the furnace.
8 are fabricated with the machine A of the model line.

Machine D; 5 kinds. 5 kinds (Produce in model line).
All 5 are fabricated with the machine D of the model line.

Machine E; 8 kinds. 8 kinds go to Machine D. (And after to inspection.)
All 8 are processed with the machine E, and supplied to the machine D of the parts fabrication area.

Assembly time; 53.8 hours/unit. (The product "8"; 36minutes.)
Assembly in the model line.

And the project team had following 3 difficulties.

1) Setup time reduction of Machine A and D of the model line.
In the model line the machines A and D needed to fabricate for the product "8".
Machine A; 8 parts.
Machine D; 4 parts.
And additionally for the product "7". A; 8 and D; 5.
Therefore as the total.
Machine A; 16 kinds of parts.
Machine D; 9 kinds of parts.
For realizing this, they planned to implement following 2 things.
-1. Changeover time reduction; Current level 7 minutes to 1minute.
-2. Reduction of lot size 10 to 5 (for the product "8").
1 minute changeover was a dramatic challenge.
For producing the parts of the product "7" in the model line it was required to reduce the lot size and to improve the changeover time reduction in SMED activity.
2) Furnace. (Which is the neck and constraint process.)
They needed to find the control method of this neck process for new production stream.
3) The flow production system of other parts (Press, machine E and Furnace of the parts fabrication and entire parts preparation area.) for the concept of "Making Stream of Production".

1). Setup time reduction and lot size reduction in SMED (Single Minutes Exchange Die; Advocated by Shigeo Shingo)
SMED (Single Minutes Exchange Die).
As you understand for making the smooth stream of production, minimizing the lot size is required. Therefore the SMED activity is essential.

This project team also targeted to minimize the lot size

From 7 minutes/changeover to 1 minute and
From 10 sets/lot to 5 (for the product "8").
1set/lot (for the product "7".)
(Don't be dazzled by the "lot size 5 or 1. Because in the parts fabrication, the machine run time is not major problem even though 1 or 5 or 10, and the major issue is the changeover time. )

How they could achieve this difficult hurdle.

Note) SMED

Before going to this theme I describe the activity of SMED.
This is the symbolic name of "Time reduction of changeover (setup)" of the machine and production line.

The process of SMED improvement is as follow.

1. Environmental improvement.
   -1. 5Ss improvement around the machine and jigs & tools preparation area.
   I believe you can understand the necessity.
   (Then I omit the exact description of this item.)
   -2. Utilization of "Production Control Board" of the machine and jigs & tools preparation area.
   Contents of Production Control Board.
   Production schedule, Cycle time, Hourly production schedule, Dfference between the plan and actual.
   Production control board is one of important factor for SMED activity because it is essential to identify the next necessary preparation.
   I describe more detail in the column of "Visual control" in factory management.
   -3. Preparation of ANDON.
   For the visual control and the quick response.
   (Omit. Describe in factory management.)
2. The step of SMED activity.
   -1. Time study and investigation of the current changeover work.
   Work contents, VTR and Time study, Necessary tools and skill in each process.
   One group of my students made the QC Process Chart of Changeover which is quite good idea and recommendable.
   -2. Separate and identify Internal Setup work and External Setup work.
   Internal setup work (Uchi-Dandori in Japanese.): It is necessary to stop the machine for this work.
   External setup work (Soto-Dandori in Japanese): The work should be implemented or is possible to do during the machine work.
   (Uchi; Internal. Soto; External. Dandori; Preparation.)
   Example of external setup.
   Preparation of

Materials, Dies, Jigs & tools, Cart, Pallet, Container, Standard,
Instruction sheet, Drawings, Prior heating of Die,
Pre-Setup tools.

Prepare these in one set.

-3. Standardize the current Internal and External setup work.
In the QC Process Chart and (or) the standard.

-4. Convert the Internal setup work elements to External setup.
Of course above setup example should be converted completely before this step.

-5. Reduction of Internal setup time and External setup with Creating ideas.
Example of Internal setup time reduction.
Abolition of Shim usage, Unification of the Base metal (of die),
Unification of position of bolts holes, One touch bolt,
Reduction of revolution of bolts, Convert bolts to clamp jigs,
Specialized tool, Pre-setup of die,
Reduce the kinds of necessary tools, Common use tools,
Convert crane to Cart (with roller conveyor), Tool cart,
Convert Scale & gauge to abutting tool, Block gauge with scale,
Jigs unitization, Setup by plural operators.

-6. Standardization.
Working standard of the Internal and External setup.
Modification of the QC Process Chart.

-7. Training of the setup work.

-8. Change and reduce the lot size more.

This is the common step of SMED activity. And the base of this activity is also IE (Industrial Engineering) and Kaizen.
Now I say that the activity itself is never difficult. And the most difficult item in the step is “adjustment (fine adjustment)” in the Internal setup time.

Now from here the main subject. How they challenged this difficult hurdle.

Jishu-ken

Do you remember the Jishu-ken which is one kind of Kaizen activity method?
This team also had very high hurdle which seemed to be reckless.
However they could get over this difficulty.
How?

