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1973 TPS Manual - Chapter 2 - Efficiency

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Section 1 – What is Efficiency?

As already mentioned in Chapter 1, it is most important for those working in manufacturing companies to reduce unnecessary activities and develop efficient production methods, which consequently reduce costs.

For that purpose, we must do our best to eliminate unnecessary activity daily and do our utmost to raise the efficiency of production through continuous improvement.

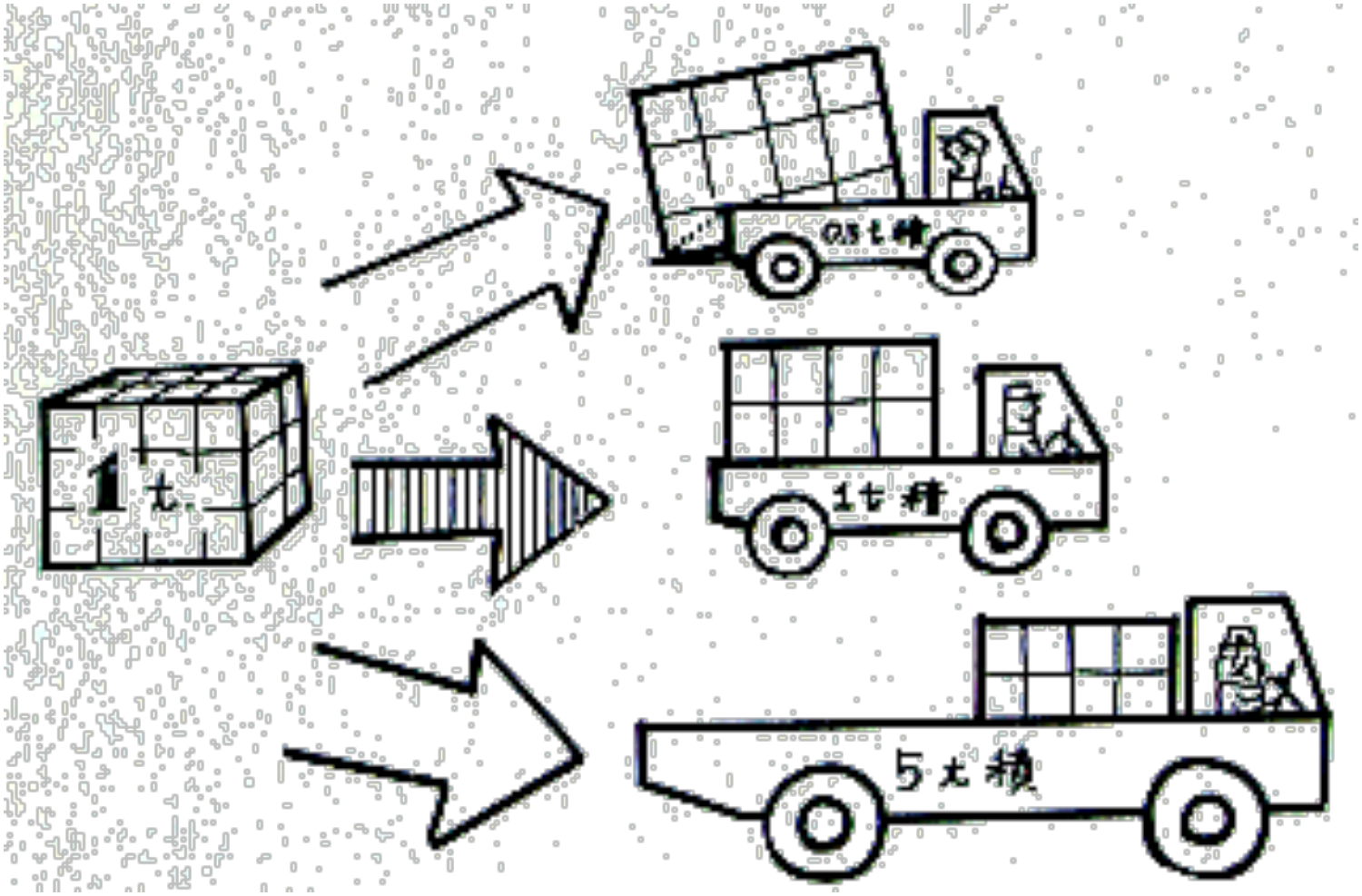
We generally use “efficiency” as a “scale” to measure how much our productivity went up compared to the past because of our efforts.

