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TPS Manual - Chapter 1, Section 3

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> *Section 3 - Labor Reduction and Quality*

About Quality

In this section, we will explain how one should think of quality regarding labor reduction routines, as well as what's the relation between quality assurance activities and labor reduction.

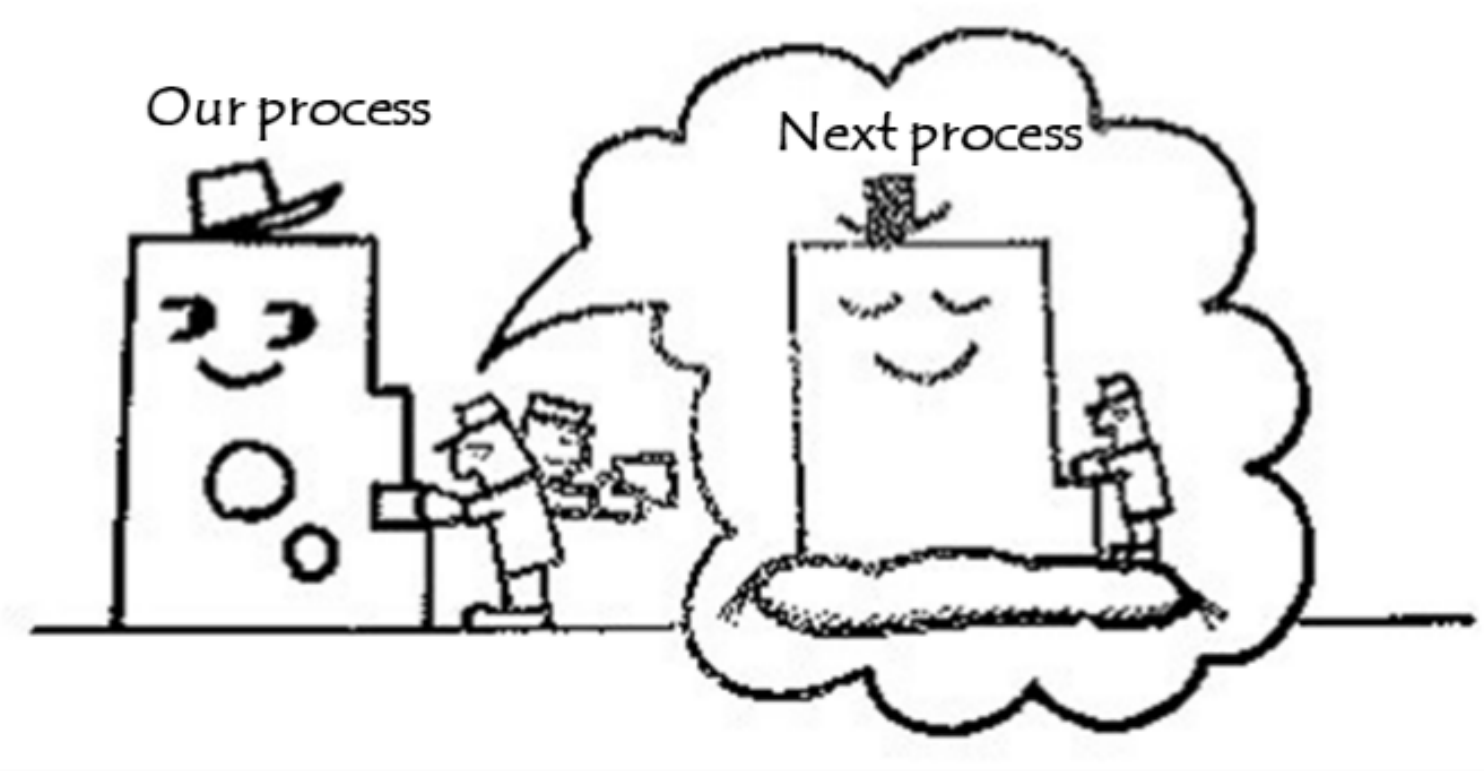
Here, the primary subject is production quality rather than the design quality. So, except for special cases, quality is referring to manufacturing quality.