1. Setup (changeover) time reduction.

They made the Jishu-ken 2 times in the week. Normally Jishu-ken is made once in a week from the afternoon of Thursday to endless (at the necessary occasion.).
But they made this at Thursday and Saturday (Saturday is a holiday work.)
They created many kaizen ideas. And one of noteworthy item was

1. Jigs unitization.
Unification of the base metals of the machine A &D.
Based on the unified base metals, the jigs unitization were

made.

Jigs unitization: For processing one part in the machine A or D, it was required to use several jigs.

Then they made the jigs kit in one brock which I say jigs unitization.

And they could convert the jigs setup time which is Internal setup time to External setup time.

This Jigs unitization and unification of base metal are required following new investment and were expensive.

Unification of base metal for all machine A (and D).

Number of same jigs (because of parallel jigs preparation).

For these new investment, and jigs preparation and the unification of base metal which was required the very high accuracy and job role change which it is to convert the job role of jigs fitting by machine operator to the jig & tool store person, the congruence conference of the management team and the project was made.

Then their ideas, new investment and the job role change were accepted.

With the idea of jig unit (jigs unitization) they could realize to reduce 3.2 minutes.

And still there was the gap of 2.8 minutes to the target.

2. Adjustment time reduction.

As I wrote above, one of difficult job of SMED is to eliminate the adjustment rather than the SMED step.

When investigating the contents of 7 minutes

Setup time = 4.2 minutes and

Fine adjustment = 2.8 minutes.

Then the adjustment time (2.8) was targeted to 0 in following step. (with the help of maintenance engineers.)

In Toyota 0 fine adjustment is natural. And in Japan it is said that

Ippatsu Ryouhin.

Ippatsu; Just once time or from the first. (non-trial)

Ryouhin; Non-defective product.

Their activity was.

a) Hearing of the voice of the operator.

According to the machine operator, the most difficult job is the fine adjustment and confirmation of the dimension in the tolerance with the trials.

And if there is the case of out of tolerance, it is necessary to make the fine adjustment with utilization of shim (~0.05mm thickness).

This occasion is not all, but the occurrence to be 30 % (approximately).

b) Machine fine adjustment (help by the maintenance engineer).

- All screws in key points in the machines, re-tighten up and yellow mark.
  (or change).

- Oiling and greasing.
- Distortion check and the correction.
- Check air pressure.
- Inspection of hydraulic pressure.
- Jigs inspection.
- Gear clean up and oiling.
- Inspection of timing belt and change.
- Inspection of electrical system.

Then many efforts were made by the group.

c) 100 pieces trial to confirm the process capability. (In the Thursday Jishu-ken.)

Unfortunately the process capability wasn't improved.

(For this trial, they got the permission of the production of common parts.)

The condition of this trial.

After the fine adjustment of machine A (& D).
Trial 100.
No utilization of the shims.
Use of virgin jigs (inspected).

In this trial 3 defects (out of tolerance) were recorded.

(Machine D also was made above activity as well. But omit the description.)

Of course in this situation, it was not possible to eliminate the fine adjustment work.

Again machine fine adjustment.

They were their wits' end and visited me in the hotel and required my suggestions at the Saturday morning (Their Saturday Jishu-ken).

They had their confidence to resolve the fine adjustment work with the idea of the fine adjustment of the machine A (and D).

However 3 % of dimensional defects were occurred.

Then we went to the factory. And I required them to show the data of 100 pieces trial.

How unwise it was of them not to take the record of the trial!

They checked only whether to be in the tolerance or out of tolerance and didn't record. What a fool they were!

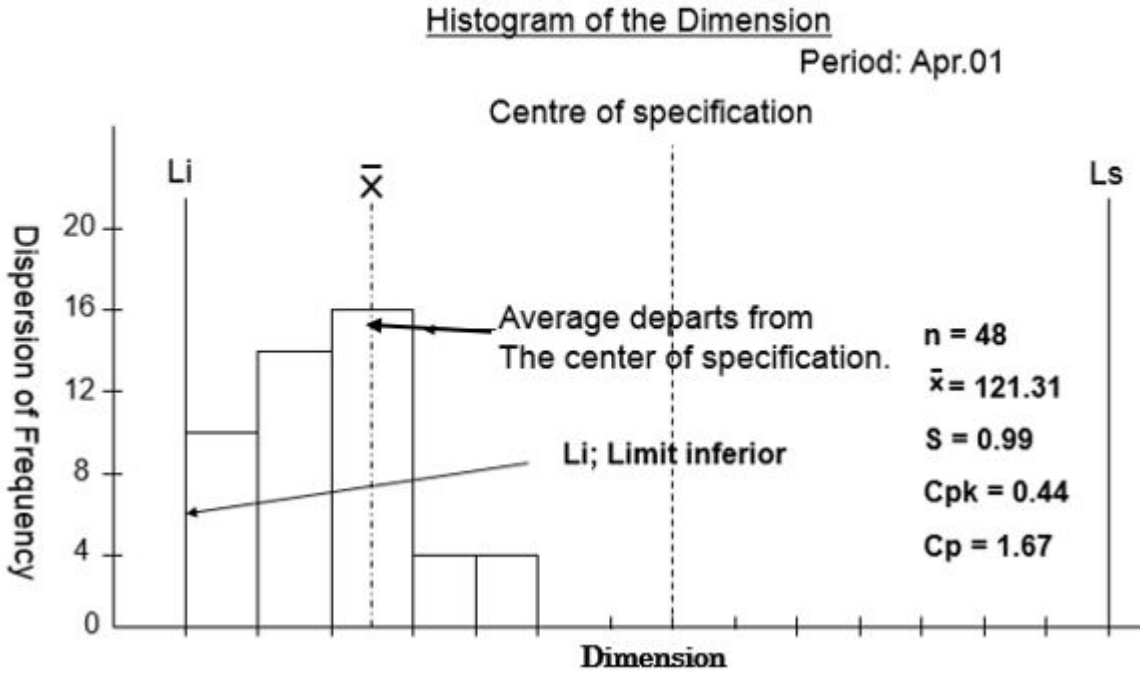
Anyway I required to look for the 100 parts.

