

Making stream of production

-3. About TOC.

I'm writing TPS from the point of view of the "Making stream of production" in my experience. And I continue to describe the case of the company and the product "7".

Before going to the theme I would introduce very interesting question and my answer.

I got a question and was required to make a comment about TOC (Theory of Constraint) from my student. He told his point of view regarding the KPI (key performance index) which I described in "the Way of TPS" and said that these KPIs promote "the best in part (Optimum in part)" rather than "the best in entire (Optimum in entire)". Why? Why this student thinks that KPI promotes "the best in part"? Initially I couldn't understand the meaning of the student's opinion. Then when we made the regular TV conference, I confirmed his opinion and could understand his misunderstanding.

KPI promotes "Optimum in entire"?

His opinion came from the book of "The Goal" written by Eliyahu M. Goldratt who is the proposer of TOC (Theory of Constraint).

In the book there seems to be a story that the hero had the troubles which is caused with the method of evaluation of factory and had the conflict to the company headquarter.

I don't know this book and made the assumption (of the company written in "The Goal") based on the student's word as follow.

- 1) The factory of this hero (the factory manager) is red (unprofitable).
- 2) The Headquarter accused him of the insufficient performance improvement such "cost reduction, machine performance, labour efficiency ---".
- 3) The Headquarter believes that the red are caused with the insufficient individual performance improvement.
- 4) He makes efforts to improve the performance. But on the other hand he had the problems of inventory increase, long LT, delivery delay (even though having many stock).

And the book tells (or the student believed) that the evaluation of a factory by the KPI promotes the "best in part" and prevent "the best in entire" (and as the result, increase of inventory, worsen of LT and cash-flow).

And my response to him is as follow.

- 1) KPI is never the index of “evaluation of factory” but index of factory management.

Index of evaluation of factory is “Safety, profit/loss, LTE and cash-flow”. (And if there are indexes of business continuity such CS, ES, SS)

CS; Customer’s satisfaction, ES; Employee’s satisfaction,  
SS; Society’s satisfaction.

- 2) KPI is the tool of

-1. Factory control.

For instance it is necessary to make the Monthly Production planning. (Even the company who implement TPS, monthly production planning is essential for controlling the factory.)

-2. KPI is a tool of “Target control”.

I studied and know (probably) well the TOC (Theory of constraint) and was introduced by the book namely TOC Revolution written (or introduced) by Kimio Inagaki (President of Jabil Circuit Japan) 17 years ago.

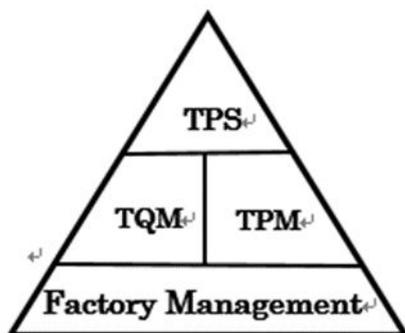
As you know TOC has 2 phases which are

- 1) One is the technique of production control for resolving the production problem in finding the bottle neck (condition of constraint) and optimizing throughput.
- 2) Another is “thinking process”.

(The point of this student is the technique of production control.)

And I believe that TOC never deny the importance of Basic Factory Management including the cost reduction activity.

As I have written, the issue of “the best in part or the best in entire” is the theme of factory management. Do you remember following picture.



And said TPS also one of technique. And the issue of “the best in part or the best in entire” is not the range of TPS, but the range of factory management.

TOC also same. For the implementation of TOC, factory management is essential. And “part or entire” is not the range of TOC, but the factory management.

A little more let us look the student’s saying.

Improved performance (for instance labour efficiency or machine out-put) increase, but increased the inventory? Why?

The cause is very clear and easy. The hero made unnecessary production to improve the tinsel efficiency. How?

As you understand if making very large batch which is (for instance) preempted the next month order (which is uncertain), it is possible to reduce the changeover time and changeover scrap and as the result the tinsel performance improves. But in the reaction, the inventory, work-in-progress and LT increase and worsen the cash-flow. TOC proposes in the technical part has following step.

- 1) Finding the condition of constraint.
- 2) Completely use the capacity of the constraint process.
- 3) Let other processes subordinate to the constraint process.
- 4) Improve the capacity of the constraint process.
- 5) Appear new constraint process (in comparison) and repeat to 1).

(From the book of TOC Revolution)

And just looking this part, I never give my importance to TOC. This part is only the production management & control in basic factory management.