Quality is Built into the Production Process

We are engaged in the automotive industry, and it is our mission to provide a trouble-free car to the customer. To do that, it's necessary to manufacture products that meet the design quality requirements, and this drives the need for quality checks. Conventionally, finished products were checked by a quality inspector, and then sent to the subsequent production process; however, no matter how much you evaluate the quality of a product that has been already manufactured, this will never lead to manufacturing products of good quality.

If the quality inspector performs a sampling-inspection and declares the products to be good, but of one them is found to be defective, if we put ourselves in our customers' place, there's no way we would say "It can't be helped, it's only one in a thousand."

The next process is our customer



All products are subjected to a hundred percent inspection in some form or another. This is where the elimination of a dedicated full-time quality inspectors, and the concept of "build quality in the production process" was born. Which means completely assuring quality in every single process step where it can only send a good product to the next process. The inspection should be done inside the process and defective products are removed on the spot.

For the concept of "building quality into the production process," every single person is held responsible. The basic idea is that "the next process is our customer," not sending a defective product to the next process is the basis of building quality in the production process.

Despite these efforts, sometimes a defect will be discovered in a subsequent process. If this happens, they immediately contact the preceding process, and the department stops the production process, root cause is investigated, and countermeasures implemented.

Without prompt response, defective products will continue to be produced. In addition, it is necessary that the process that produced them must do the rework of defective product. Keeping silent just because it's a minor flaw should never happen.

Letting the next process do the rework without notifying the preceding process is unacceptable. This may result in the production of more defective products. The rework must be done by the department that produced the defective product.

Quality is the True Value of Improvement

To build products of good quality is a priority more than anything else for our manufacturing industry. No matter how many products you produce, if they are of poor quality, then customers will not buy them. Even if you reduce the production costs, if you can't sell them, there will be a loss.

In the case of automobiles, safety is especially important. We would fail our social responsibility if we bring products to the market where we "cut corners", or made the excuse of "we had our hands full", or "we made it cost less". This can turn out to be fatal for a company.

In short, ensuring the quality is the first thing that must be considered. You are giving priority to a less important thing when you make little of it for some other reasons.

Let's consider what kind of work does the term "quality assurance work" refers to.

Unlike in the past, when the intuition of the operator or the degree of skill played greater role, today each process is segmented, and less specialization of skills are needed. A standard operating procedure in each production process is part of quality assurance.

Standard work must be designed to ensure the required quality. If there is unevenness among the processes, checking process by visual observation or gauge must be incorporated into the standard operating procedure as a single process.

If defects are still produced under these conditions, then it is either because the standard operating procedures are not followed, or because there is some defect in machinery, equipment, molds, or tools. Let us discuss people not following the standard procedures.

Sometimes people say things like, "When we tried reducing labor, defects increased" or "We reduced too many people, which shows up in our product quality."

As we explained earlier, looking at it from the concept of the TPS, this is putting the cart before the horse, and it should never happen.

By looking at what kind of issues take place, they can be broadly divided into the two categories:

(A) Omitting or forgetting some of the necessary procedures, under the impression that the work that must be completed in a shorter time. In other words, rather than eliminating unnecessary activity, they end up cutting corners instead.

(B) Since we previously had surplus of time allotted; creating intermediate stock and rework were possible. The labor reductions have exposed our quality defects.

The case of (A) is commonly encountered in assembly work done on conveyor lines. This mistake occurs because the line was not stopped to avoid delaying the production process

In the labor reduction activities, people are well taught about the importance of stopping the line. The first thing to teach a new person is how to stop the line.

By stopping the line, we can find out about the imbalance between the amount of work assigned to each person, and discover facts for the elimination of unnecessary activity. It is also possible to solve the fundamental cause of the delay.

If people omit some work because there is not sufficient time allotted, it may be because they think the line must never be stopped. The supervisor is responsible to make sure that people understand that passing a complete product to the next process is more important, even if it requires stopping the line.