As the results of looking for, 48 pieces were remained. (The others had been shipped already.)

Then I required to recheck and record the dimension of 48 parts and to make the Histogram.

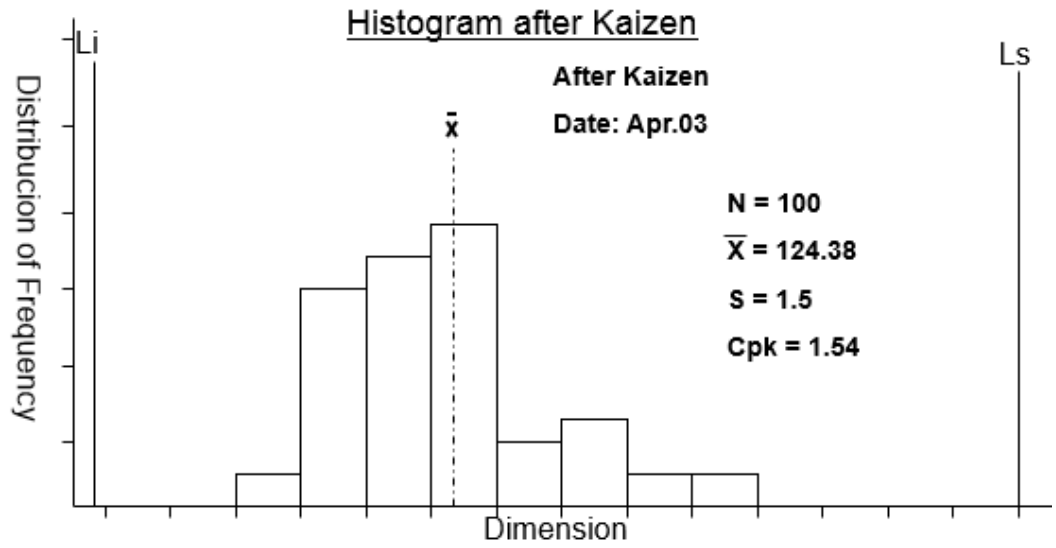
And the Histogram was made as follow.

They made the following histogram and clarified that $\bar{x}$ was far from the center of the specification.
Cp = 1.67 y Cpk = 0.44 is too low reliability.




They made machine fine adjustment. However the defect trouble wasn't caused of the machine accuracy.
Because Cp = 1.69 shows very high and sufficient process capability.
On the other hand Cpk (Katayori process capability) = 0.44 shows very low reliability.
Then they could understand that the causes of dimensional defects were not caused of the machine accuracy, but the central of the $\bar{\bar{x}}$ .
Of course the 48 sampling number is never sufficient to know the Cp and Cpk. But it is possible to look the tendency.
Then the maintenance engineer adjusted the machine and position of the central. And they made additional 100 trial and inspection.
And at this time they never forgot to remain the record. As the result the machine reliability was confirmed with the Histogram as follow.

After the Kaizen activity in Jishu-ken
As the result, the average value of the dimension was 124.38.
And the Cpk was 1.54




In these trials in the troubles and fuss, they could confirmed the possibility of elimination of the fine adjustment work and also confirmed the possibility of 1 minute changeover.
By the way
At present, Histogram is possible to make in Excel.
At the period of educating this company, there was no system in computer.
Several years later.
When teaching QC Circle to a group, the excellent student showed me the histogram calculation in computer.
It was amazing for me. I didn't know Excel well, but just manual calculation and drawing figures.
Following is the example of their histogram analysis. It was very smart.