(Finding the condition of constraint? Is it difficult to find? Solution? If the company makes normal monthly production planning, this problem is discussed in monthly.)

The story digresses a little.

But it is quite true that companies have insufficient method of the production management & control.

When I visit a manufacturing company I require to let me see the production

planning. Then the managers show the production schedule which identifies

the products, production timing and production line. Most of the medium company is like so. And I tell him that “do you hire Harry Potter who can use magic and produce anything in air”?

And their answer were “No but why?” in bitter smile. And I continue

Why don't you have the material planning, machine capacity planning and labour capacity planning? Is the labour capacity sufficient? If sufficient,

how

handle the excess capacity? If not sufficient and is required the overtime and/or holiday working, when do you implement these countermeasures?

Is machine capacity sufficient in total system of producing the products?

Is there the bottle neck for the production?

If you have insufficient machine capacity and the bottle neck (constraint process), what is the countermeasures?

In my coaching of production planning, I teach the capacity (labour and machine) calculation in both

- 1) as the flow production system and
- 2) calculate the capacity in individual process (or machine).

And the sum of (for instance) machine capacity in individual flow is the true machine capacity.

Again in the production planning following discussion and data are essential.

- 1) Demand expected of next month and 3 months forecast  
(Sales information)
- 2) Necessary capacity planning and countermeasures.  
Labour, Machine.
- 3) Necessary material procurement. (Stock level, obsolescence, excess)
- 4) Machine maintenance and design engineering information.

(I shall describe more detail in the column of factory management.)

As you understand the technical part of TOC also is the range of production management (including planning) and control.

As I wrote before in the case of “model and demonstration line”, the important thing is not the individual machine performance, but the performance (LT, cash-flow, throughput) of the “stream of production”.

When using a machine in a flow line of production, the machine performance

falls. Therefore TOYOTA doesn't like high performance machine which is expensive. TPS (also) prioritizes the line performance rather than individual machine performance.

In the TV conference with the students.

(Doesn't know his neck-process?! Is there such factory manager?)

For your reference, I introduce the conversation with them.

While saying students, they are the management team of my client company

and are the president, departmental managers including the factory managers and accounting manager.

After the regular follow up meeting, we make some debate about their occasional interesting things. And at this time the theme was TOC.

Now the contents of the conversation.

President; Alan Ford. Factory manager; Fred MacMillan.

Factory manager; Tim Kerry

A.F: How the factory manager can and should identify the bottle neck?

K.K: Frank. Can you identify the neck process in your factory and how?

F.M: Well. I have had no problem to find the neck process. As you know my factory also have the neck processes. But I can identify them in looking the production gemba. Also now we make the monthly and weekly production meeting. And in these meeting we discuss the countermeasures with the data of KPI.

K.K: Very well Frank. Again question. How much hours are you in the Gemba as a factory manager?

F.M: About 3 hours sir.

K.K: Tim. Same question.

T.K: I also 3 to 4 hours. But professor, is there such factory manager who can't know the bottle-neck of his plant?

K.K: As the case of Toyota, the factory managers are in their gemba about 80% of their working time. And their working in gemba are

- 1) Checking the process (workers, standards and job, WIP, takt time & cycle, difficulty job, abnormality, safety. etc.)
- 2) Conversation with the supervisors (same as above, graphs & charts which are one of tools of dialogue).
- 3) Discussing with engineers and other relevant managers.
- 4) Chatting with supervisors and others (without line worker).

And their job role is very clear.

- 1) JIT with correct and planned working time and stock.
- 2) Keeping line condition.
- 3) Thinking safer, easier and quicker working method and the arrangement of better working environment.

Of course as the factory managers, it is quite true that they have the desk work. However most of (never say all, but) the desk work can be done in the activity of gemba.

Factory managers!

Please be in gemba more and more. Next month please let us know how many hours could you be in gemba.

Alan.

Your factory managers are excellent. And the answer to your question is that

It is possible to identify the neck processes if the manager can be in gemba sufficiently.

And if these is the manager who can't know the neck process, your taking action is very clear.

“Please dismiss immediately”.

Finishing the meeting in laughing.

Again “The best in part and in entire”.

Let us look the word of “the best in part and the best in entire” from the different point.

Is “the best in part” evil?

Who does use the words of “the best in part and the best in entire”?

This word should be used in the factory management by the manager class.

And how about the position of a supervisor who has the responsibility to manage a range limited in the factory.

As the supervisor, seeking “the best (performance) in (his) part” in his responsible range is good thing and necessary in the condition of keeping the production plan.