Regarding viewpoints and ways of thinking about various things related to efficiency, it must be well organized from day to day. If you misuse the way of using the standards, you cannot evaluate it correctly.

Not to mention, we might end up facing a situation where cost goes up despite the increase of efficiency.

In this chapter, I will explain the explanation focusing on the way of thinking about efficiency.

Effectiveness and Efficiency



I want to think about effectiveness first. effectiveness means "the ratio of the work that the machine can actually do to the energy that it has supplied to that machine, so it is indicated by a number within 100%".

By applying this way of thinking to production, we refer to the effectiveness of production, which is “for a certain product, it’s the percent ratio between the labor (energy) that turned into a product (or possibly the labor needed to proceed with the production processes), and the labor that was actually consumed to produce it.”

To say that effectiveness of production is 50%, only 50% of the workers' efforts are producing the product (or to advance the process), and the remaining 50% is unnecessary. It means that it was done. Speaking of 80% production effectiveness, 80% of the workers' efforts are useful, so production effectiveness is quite high when compared to the previous example.

Effective production means that most of the effort that everyone makes is an effort that creates something (or increases the value-added), and this is positive.

When you consider it, everyone works as hard as they can when they start at a company. But when you look at the nature of their work, for example, piling things up here, lining them up there, carrying parts off the pallets in small amounts, arranging them together; there are times when they labor in work that’s completely irrelevant to the progress of the other processes. There are times when you are sweating. Although we are producing products at very high speed, about half of them are defective and require rework. They are trying hard, but these are examples of low work effectiveness that does not lead to added value. This is an unnecessary use of precious energy, and this does not make good use of the people’s true capabilities.

The supervisor is the one who decides on how work is done. So, if the effectiveness of the work is low, it is the responsibility of management. Management, supervisors and staff must keep improving the contents of the work daily so that the people can be highly effective in their work.

Next, let us assume that a lot of effort has been continuously made towards improvement, and as a result, the effectiveness of the production went up, and we started making relatively more items than we used to. In cases like this, we say that the efficiency of the work went up.

Efficiency is used to compare yield, as in how many items, and with how many people, we made within a unit of time (for example, per hour). In this case, our reference (standard) is often something derived from the achievements we made so far, like the previous month or the average of the past six months. It's used as in "This month, our efficiency went up by 15% compared to the standard." Accordingly, unlike effectiveness, it can go above 100% at times.

We often see many ways of expressing the ratio between the work results and effort spent in a company. Other than "Efficiency," there are many different measures used to evaluate whether work is progressing effectively or not, such as "operation ratio," "labor productivity," "SPH (amount of production per unit time.)"

There are two or three points which we should particularly pay attention to when we are using such measures to evaluate the results of work.

(A) Whether you use operation ratio or SPH, raising these values is not the objective itself, your objective is cost reduction.

By ignoring all kinds of conditions and raising the operation ratio or the SPH, then, depending on the situation, we could end up increasing the cost.

For example, to raise a line's operation ratio, we can resort to methods like making each process have intermediate work in process that's enough to cover up any minor equipment failure, or keep large amounts of all kinds of product parts, and make it such that both parts as well as their setting methods are available to avoid being affected by a stock out in a preceding process; doing things that way can probably be thought to increase the operation ratio.

Through our past 30 years of experience in work site management, we can tell that these methods often lead to increasing the costs. It is essential to keep in mind that we can use these "measures" effectively only if we constantly make it clear whether they coincide with our objective or not, and fully understand the conditions of each when using them.

(B) The way we regard efficiency is extremely important

When it comes to mechanical equipment, they are most effective during the machine cycle time (the uninterrupted machine operation time). We need to clearly find out where the machines we are currently employing stand in terms of capacity, and we should keep in mind that we can increase their capacities if we ever need to.