**Cp de la maquina (prensa).**
**En la investigación de la credibilidad de prensa, escogimos el Cp de diámetro de capuchón.**
**Investigación de Cp en Histograma.--- ago.28.11**

**Actividad en Planta:20-21/9/2011**
**Tema:** Medición de diámetro de Terminal después de prensar

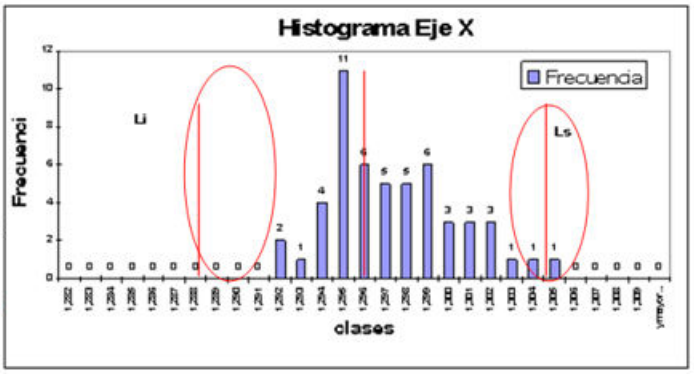
**Descripción:**
1) Se realizó la medición en 70 terminales después del prensado, numeradas anteriormente

2) La segunda medición se realizó en el extremo del capuchón, en total se tomaron 140 valores, 70 por cada eje cartesiano X e Y.

límites determinados por Parker

**Instrumental Utilizado:** Calibre digital Marca Stronger
**Unidad de medida:** pulgada

| | Medida X | Medida Y | |
|---|---|---|---|
| Desvío (δ)= | 0,0030 | 0,0025 | |
| Cp= | 1,1069 | 1,3436 | Cp=(Ls-Li)/6 δ |
| Cpk sup= | 0,8475 | 1,1689 | =(Ls-X)/(3δ) |
| Cpk inf= | 1,3662 | 1,5182 | =(X-Li)/(3δ) |
| Cpk= | 1,3662 | 1,5182 | =((1-k)*(Ls-Li))/(6δ |
| X= | 1,2973 | 1,2963 | Promedio |
| k= | -0,2343 | -0,1300 | =(((Ls+Li)/2)-x)/((L |
| Límite superior = | | 1,305 | Pulgadas |
| Límite inferior = | | 1,285 | Pulgadas |




(Reference: Process capability. From the book of TQM by Kaoru Ishikawa.)

| | Cp or Cpk | LI LS | Judgement of capability | Countermeasure |
|---|---|---|---|---|
| 1 | Cp >= 1.67 | | Too sufficient capability. | Even though there is small variation of production, there is no concern. It is necessary to consider the simplification of control and cost reduction. |
| 2 | 1.67 > Cp >= 1.33 | | Sufficient process capability. | To be ideal condition and to keep the condition. |
| 3 | 1.33 > Cp >= 1.00 | | It is at the limit of necessary capability. But it is not sufficient level. | Keep the control situation in sufficient process control. But if it is closer to 1.00, there is concern of happening defective product. |
| 4 | 1.00 > Cp >= 0.67 | | Lack of cprocess capability. | Defective products is occurring. And all products should be screened. It is required to improve the process control. |
| 5 | 0.67 > Cp | | Too much lack of the process capability. | It is not in the situation of maintain quality. It is necessary to do urgent quality improvement in investigating the causes. And reconsideration of the standards is required. |

I'm writing this description with my old diary and consulting record.
When looking at this diary, I found the record that I was a little ill-tempered at the Saturday Jishu-ken.
Why?

Saturday working? It wasn't major trouble for me, because anyway I worked Saturday and Sunday for making teaching report.
The major reasons of my ill-tempered were following 2 troubles.

-1. No record for the trial.

I very much disappointed that they made the 100 pieces trial with many troubles. However they didn't write any record, but just inspect and select.
When making a trial and test, there is the step as follow.

1) Make clear the purpose of trial.
2) Decide the objects of trial.
3) Consider the trial method.
4) Decide the inspection and evaluation points.
5) Decide the recording items. (Trial conditions; speed, air pressure, use virgin jigs, same materials, same work process, ----)
6) Consider the evaluation method. Such consideration behavior was needed. 6Sigma? Taguchi method? In such simple case it is no necessary, but a little consideration behavior was required.

-2. The level of the Quality department manager.

In this Saturday Jishu-ken, the quality department manager who was advertised as the certificate holder of 6 Sigma also attended to help to this project group.
Amazing! It was indeed amazing that he couldn't use the method of Histogram. He couldn't calculate sigma (s or σ), Cp and Cpk also couldn't draw the histogram.

With these happening, I very much disappointed and felt the frustration.
Anyway they could clear one of hurdle which was the mixed parts production in the parts fabrication area of the model line and

1 minute changeover; 4.2 minutes setup time to 1. 2.8 fine adjustment to 0.
Lot size reduction 10 sets/lot to 5.

Now as you understand as SMED activity, the most difficult job is not "so-called SMED process", but is

Environmental improvement and
Elimination of fine-adjustment work with machine improvement ("Ippatsu Ryouhin in Japanese").