However as the manager who needs to oversee including the area of the supervisor, “the best in part” is not good thing, and needs to manage to seek “the best in entire” for seeking cash-flow, improve LT and throughput increase.

For seeking the best of his range to achieve the target in target control (Kaizen), “the best in part” is good thing. But on the other hand the manager is required to change the results of “the best in part” to “the best in entire” in the control of the balance of labour capacity, machine capacity. This issue is managed in the “Monthly Production Planning” and daily control.

Compare the Labour efficiency in both of the responsible ranges.

As the supervisor class the labour efficiency is

$$\text{Labour efficiency} = (\sum \text{ST} \times \text{out-put}) \times 100 / \text{Total Working Hours}$$

Out-put; Out-put result in the production schedule.

As a factory manager

$$\text{Labour efficiency} = (\sum \text{ST} \times \text{sales}) \times 100 / \text{Total Working Hours}$$

Sales; Sales result (of the month).

I guess the image of this hero was (initially) drawn as the worst manager who

doesn't know the factory management particularly the production management & control.

KPI (Key Performance Index) which I showed is quite important for the "Target control", "Production planning" and "Analysis of the situation of the factory".

Now my interesting point is not the discussion of "KPI promotes the best in part?", but are following 2 things in the book.

-1. The assumption of the accounting system of the Headquarter of this story.

-2. Is the book negative to "Cost reduction"?

-1. The assumption of the accounting system of the Headquarter.

Again the Headquarter accused him of and thought that the bad factory result (red) is caused of bad performance indexes.

On the other hand the hero had the problems of many inventories but delivery delay and bad profit/loss result. (I believe he was ignorant to the production planning and control.)

Now let's consider why the Headquarter of this story fell into "the best in part"?

For seeking the reason, I need to explain the structure of "Income Statement".

As you know as the income statement there are 2 types which are "Financial Accounting and "Managerial Accounting". And the financial accounting form is not possible to use for factory management because sales amount and the cost are un-proportional. Therefore I guess the Headquarter used the form of Managerial accounting and direct costing.

The basic structure (as you know) is as follow.

Basic structure of Income statement

(Managerial Accounting)

Sales amount	
- Cost of sales	Labour cost, Material cost, Expenses (in factory)
Labour cost	Salaries
Material cost	Direct materials for production
Factory expenses	Utility costs, gas, air, spare parts, oil. Lubricant, jigs and tools Repair cost
Gross profit	
- Selling Expenses	Sales commission, Advertising and promotion expenses Travel and transportation expenses, Packing costs, Transportation costs, Entertainment expenses

-	General and administrative expenses	Salaries, Executive pay, Bonus, Severance pay, Welfare costs
	Operating profit	
+	Non-operating income	Financial income, Receives rent and land rent
-	Non-operating expense	Financial charges, Exchange loss, Loss on sales of securities Inventory write-downs, Amortization of deferred assets
	Ordinary income	
-	Extraordinary loss	
	Profit before tax	
-	Tax	
	Net income	

This is the commonly used structure of income statement. There are some modifications, but the base is same. (The modification in material cost and labour cost.)

(In the case of managerial accounting, direct costing)

If using the amount of (for instance) procurement result as the material cost, it is possible to see the real profit & loss of the month. But as you could understand the amount of procurement and actual use in the factory are detached. If the material cost of the actual use, it is easier to compare to factory indexes, but needs to recognize the “virtual profit”.

Most of the company which I know doesn't use the material procurement cost, but actual use which is reflected and proportionate to the sales result.

Anyway this current accounting system is very much unsuitable to the factory management.

One of biggest defect of this system is that it is not possible to follow how the production activity (use of material, labour capacity ----) is changed or contributed to the sales amount and cash-flow.

This hero made excess production for seeking the tinsel efficiency. And some part of the excess production was changed to the sales amount of the month. But some part became to the excess inventory (which are recorded in the assets section in the balance sheet and is not reflect to the profit/loss). (Is inventory evil? Once again I return to this issue later.)

I guess the assumption of this Headquarter uses this income statement which is managerial accounting and direct costing and is not possible to see the process of enterprises resources to be changed to profit/loss, but promotes the harmful effect (the best in part). (Therefore the Headquarter considered to look both of KPI and above income statement.)

Regarding the words of my student, the Headquarter evaluates the factory in profit/loss in the (I guess) primitive income statement and individual performance in KPI which seems not to be had the indexes of “Inventory turnover ratio and cash-flow”. And it is difficult to analyse the causes of the result of profit/loss (even so the lists of individual expenses and cost are prepared).