There is no need to obsess over line speed or Takt time. It's important to clarify that "Takt time and the number of people are unrelated." The person is doing all that is required at their own pace, so a cycle of work is completed.

If they don't finish within the Takt time, the line may be stopped until it is completed. Making sure that work fits within the takt time requires completely different measures, and that's the job of managers, supervisors, and technicians

For instance, if a person requires 70 seconds to finish from process one to process five, while takt is 60 seconds, they would exceed takt by 10 seconds. There should be no need to explain that we must never omit those 10 seconds. The people should do their work normally, and the line should stop for 10 second intervals every time to make products with good quality.

It's the job of the supervisors and the technicians to implement improvements to make sure that any person can finish the processes within 60 seconds working at a normal pace. By cutting down unnecessary activities or reducing the distance they walk, with improvement, there would be no need to stop the line.

If you try to eliminate the line stop without improving the working process, this will naturally result in a lower quality of products; this must be strictly avoided.

In the case B, by reducing the number of people and inventory, we see that many defectives were produced frequently. These were reworked within the production process rather than solving the root cause.

A following process fixes the defect caused by a preceding process without giving feedback.

For example, there is a mismatch with the tapped hole due to a design problem. You fix it with the correct screw holes in your process.

Because the problem is managed, the root cause remains unsolved. The additional labor and inventory for these makeshift repairs increase the cost. When these problems are made obvious because of labor reduction process, it is a chance to improve.

Supervisors and technicians must return the defective products to their respective departments. They should visit the preceding process to pursue the root causes behind these defects, and solve them starting with understanding the root cause.

This can be compared to taking pain medication for chronic appendicitis, instead you decide to get surgery and fully recover.

This concept also applies to solving the defects caused by machines, equipment, molds, and jigs, which we have described earlier. If we find that the equipment is causing a defect, it is important that we stop the line immediately and to identify and eliminate the root cause.

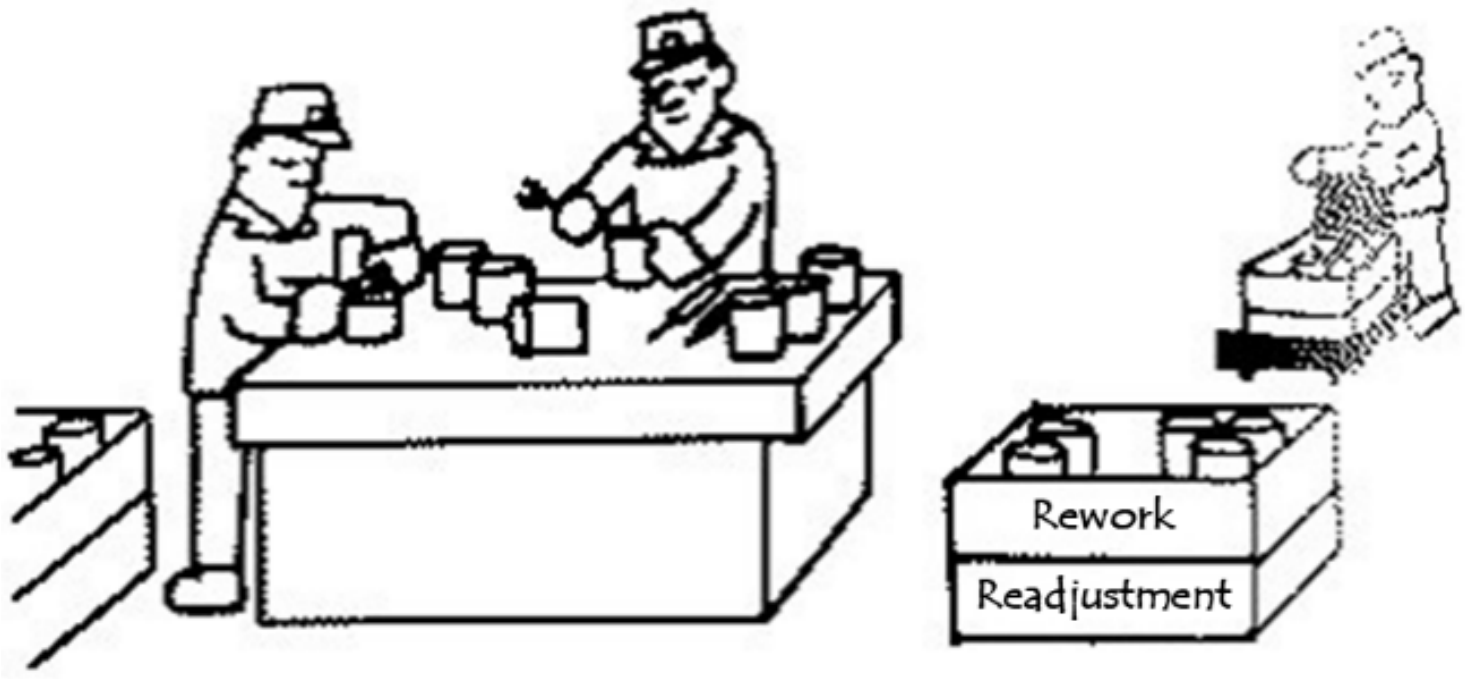
If we end up doing in-process readjustments on our own just because the maintenance department wouldn't respond after we contact them, we may start to fix the problem within our own production process, and this imperceptibly becomes a part of the regular process.