In the case of people, it is necessary to separate movement and work. Within the cycle time, even if the

people are continuously moving, we can always divide that into things we need, and things we don't. The former is a movement that increases the value-added (in the TPS, we refer to this as "work" to differentiate it from simply moving), as well as the indispensable movements that are connected to it, while the latter includes all other movements, that's to say, ones which bring no harm if they are omitted. This is what we call "unnecessary activity." Do not think of this as the ability of a person, while unnecessary activity is still included in the process.

(C) It is important to sufficiently consider the sense of time, as in "being faster."

Performing work faster only bears meaning once it allows for handling even more processes; hence performing work with fewer people overall. Making products faster, thus making more, can lead to an increase in efficiency. However, depending on the situation, this could result in losses. As we discussed in the beginning, efficiency is just another "measure." We must only use it while checking it against our objective.

Objective is Cost Reduction

As mentioned in the previous section, the objective of improving efficiency is in reducing costs. If increasing the efficiency became the objective, there is a risk of making management mistakes. When high efficiency coincides with low cost, there will be a meaning in improving capabilities. For this reason, you must always have your eyes focused on having those two things meet, and then act.

For example, we often see work sites that set raising the SPH (amount of production per unit time) as their management target.

Note: This is not a ratio but since it's used as a scale to measure productivity, it could be seen from the same point of view.

A production line has been using a method of putting a blackboard at the end of the line, and writing down their production output every hour. If the work site continues to do this, before anyone would realize, they will end up falling for the delusion of increasing SPH itself becoming their objective. To increase SPH, you must keep setup changes to a minimum, and to produce using large lots.

Even if today's share has been already produced, if there's still time left, they continue producing the next day's share, and that of the day after it. Certainly, the SPH would go up; but does this really lead to cost reduction? Those doing the work believe that their high efficiency is bringing profits; but, this would only lead to increasing the mountains of inventory between them and the subsequent production process.

In this case, the first condition for this line is to produce using lots that are as small as possible that correspond to the intake of the subsequent process, and to produce the required amount only. Only if you increase the SPH under these conditions, will result in cost reduction. While removing these conditions and simply increasing the SPH, will affect the whole production plant negatively instead.

This means that high efficiency and low cost are not always equal. In relation to this concept, we differentiate between the operation ratio/operational availability in the TPS in the following manner:

Operation Ratio and Operational Availability

Operation ratio is the actual production results of a machine at the present point in time, in relation to the

ability of this machine when it's fully operating.