Also in the same cause, it is not possible or difficult to use for the “Target Control” against the “Budget control” which is based on the annual policy (policy control).

(Is inventory evil?)

Taiichi Ohno taught us that “Inventory is worst Muda” from the eyes of production gemba. And I teach that “Inventory is the result of Muda and the cause of Muda” from the eyes of production gemba and accounting.

I teach “Increase throughput & cash-flow in the improvement of LTE and inventory turnover” which is the way of TPS.

\*LTE; Lead Time Efficiency.

Again what is throughput?

Throughput = Sales amount – True variable cost.

And the variable cost is mostly the material costs.

And material is reflected to sales. But some parts reflect to the inventory.

\*Inventory; Raw material, Finished products, Work-in-progress,

Obsolescence or excesses of materials or parts or finished products,

Defective materials & parts.

And for increasing throughput there are 2 ways. One is the increase of sales.

One is to decrease the material cost and is to improve the scrap ratio and inventory turnover ratio.

In the current accounting system, the inventory is accounted as the assets.

What is assets? The definition of assets is “The value which is possible to change to the profit near future.”

For instance defective materials and obsolescence are not possible to change to the sales amount, nevertheless are these assets?

In my teaching the inventory is required to control strictly.

And in the warehouse the inventory is controlled in 3 colours and the standard.

Obsolescence; red tag: No chance of use because of Stop production, Design changed.

Excess; yellow tag: stock more than (for instance) 3months and reserve obsolescence.

Normal stock; White tag.

Also it is reviewed in the “Monthly production and Monthly management meeting”. And the obsolescence and excess should be reviewed the cause of occurrence, the treatment and the way of the prevention.

Again the assumption of the story of “The Goal” is used the primitive income statement (and KPI).

For your reference.

I show one of income statement form which gives the importance to “Target Control or Budget Control”.

Now I teach and recommend next form of income statement to my student.

The basic structure is same. But it is used the system of “Planned cost = Budget cost” in the statement.

Sales amount	This form is very much useful for the target control and budget control in the “Policy Control”.
- Sales planned cost	
Labour cost	
Material cost	
Factory expense	
<b>Gross planned profit</b>	
Direct costs modification	
Actual material cost	
-planned material cost	
(loss ratio, Inventory turnover)	
- <b>Material costs modification</b>	Once, from the sales amount subtract the sales planned cost which are the budgeted cost of labour, material and factory expense and calculate the “Gross planned profit”. In the “Direct modification” the actual cost which is actually used and the planned cost which is budgeted are compared and is got the differences (costs modification). The planned costs are one kind of target cost. And the actual cost should be achieved less than the planned cost in the usage or actual price for getting profit. And in the comparison it is possible to do the target control and budget control.
Actual labour costs	
-planned labour costs	
(Labour efficiency, Machine performance)	
- <b>Labour cost modification</b>	
Actual factory expense	
-planned factory expense	
- <b>Factory expense modification</b>	
- Loss on disposal of waste	
- Repair loss	
<b>Gross planned profit modification</b>	And scrap disposed and repair cost are subtracted and is got the “Gross planned profit modification” which is equivalent to the “Gross profit” in above income statement.
- Selling Expenses	
- General and administrative expenses	
<b>Operating profit</b>	
+ Non-operating income	
- Non-operating expense	
<b>Ordinary income</b>	
- Extraordinary loss	
<b>Profit before tax</b>	
- Tax	
<b>Net income</b>	

The merit of this form is

- 1) It is easy to compare the budget (target) and actual; Budget control (Target control).
- 2) It is easy to see how the enterprise resources to contribute to the P/L. And it is possible to eliminate the problem of which producing excess inventories to seek tinsel performance.  
If producing unnecessary (for instance) parts in using actual material cost, the material cost modification (minus) increases.

On the other hand this form also has the lack of

- 1) The P/L shown also is not real, but virtual.
- 2) It is a little taking of troublesome for establishment of the budget system.

The target; Planned cost (Budget cost).

Before the start of new fiscal year, it is necessary to decide the planned costs (profit planning) in the budget which is the milestone or guideline of the profitability.

The planned cost is decided in the labour cost, material cost, factory expenses, loss ratio, sales expenses and general and administrative expenses.

Then the individual item, the budget (planned cost), actual, outlook of this month, outlook of next month is reviewed in the monthly management meeting.

Again this system is very useful and I teach this in the Basic Factory Management. Once again I need to warn.