We shouldn't stop with a single written request or a single phone call. We must keep taking measures patiently until we get a product of perfect quality.

Defects and Inspection - Let's think about why sending out a defective product is unacceptable. If the assembly line which is the final process of production, sends out defective products, then it is highly possibility that a defective product might reach the customer.

This is unacceptable, because this affects the trustworthiness of the company and the credibility of the product, more than anything else. Normally, defects are discovered by inspection and reworked before they are sold to the customer. The more the company is determined not to put a defective product on the market, the stricter their inspection becomes, and thus the more frequent rework needed. This only increases your cost.

Value Adding



The extra inspections done is work that does not result in any value being added to the product. Manufacturing can build gauges into their jigs and fixtures an automatic inspection process that reduces the possibility defective products being used (this is called poka-yoke). This is done to ensure that every single product is of good quality.

We believe that the readjustment should be regarded as work that should not have existed from the beginning. The more people you need for inspection and rework outside of the process, the lower value-added ratio in the plant becomes, and the more the costs will increase.

You cannot say, "This product is expensive because we test it 10 times". This will not be accepted in the market. Work that does not add value is just an unnecessary activity. It is something that should be eliminated from the beginning.

Even if you omit the unnecessary activity within the direct work process and achieve some labor reduction, if you produce defective products, then inspection and rework increase the labor requirements. If you consider this from the point of view of cost reduction, the result may come out even, or even a loss; this result is far from the original purpose.

For this reason, we think in the following manner:

The inspections outside the process as well as rework are both unnecessary activity. We want to eliminate them as much as possible. Inspection should be the minimum necessary, and no rework required. And you inevitably reduce labor.

It is important to be aware that large labor reductions are possible by eliminating inspection and rework operations, as you strive for improvements.

The in-process inspection should be considered as follows:

It is necessary for the people to check the quality of products they made, namely the 100% in-process inspection. We regard the subsequent production process as the customer, so not a single bad product should be released.

It's important to be creative with all the various aspects of inspection methods. In addition to visual inspection or gauge inspection, "Poka-yoke (error-proofing)" must also be considered.

As for lot production such as that using high-speed autonomated presses, we accumulate say 50 or 100 pieces over the chute, and inspect the first and last piece. If they are both good, they go ahead and get transferred to the pallets. If there is a defect with the last piece, examine from which piece the failure began to occur, get rid of them, and you must take measures to prevent such defects from happening in the future.

This is a type of total inspection. Even in a fast, quick production process, you should not think that you can conduct only sampling inspections. It is important to build in the quality within the production process.

The Goal of the Inspector - Let's approach the concept of "inspections performed by an inspector."