(So-called SMED activity process is mere creation of kaizen ideas which there are examples and patterns.)
Then they could clear the one of difficult hurdle.
But they had no allowance to soak in the pleasure and had to challenge to the next hurdle which is Furnace. (Which is the neck and constraint process.).
But before going to the story of next hurdle, I would introduce the situation at that time of the model line "8", which still had quality problem.

Quality problem and Toyota DNA.
Still this model line hadn't brought up one of Toyota DNA which is "Quick response and Kaizen".
Quality problems (Process reliability) in the model line.

I have written before that the model line establishment was succeeded by this project. But actually the situation was still in middle of the way.
The biggest problem was the quality and particularly in the machine (parts preparation) process. And the result of this weak point caused following problems.

Repair of finished goods.
Defect parts disposals.
Difficulty of WIP level reduction (parts WIP; maximum 20 to 5 sets targeted.)
Overtime work of machine process operator and line workers.

At the night of this Saturday, I and Chris (Wilkins. President) made a dinner and made following conversation.

C.W; Very sorry but very much appreciate for your Saturday work.
And how was the Jishu-ken today?

K.K; It was good. However there were some problems which I was discouraged.
------ omit.
Chris, very frankly I tell you. The model line is still in middle of the way.

C.W; Middle of the way? Still middle of the way?
What is insufficient?

K.K; The lack of Toyota DNA. Still we couldn't have brought up the DNA yet.
Chris, as you aware they have one difficulty (except the issues of changeover reduction, furnace and creation of new system), which is the custom of "Quick response and Kaizen" which I call one of Toyota DNA.
This model line has the illness which is the lack of process capability in poor quality.
Chris. If you were the member of this project, how you could solve the quality problem?

C.W; 6 Sigma! Yes Kimura-san I wish to suggest this activity.
Is it possible to help for the project?

K.K; (With wry smile) it is good idea. But I have a better idea.
I recommend you to make the activity of QRQC (Quick Response Quality Control).

C.W; QRQC? I haven't heard it. Is this better than 6 Sigma?

K.K; For problem solving in gemba, of course the activities of QC Circle, 6 Sigma are very useful. There is no doubt.
However for problem solving QRQC is the best activity and approach in a production process. Again it is the best.

C.W; Why Quick Response Quality Control is the best?
Why better than 6 Sigma?

K.K; Please don't misunderstand, and I like both of them and think that these are important.
But these have 2 flaws which are the speed and the effect.
The improvement of quality problems in 6 Sigma is (of course) based on "Statistical data". As you know DMAIC.

D; Define: Define the target theme.
M; Measure: Collection of data and focus on the theme.

A; Analyze: Investigate the relation of the results expected and causes.

I; Improve: Create the countermeasure ideas.
Study the countermeasures from the point of view of engineering. Confirm the effect in the experiments.

C; Control: Introduction of countermeasures confirmed in the actual process. And.
Clarify the next items which should be resolved.

Chris.

This is the step of 6 Sigma and is one kind of "project management and education system". And the process is (the expression is different, but) same to "QC Story" in QC Circle (of TQM).

And 6 Sigma activity is like as very large scale QC Circle with project.

Anyway both of them are based on the "Statistical data".

I never deny and know the importance of "Statistical data" for quality improvement.

However 6 Sigma or QC Circle whatever, quality improvement based on the statistical data has 2 defects.

One is the speed. If in Toyota line and quality problems (for instance), the managers, supervisors and staffs gather in the gemba immediately and analyze and find temporary countermeasure and (in same day) implement the final solutions. And most of the case this immediate action is possible because of the "better phenomenon analysis". Occurred a quality problem and very fresh data can realize the corrective and certain action.

On the other hand the statistical data approach.

Chris.

When looking the quality control graph, the major quality problem of this model line is dimension defect and occurred 9 at the last week. These were categorized in "Dimension defect".

And as you know, a quality text book says that

"If gain the true causes of the defect, it is easy and possible to resolve". Therefore it is important to seek "true causes".

This story is a "lie" because anybody can't know the true causes", but make mere assumption.

Have you a staff who has a magic wand like as Harry Potter or time machine like as Back to the Future (of old US movie) to look at the past time when occurred the problem? Of course no.

The cause based on the statistical data is not the true cause, but mere "assumption and sum".

C.W; I understand the speed of Toyota style. But still I don't understand the true cause which is mere assumption.

K.K; For instance at the last week 9 dimension defect were occurred.
Probably some would be resolved in the fine-adjustment of machines in the Jishu-ken. And probably some would be not.

Chris. 9 defects were categorized in one cause of defective products.
However the true causes or (another word) the condition of individual defect case were different.

Kind of parts, jig, fitting condition, machine speed, oiling, greasing, variation of air or oil pressure, variation of voltage -----.

Any product condition is different.
Therefore one of important factor for improving quality is to minimize these variation of condition (without the parts of products.)
Different condition but one assumption of cause, it is ridiculous.

C.W; Perhaps I understand. But is 6 Sigma approach no effective?