Sometimes I have told in this TPS column that even though it is profitability (in your income statement), it is possible to occur the bankrupt (in bad cash-flow).

The profitability in the income statement is of course important. But the cash-flow is more important rather than the profit shown in the income statement in the factory management.

-2. The book is negative to “Cost reduction”?

According to the saying of the student, he said that the book “The Goal” refers cost reduction as negatively because of following 2 points.

- 1) Cost reduction activity promotes the “the best in part”.
- 2) Cost reduction has no meaning without the process of bottle neck.

I don't know the detail of the depiction of this book. However TOC never deny the Kaizen including the cost reduction in individual process. Because TOC also one of management tool and consists of the base of factory management which includes production control and management, TPM, TQM, QC, Target control, Budget control, 5S, 4R, Kaizen ----. And I believe the book shouldn't deny the cost reduction activity.

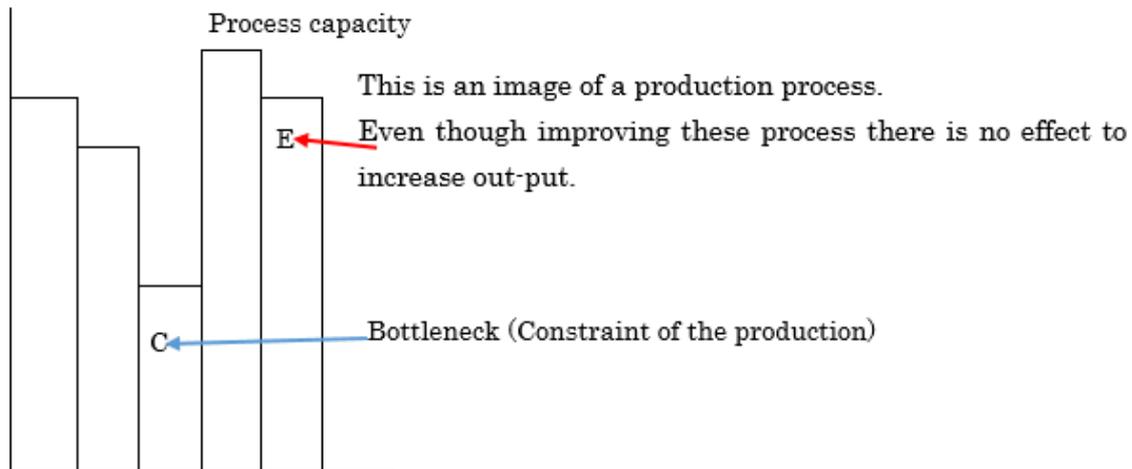
If so, what is the causes of his misunderstanding (of my student)?

When responding to him, again I got his objection with following picture. And said that Kaizen (improvement of labour or machine efficiency, and excluding the effect of quality or safety improvement.) is not the main theme for “throughput” improvement. Also he emphasized that Kaizen (cost reduction) is no effect in the condition of which the factory has a “Bottle Neck = the process of constraint”.

I couldn't understand his opinion firstly. And after the several communications, I

understood his misunderstanding of the relation of “management” and “the best in part”.

I use his picture.



His theory is quite true. Even though improving these process (E) there is no effect to increase out-put (or throughput) because the out-put is constrained by the process C (bottle neck).

However this theory should be used in the case of which the company should concentrate the resource limited and deciding the “improvement priority or priority of an investment (money)”. And in just because, it is not possible to say that Kaizen (cost reduction in any process or case) is unnecessary and no meaning.

This theory misunderstands the relation of Kaizen and Management.

For instance if implement a Kaizen, is it possible to increase the (labour) performance? The answer is “No”. For effecting the Kaizen result, the interposition of “Factory Management” is essential.

The task of management is to use the enterprise resources effectively. The case of above picture. The effects of Kaizen of the process (E) should be used to the constraint process (C or other process) to improve the total capacity.

The student could understand

- 1) TOC also is one kind of management technique and is based on the basic factory management.
- 2) KPI is essential for the factory management (target control, production control, investigation of factory situation).
- 3) TOC doesn't deny cost reduction activity.
- 4) “the best in part or the best in entire” is not the theme of individual technique (TPS, TOC, ---), but the theme of the factory management

(particularly production control and management).

- 5) The role of management is to optimize the usage or the effect of enterprise resources and to handle the effect of “the best in part” to “the best in entire”.
- 6) For the evaluation of a factory, KPI shall be used. But the important indexes are P/L, cash-flow, LTE. Unfortunately with the income statement in current accounting system, it is not possible or is difficult to analyse the cash-flow monthly basis.