The job of an inspector is the determination of whether a product is defective. They sometimes think that is enough to just pass the results back to the previous step.

This is not enough. The inspector should be responsible for doing on-site analysis why the failure occurred, and as much as possible, for determining the cause, and stop the reoccurrence of this problem.

They should not merely be an inspector who performs a of pass or fail test. Instead, inspector must be a teacher who explains what was wrong and teach you so as not to repeat the same mistake.

For example, if a matter that came up was a mistake during parts assembly, the cause might not be just as simple as "I was careless".

There might have been many various causes, for example: the parts were not lined up in their assembly order, the line stop button, or the call button was too far away, or the work instruc-

tion information was difficult to read.

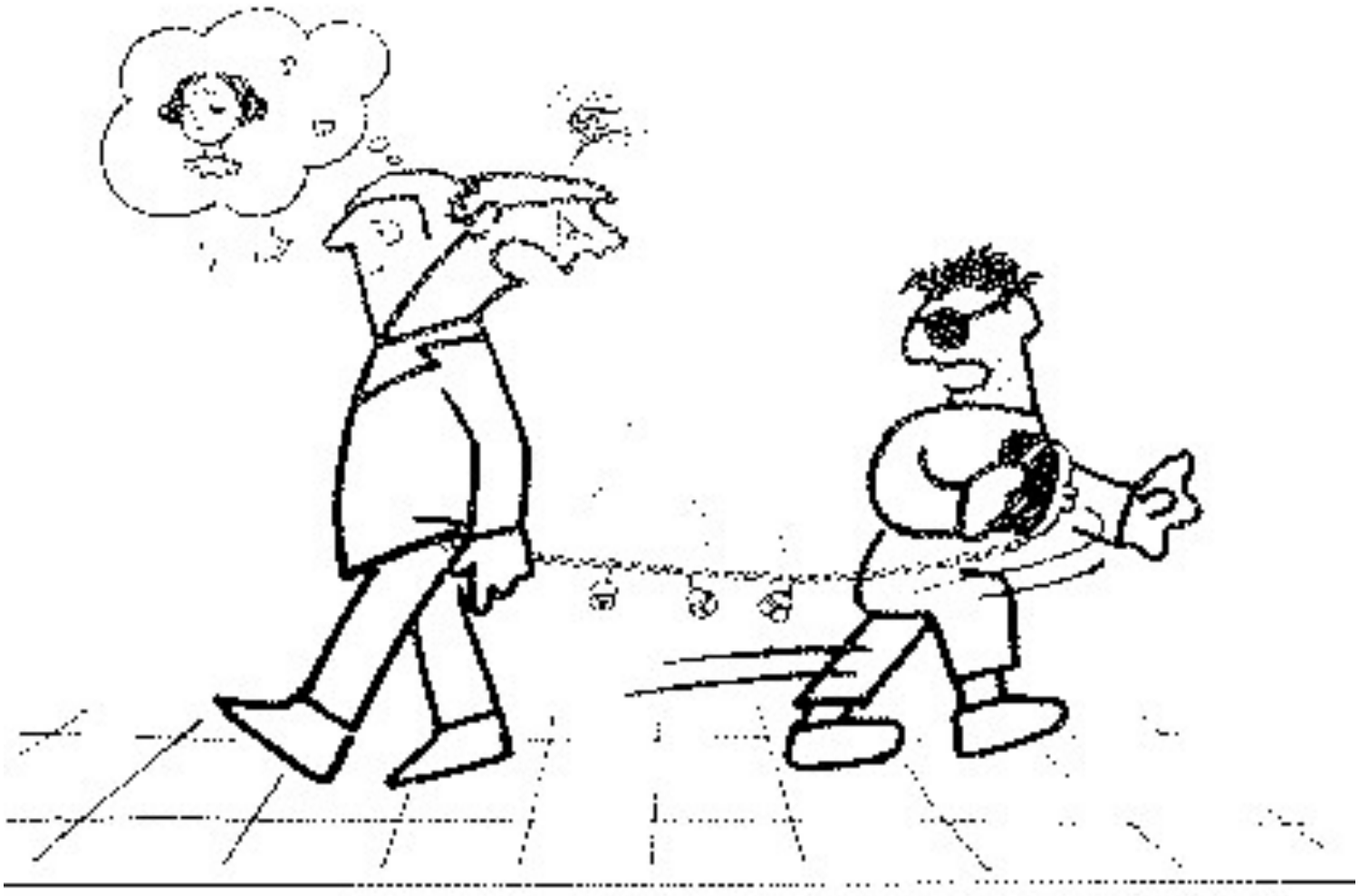
Without identifying these causes and taking the appropriate action, failures will not be reduced. The purpose of the inspector's work is not to toss out the defective product but to reduce them to zero. Their work is evaluated on fulfilling this task.