K.K; I never deny the effect of the approach. Never.
But Chris.
6 Sigma approach which is one of project management should be used for company's wide and total company activity.
And again one of issue is the speed to resolve the problem. Also one of purpose to the activity of QRQC is to bring up the culture of quick problem solving (Toyota DNA).
I would recommend to stop the re-start of the line until resolving problems.
Do you know the approach of 5 Whys, don't you?
Why, Why, Why----- to seek the true cause (exactly seeking better assumption of the cause). Taiichi Ohno also recommended this.
In any case, better assumption of the cause of defect occurred should be sought.
However 5 Whys also isn't adopted for plural causes of defective product, but for just one occasion.
(In the classification of "Dimension defect", there are many different condition and cause.) The problem is the speed. We don't have time to establish additional project.

C.W; I understand and then you recommendation is to make the Toyota style kaizen approach in QRQC. Yes?

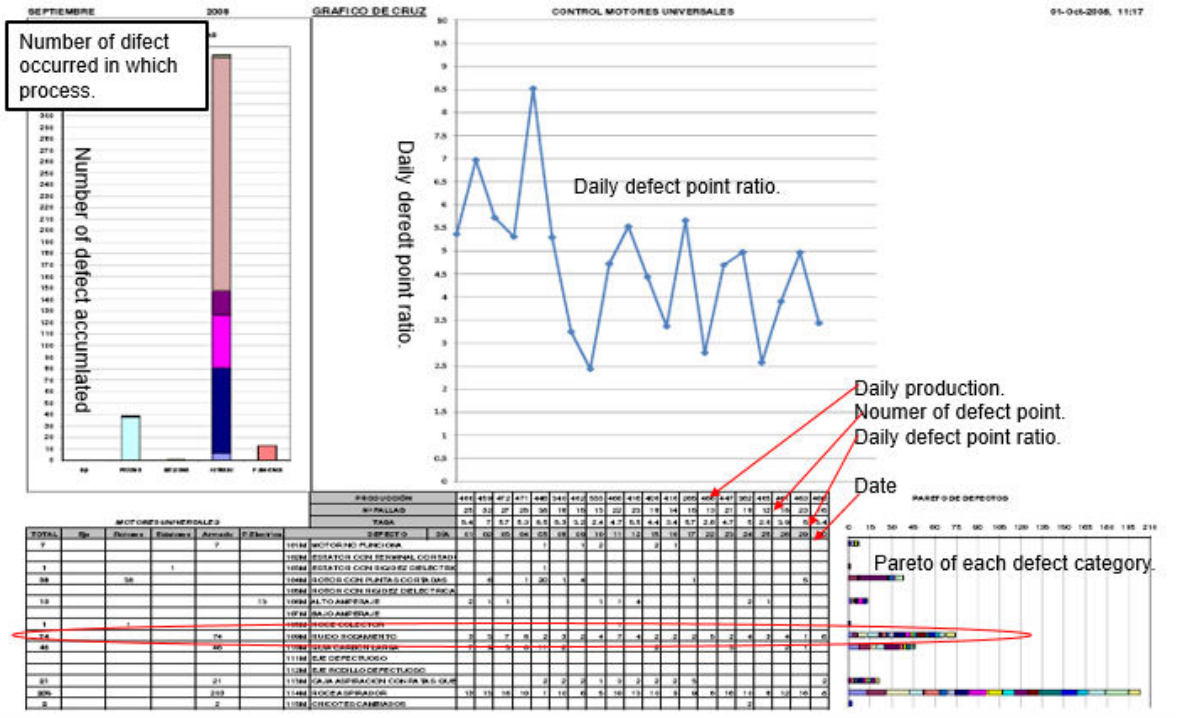
K.K; "Right". And I need your assistance.
I would make the training of QRQC in the model line. And the purpose of this training is not only the improvement of quality of the model line, but also to bring up the culture of Toyota Kaizen (quick response).
Would you please suggest to the engineering manager and quality assurance manager and also the staffs to gather immediately in the gemba when a quality problem is occurred.
And I also explain the importance to them.

C.W; OK, I do this at the next Monday.

Additional explanation of QRQC.
Statistical data is important. However it is quite or almost difficult to seek the true cause from this.
Because nobody can go back to the moment when occurred the problem and look at.
And the key factor is how we could gain the good assumption in the fresh information.

Following graph which I made and call “Quality Cross graph”.
This graph form is very excellent for quality control and shows “daily defect ratio, what kind of defect classified, and in where”.
I teach this graph in Factory management course.
This graph is made based on the statistical data. And is used in the daily quality control and QC Circle.

## Cross Graph




For instance the defect category of above red circle shows the occurrence of the deformation defects. But as you aware, individual defect cause is in the different condition. And therefore it is almost impossible to seek the individual true cause.

The conflict.
In the weekly management meeting, the president explained and instructed to attend QRQC activity to the relevant managers. Also I made the presentation of Toyota style quick kaizen and QRQC activity.
Then the first chance of QRQC implementation was happened at the Wednesday afternoon.
The engineering manager and staffs and maintenance engineer gathered immediately and confirmed the fresh assumption and the countermeasures.

Note)
One person took the record.
One person checked the time required (which was 29 minutes.)
(29 minutes. It was passable workmanship as the first try.)