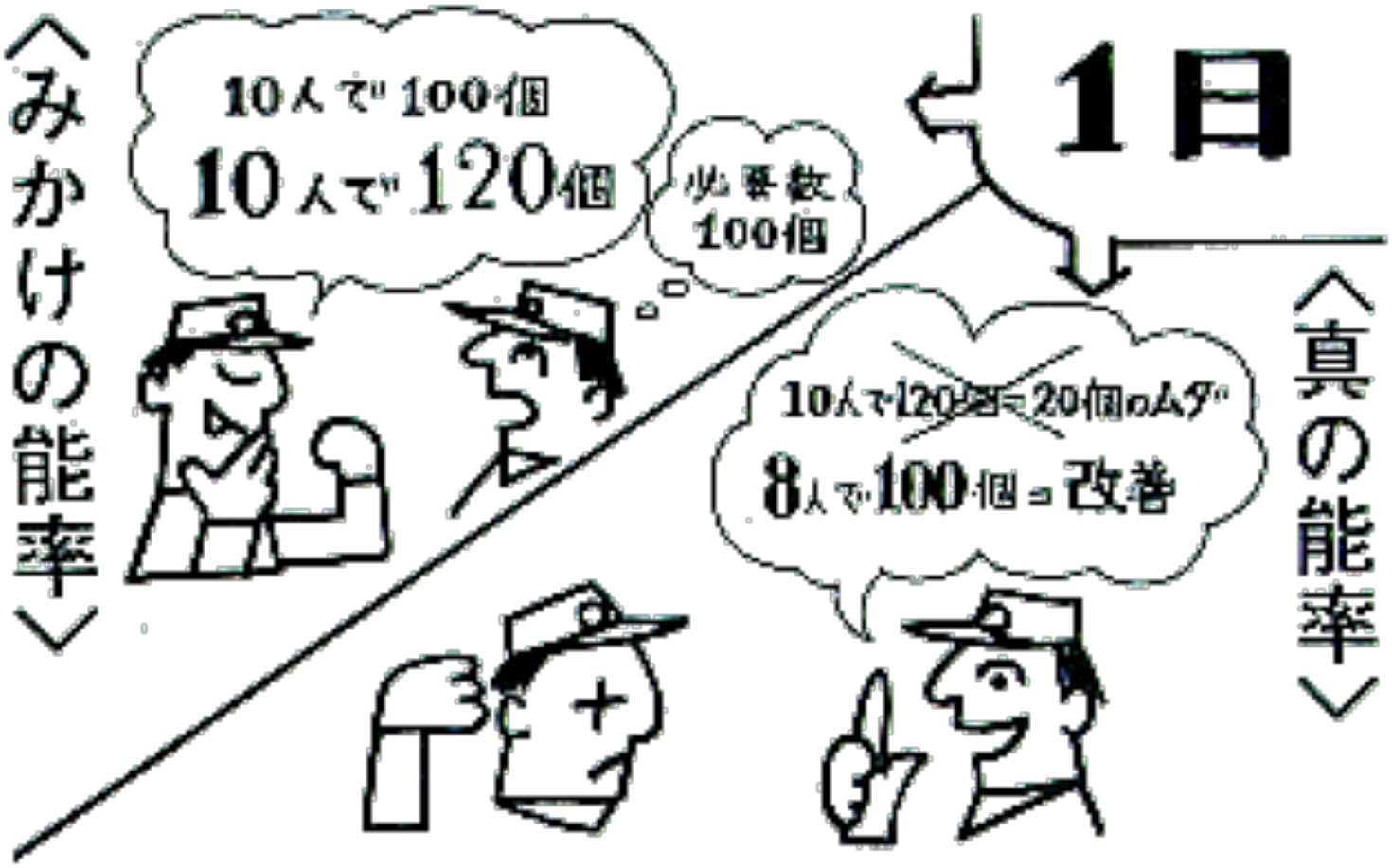
Consequently, it's natural for the monthly produced number of units to fluctuate, since there are times when it decreases if sales are deteriorating, and on the contrary, there are times when you must reach 120% or even 130%, through long overtime hours, or extra work shifts, when there's high demand. (The full regular time operation equal to 100.) Therefore, raising the operation ratio when not necessary is a big loss.

On the other hand, operational availability means to be in a state of being able to operate whenever you want to do so; and having 100% operational availability is the ideal. For this purpose, preventive maintenance must be carried out reliably, and you must aim to shorten the setup and changeover times.

You must strictly differentiate between operation ratio and operational availability when you consider things. To understand this way of thinking, apply this on the car you own yourself, and it will be easier to comprehend. Operational availability is the ratio that expresses the state of the car as it runs in good condition when you ride it whenever you want to; so, it's desirable for this ratio to be 100%. On the other hand, the operation ratio is the ratio of how much time you drive the car each day. Since everyone drive their cars only when they need to do so, we can't say that 100% operation ratio is the ideal. Instead, if you drive it around from morning to night without any purpose, this will only lead to increasing your gas and oil consumption more and more, and the chances of having an accident will also increase; so, it will be a loss.

We can say the same about the production amount and number of personnel. Which means, if you express the relationship of how much to produce using how many people in the terms of efficiency, which of the options will directly lead to cost reduction. Here, too, we must make it clear that increasing efficiency and cost reduction are not necessarily equivalent to each other.

True efficiency and apparent (calculated) efficiency



Let us consider the following example: The line uses 10 people to produce 100 items per day. By applying improvements on this line, the capacity went up so that it can produce 120 items per day with 10 people. This is a 20% increase in efficiency. The implementation of this improvement came at the time when production quantity was needed to increase to 120 items per day.

In this case, we managed to avoid increasing the number of additional people needed by two, while being able to raise the number of items produced. Thus, it's an improvement that leads to profit.

What would happen if the production requirements stayed as 100 items per day, or even lower to 90 items per day? When this happens, if we make 120 items per day just because our efficiency was improved, we would have 20-30 extra items per day. Not only will we be consuming the raw material costs and labor costs before we needed to, but the pallets, storage places, and labor required to manage this inventory would also go up, which would be an extra cost for the company. This would be an improvement that doesn't improve the company's results, rather, it would be a change for the worse.