Poka-Yoke (error-proofing) - During a production process, to build in high quality, we must think about which points the people need to check, which places do they have to measure, or when do need to replace cutting tools.

Devise ways of using jigs and fixtures so that products sent from the previous step are checked spontaneously. This means that you incorporate poka-yoke (error-proofing) within the production process to discover defects.

It is important to standardize poka-yoke to make sure that even if people are replaced, stable quality is produced.

Even the most careful people sometimes can make inadvertently mistakes, especially when they measure while performing other tasks, or doing the check by following a checklist.



That's why it's important to devise a mechanism that spontaneously eliminates defective products, operational errors, injuries or any other problems, even without a person paying attention to everything. The automatic discovery of any shortcomings, that is "poka-yoke."

To explain the mechanism of "poka-yoke" a little more specifically,

- A mechanism where products cannot be mounted in jigs when there is an operational error.
- A mechanism where the machine will not start when there is a problem with the product.
- A mechanism where the machine will not start when there is an operational error.
- A mechanism to automatically correct operational errors before proceeding with production.
- A mechanism to detect problems made in the preceding process.
- If some work is left incomplete, the next step will not start.

Mechanisms other than these can also be considered.

The following can be thought of as poka-yoke methods.

1. Signs... visualize the fault with lamps and color coding to make it easier to be discovered.

2. Jigs... devise a jig so that it won't accept different products, or it doesn't operate when there is a mounting mistake, etc.

3. Autonomation... to stop the machine when a problem happens during manufacturing. This is sometimes not counted as "poka-yoke."

Poka-yoke is an extremely important part of building in quality during the production processes. The aim is reducing problems to zero. To achieve this aim, it's important to think of methods like those mentioned above, and to find the places that are easiest to grasp, as well as those with minimum loss, when establishing "poka-yoke."

> *To be continued...*

Section 4 - Labor Reduction and Safety

Addendum:

The TPS manual translation is part of a much larger project; one to bring to light the core principles of flow that Ohno used to build TPS along with some of the tools that are mentioned in the manual, but not detailed because they were assumed to be public knowledge.

If you would like to hear about my current experiment applying the knowledge in this manual and be notified when we publish the step-by-step examples used, please forward your request to: Mark.tesla2@gmail.com

A large manufacturing company that has applied lean for many years is graciously hosting an experiment involving four teams of managers and supervisors that are responsible for more than 50 production lines. We are starting from about the same point as Ohno did in 1951, armed with the principles of flow, the first chapter of the TPS manual, and the TWI skills; we are revisiting their production lines.

The first week was one of just getting our bearings, learning about each other (plus a few experiments) and choosing lines to start working on (in addition to their full workload).

The second week has just been completed applying the TPS insights and synchronizing processes. We are cataloging the success stories where unnecessary activity was removed which resulted in jumps of line productivity from 28% to 72%. In addition, with hundreds of SKU's, line changeovers are problematic. Two teams revamped the changeovers for lines and recorded reductions on subsequent changeovers to be about 1/3 or less than the previous averages. (One team is getting close to under 10 minutes for a 20 station line, using their existing staff.)

For more information, contact Mark Warren (mark.tesla2@gmail.com)

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