(Unfortunately the quality manager didn't attend in the activity.)
I went to the office of the quality manager and questioned why did not attend.
I reproduce the conversation with the quality manager.

The quality manager; Andrew S.

K.K; Hi! Andrew. What was the problem? And why not attended to the gemba meeting?

A.S; Sorry Kimura-san. But I was so busy for my job.

K.K; Andrew what is your job?

A.S; Of course improve quality and stabilize.

K.K; It is good. And I could confirm your final purpose which is the improvement Quality and process capability.
And simply the approach methods of mine and yours are different.
Am I right?

A.S; Yes Kimura-san. And I wish to implement 6 Sigma in this company and therefore I'm here.
I desire to resolve the quality problems in 6 Sigma and apply one project.

K.K; I see. But however you do 6 Sigma, you must know the situation of gemba. Right?

A.S; Of course yes and I'm doing and I can know the gemba like a book.
Look at Kimura-san these data in my computer, I gather the daily data which are the base of the 6 Sigma activity.

K.K; Is it true that you can grasp the condition of the gemba?
For instance this afternoon one of dimension defect occurred.
How do you think what was the causes?
In your computer is there the information of true cause?

A.S; No Kimura-san I have not the exact data, but I can assume by the past experience. Generally the causes of dimension defect are
Setup mistake, loose of machine or jig ----.
And it is possible to make the assumption in the activity of "fish bone diagram".

K.K; Andrew. Fish-bone-Diagram is used to analyze for one characteristic and not use for plural.
But anyway how do you think what was the true cause assumed?
Note) Dimension defect has plural characteristics.

A.S; I don't know. But again it is possible to seek the true cause, but is necessary more time.

K.K; Andrew. How much hours do you need to seek the assumption for taking immediate action? The line is alive and moving. It is necessary to take very quick action. The management team decided that up to find the true cause assumption, we can't run the line.
The true cause assumption was the jig which doesn't exist in you assumptions.

A.S; Jigs? Defective jigs?

K.K; No not really.
The jig's long is short. And the operator mistook the adjustment.

A.S; Then it was the setup mistake as I listed up.
And to solve the setup mistake the taking actions are 2.
One is the self-inspection as you taught us.
Another one is re-training of the operator.

Note) At this time the production system of the machine was already changed as follow.

1) Jig preparation is obliged to the jig & tool store.
2) Fine adjustment by the operators was abolished.
(But first product inspection by the operator was implemented as usual.)

K.K; That's right. The operator missed to find the dimension defect also.
But why he couldn't find the defect?
Also why he made the setup mistake?
And the true cause assumption is different and was the mistake of the jigs preparation area (jig & tool store).
I believe you also got the training of 5 Whys in the 6 Sigma certification course.
Then Andrew.
For instance how is the 5 Why analysis of the "setup" mistake?
6 Sigma whatever requires the solution of individual cause. Yes?

A.S; Of course I got the training of 5 Whys. And it is required to resolve individual defect cause.

K.K; So, what is your 5 Whys construction for the "Setup" mistake which is related to the job of the jig & tool store?

AS; Well ---. But I need more time.

K.K; Andrew. Please understand. The line is waiting the solution.
In the 6 Sigma course, TPS and its Toyota style quick kaizen also you were taught (I believe).
And the 5 Whys analysis by the group and engineers was.
Theme: "Dimension defect" was occurred.
-First why: Setup mistake. The operator made the setup jig in dimension wrongly.
-Second why: Why the jig was fitted wrongly?
The re-used jig wasn't corrected.

Note) In this company the reuse of jigs was implemented as one of cost reduction activity. And the jigs were classified in 2 (Virgin and reuse.).
Receiving inspection of the new precise jigs and record.
Re-inspection after 1,000 times use and "correction" and record.
Then the person of this area didn't the necessary "correction".
-Third why: Why the person didn't make the necessary correction?
Actually the jig supplied to the line was needed the correction.
But he put the jig which was required the correction in the correction finished jig box.

Note) In the Jigs preparation area, 5Ss activity was implemented.
-Fourth why: Why he put in the correction finished box?

Because there were so many jigs which were waiting the inspection than the capacity of inspection tool and labor capacity.
And the waiting jigs overflowed from the box.
Also the boxes were same color (no color code control)

-Fifth why: Why occurred the shortages of inspection tool and labor capacity?
The designated person who can make the inspection and correction had concurrently other job as a jigs store keeper.
Then he made the inspection and correction jobs in batch.

Then Andrew.
They made the temporally and immediate action and permanent solution based on this root cause analysis.
Of course the inspection mistake by the operator and the countermeasures also were discussed in the 5Whys.
I suggest you to attend the QRQC activity.
For the introduction and stabilization of Lean manufacturing in TPS, the cultivation of Toyota DNA is inevitable.

After this conversation.
He proposed the 6 Sigma project in the weekly management team meeting. But it was rejected because of the difficulty of the dispersion of labor resources.
By the way the countermeasures implemented were.