What should we do to improve efficiency in a way that leads to profit, even if the required production amount doesn't change or if it decreases?

In this case, we must apply the improvement on the production process to produce 100 items per day with 8 people (if the required number is 90 items per day, then we will do it with 7 people.) This will improve efficiency as well as reduce costs.

We have two ways to make the same efficiency improvement. One way to build 120 items per day with 10

people and another way to build 100 items per day with 8 people. Both methods represent about 20% increase in efficiency, but we must not forget that we are choosing the method based on how many items need to be produced.

These two methods, which may look similar according to calculations, show a great difference when they are implemented in a line. The method of increasing efficiency by raising the number of units is relatively simple, and most supervisors can carry it out, but the method of increasing efficiency by decreasing the number of personnel is several times more difficult. When we think we should increase efficiency no matter what, we tend to ignore the required amount, and pick the former method.

In many work sites, including those in other companies, we often see inventory piling up behind a line like a mountain because goods are produced at high speeds under the enthusiastic cheers of raising efficiency; however, we believe that one reason for this is forgetting that the required amount is already a premise, and the other reason is that raising the efficiency by increasing the amount is easier.

If we attempt to increase efficiency with this method when production should be reduced, we will be having an increase in expenses on one hand when sales are decreasing on the other hand, and in the worst-case scenario, this could be fatal for a company (The blow is especially painful in small to medium enterprises).

In TPS, the method of raising efficiency by increasing the amount, when the required amount is unchanged, or when production is to be reduced, is referred to as the “apparent efficiency (in other words, an increase in efficiency that is only based on calculations,)” and it is considered as something that we must never attempt.

When we must increase efficiency by reducing labor, then we must take that challenge, no matter how hard it is. If we become capable of doing things this way, increasing efficiency during times when production is to be increased would be incredibly easy. In this sense, we can say that periods of reduced production are a chance for the management, supervisors, and staff to grow stronger.

"Production volume = required number" is a major premise

Now that we have discussed it, we must consider what the “required amount” is.

As we have explained in the previous section, there are two methods for increasing efficiency. One is to increase the production quantity, while the other is to reduce the number of personnel.

In actual lines, if it turns out that choosing either of them works, then most lines would go for increasing the production quantity. This method is less troublesome, and only little resistance will be shown towards it.

While this method is appropriate in lines which increase the production quantity month by month, or those which have had their hands full with overtime work because of their lack in capacity, applying it to any other case would bring about unnecessary activity of overproduction, and would lead to an increase in the cost as we have previously explained.

We have said this over and over, our objective is only cost reduction, so when it comes to increasing efficiency, the method that complies with this objective must be chosen.

To eliminate the unnecessary activity of overproduction and reduce the cost, the production quantity and the required amount must be equal. What do we use to decide on the required amount? That would be the demand. In other words, it's decided from the trends in the market. For a work site, it's something to be taken as is, and they must know that they can't just increase or decrease the amount on their own.

The increase in efficiency that's to be carried out in the production site, must regard the required quantity as a premise, and achieve this increase within its boundaries.

When using efficiency as a scale, its foundational concepts must be as described above. Once we have sorted that out, we will be able to avoid the emergence of the unnecessary activity of overproduction. Then it will turn out that "Increase efficiency = Cost reduction."

We would like to have a more detailed look at improvement in situations when the required amount hasn't changed from that before improvement, or when it has decreased.