Therefore I recommend to use the index of LT and inventory turnover.

Inventory turnover (in the case of the model and demonstration line).

Do you understand the meaning of the Production Turnover ratio: 10 turns?

Previous Production turnover: 0.1turns.

The meaning of 0.1turns is as follow.

The case of this company, the percentage of the material cost in sales is 50%.

Assumption: Sales = 100.

So Amount of material in sales = 50.

$0.1 = (\text{Sales of the month } 100) / \text{Stock of the month } X$

$X = 100 \div 0.1 = 1.000$

This company had 1.000 inventories against 50 sales materials.

Another words  $1.000/50 = \underline{20 \text{ months inventory}}$  this company had.

The model line and the trial showed the possibility and achieved the 10 turns.

Same calculation.

$10 = (\text{Sales of the month } 100) / \text{Stock of the month } X.$

$X = 100 \div 10 = 10 \text{ inventories.}$

$10/50 = 0.2 \text{ months inventory} = \underline{4 \text{ days inventory}}$  (20 working days).

This model line showed the possibility of only 4 days stock.

\*Inventory turnover ratio: Total Stock /Sales of the month

Total stock: Inventory in warehouse plus work-in-progress.

\*Production Turnover Ratio: Sales of the month/Monthly stock.

Why this company had 20 months inventory? I shall describe later again. But At the moment the project team showed the possibility that it is possible to manage the factory with so low inventory.

Now is 10 turns Production turnover sufficient?

For instance the case of my division in the previous company (SUMITOMO) was 49 turns. (The product of my division also about 50% in sales was material cost.)

Again calculation.

$$49 = (\text{Sales amount } 100) / \text{Stock } Y.$$

$$Y = 100 \div 49 = 2.0$$

$$X = 2.0 \div 50 = 0.04 \text{ months inventory} = 0.8 \text{ days inventory.}$$

The case of my division. In fact it was easy to reduce the inventory because my company has the divisions of producing necessary parts and cables for my products.

How about TOYOTA Japan.

I don't know exactly. But TOYOTA required us to supply 16 times a day for the same part number of wiring harness (not all but some). The meaning of 16 times a day is to deliver same parts every 1.5 hours to the location required in the TOYOTA line side. Also the quantity in the transportation is included in the stock.

At this time our project team showed the possibility of 4 days inventory. But it is necessary to seek the reduction inventory more.

Again 0.1 turns (Production Turnover).

When I visited this company, I required to visit warehouse and the production gemba. And firstly I visited the warehouse which was quite large and seemingly well controlled in the condition of tidy-up and Fi-Fo.

The situation of the production gemba was

From the image picture which I showed in "Making stream of production-2", you can't imagine, but there were so many work-in-progress, materials, parts, pallets, repair waiting ----. The situation was (if allegorize) like as "Lego toy box of my grandson". The space efficiency might be less than 30%. Anyway there were so many things beside of the machines, lines, passages and walls. And I called (in the irony) these things "treasure". But the similitude was not mistake. It was true that these work-in-progress, -----, were finished to pay the money and just wait to change to the sales amount.

I wasn't surprized the situation of the gemba. But the situation is, rather, familiar scene as a client. Anyway the causes of 0.1 turn were so many inventories in the production gemba and the warehouse.

The situation of the warehouse.

In the project activity, I suggested to separate the inventories of the warehouse in 3 colours. Then we could find so many obsolescence (red tag) and excess (yellow tag) materials which were the main causes of 0.1turns (about 20 month's stock against

sales.). And almost 1/2nd shelves were filled with the red and yellow card.

And we proposed

- 1) Obsolescence material & parts & finished goods to dispose by sale or dispose immediately,
- 2) Excess stock to separate normal quantity and others,  
Put normal quantity in normal stock area and others in designated area,
- 3) Excess stock to dispose by sale or dispose.

But the company management team didn't want the proposed items of 1) and 3) because of the tinsel P/L to be worse, but promised to dispose in taking long term (I said in Japanese. Suit yourself!) and to implement 2).

As the answer of (Is inventory evil?)

Proper level of WIP and inventory are necessary to respond the client's demand. Anyway "customer first". However WIP and inventory are one kind of narcotic. And.

The excess inventory is never the assets, but evil.

In this description I told that the technical part of TOC is the only the part of production management & control in factory management.

At this time I have used my hours to describe just above.

Next I go back to the original theme "making stream of production" in production "7" which uses large press and furnace and very small and intermittent demand.