1) Self-check inspection by subassembly worker.
   Machine operator first product self-inspection is as usual.
   Additional self-inspection by the subassembly worker but different and limited point.
2) Jigs preparation area (jig & tool store)
   1. Box color coded.
   2. Special occupation of the inspection and correction. 1 person.
   3. Batch to one by one.

After the rejection of the proposal (6 Sigma project), the quality manager left from the company. And temporarily the engineering manager held the post concurrently.
Again I have never denied and never deny the importance of 6 Sigma approach which is one kind of companywide project management method and education method to increase the population of DMAIC in a company.
However for one by one solution, quick and certain solution and also cultivate the Gemba-ryoku, QRQC and Toyota style kaizen are effective.
The quality manager intended to resolve the problems dramatically in the project activity.
But it does not go so well in a general company.

When I studied 6 Sigma, I have read the success stories which were introduced in the books. The companies of the success stories have (at least) the factory management capacity.

And the general companies who have not sufficient factory management capacity yet can't implement and stabilize 6 Sigma.
And even though it is implemented by the general company, the effects are restrictive and in the worst case, the new system introduced dies.

The effect of project
It was very sorry that the quality manager left the company.
And once again I introduce my consulting style and refer the effect of project activity.
When coaching an industrial company, I make 3 activities in same timing.

1. Project activity.
   As I'm introducing the case of the company, I led a project for introducing TPS.
   Of course the purpose of this activity is to realize an innovative improvement.
2. Management team.
   The purpose is to improve and stabilize the management style of excellent company and formalize the "kata" of management.
3. Kaizen committee activity in gemba.
   For establishing the custom of "Whole peoples participation (to management)".
   And to stabilize the Gemba Ryoku (in Japanese) which I call autonomous nerve.
   Kaizen Committee (Safety committee, QC Circle, Suggestion Scheme) is one of important activity for bringing up the gemba ryoku.

What is Gemba Ryoku "autonomic nerve" of gemba?

Gemba; (For instance) the place in which actual activity is (or was) made.

Ryoku; Power, Force.

Keep discipline, Keep standard and rule,
Feel an abnormality (irregularity, muri, mura, muda) as abnormality),
Find the abnormality and Kaizen,
Find hard work and difficulty and Kaizen,
Have an aim and pleasure in a company's life.

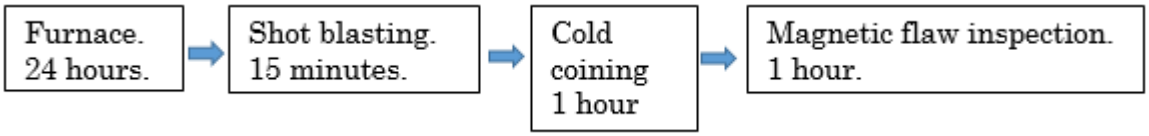
(I will refer Gemba-Ryoku in the Factory Management more exactly.)

Japanese project and European project.
As I wrote I never deny 6 Sigma. And I prefer to use it if it is suitable for the clients. However I don't teach just 6 Sigma which is one kind of the method of project management and education, but teach the management capacity improvement and Gemba Ryoku improvement as one set.

(Simply general talk) When looking at the European and US companies, for innovative activity they tend to use just the project activity.
In Japanese case, it is a little different.

To realize the innovative improvement, Japanese company also use the method of project activity. But Japanese companies pay the effort to not only the project activity, but also to the gemba autonomous.
This point is different and becomes from the difference of corporate culture.
Whole peoples participation. It might be one kind Japanese corporate culture.
On the other hand, I feel one of difficulty which is to change the mind of managerial class people which wish the instantaneous effect.
Project. It is the discontinuous activity.
Autonomous nerve, Kaizen (continuous improvement or endless improvement activity) mind are continuous.
The effect of a project is transferred to the gemba. And the gemba needs to use and realize and maintain the project effect. Therefore the continuous Gemba Ryoku improvement is essential.
The quality manager was a typical European manager and couldn't understand this point.

We go back to the main theme.
2). Furnace. (Which is the neck and constraint process.)
They needed to find the control method of this neck process for new production stream.
Simply let's look at the process of furnace.
10 kinds of parts.
After press; 7 kinds. After the machine A; 3.
These are supplied after the press process and the machine A to the furnace process.
And the process of furnace is as follow. (Hours are LT.)




And the situation of this process was chaotic because of the following reasons.
1. Complete batch production. (24 hours in furnace.)
2. Unknown the priority.

For finding solutions, they made Jishu-ken.
But again they were at a loss. Then they conceived to find the solution in the book of "Theory Of Constraint" and read this during one night.
(Wry smile. Again TOC!?)
And they found in the novel that the constraint process should be controlled.
But there was no answer how to control the constraint process in the novel.
Should the constraint process be controlled?
It is quite commonplace! (As one of usual process.)
But how?
Do you remember "Te-Ban" (LT; Lead Time).
Te-Ban and visual control are the key.
And again and again, they came my hotel at the end of their wits.

I will write the solutions of control the bottle neck next.