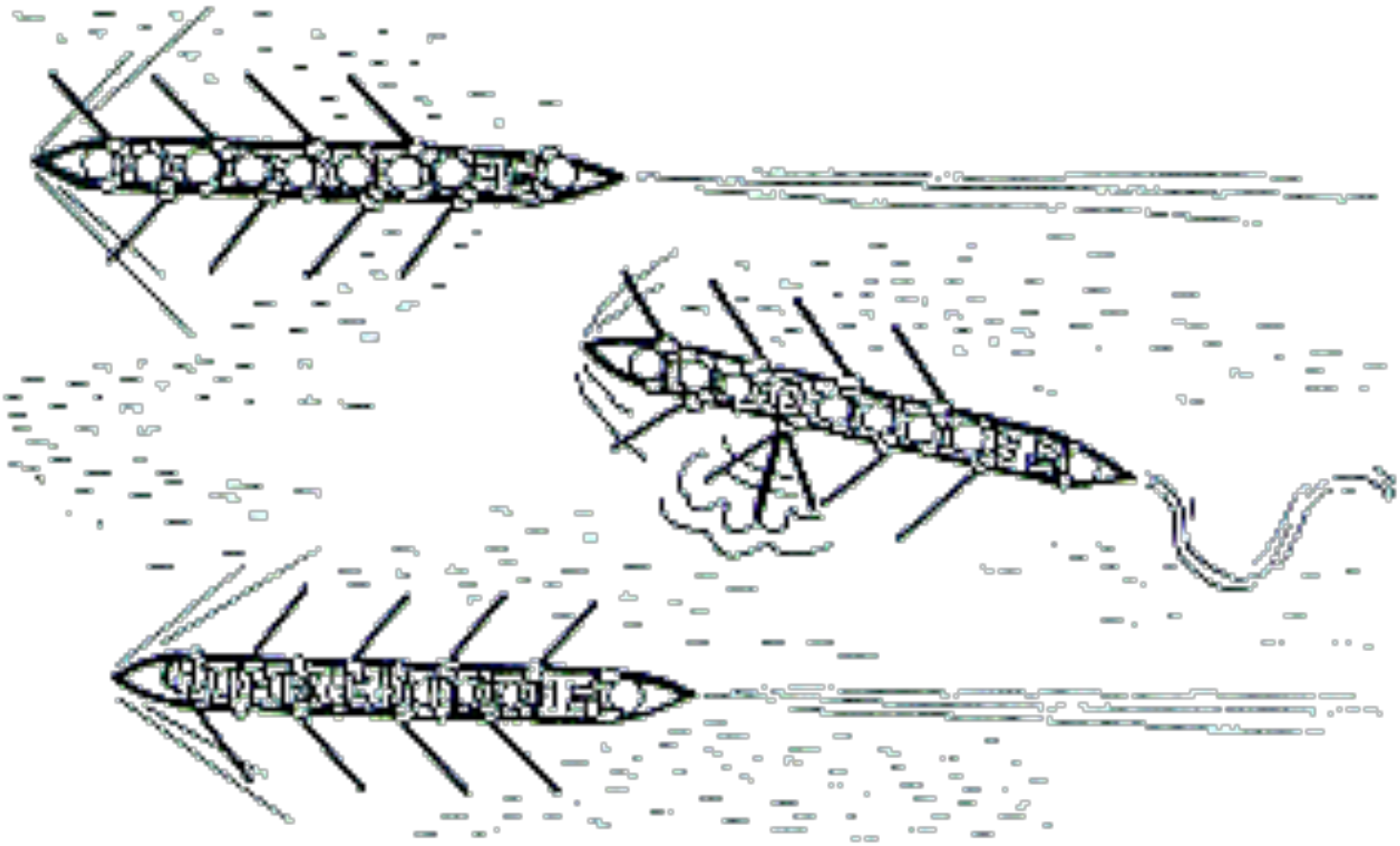
In these cases, increasing efficiency while aiming for labor reduction, will only be achieved through reducing the unnecessary activity in the operations done within the Takt time derived from the required amount, getting workers to do their jobs (work) as much as possible, or automating a part of the work done by people and getting them to do some other work instead, then summing all of that up, and carrying out the production routine with even less people.

At such times, the money for mechanical equipment, jigs, tools, and transportation equipment, would have already been spent, so they should have no future effect on cost, regardless of how they are used. We should just use them according to the Takt time that's derived from the required amount, and the operation ratio should be decided accordingly.

This is as described in the previous section.

Section 2 - Individual Efficiency and Overall Efficiency

The general idea of efficiency was mentioned in the previous section. Before concretely applying this to the factory, let's consider one of the following examples.



The boat race we have in our company every fall, is a very intriguing example when we are considering efficiency. For instance, the boat can only move at a great speed once the eight oarsmen are moving in complete synchronization. The normal pitch is about 40-50 (the number of strokes per minute), and they should maintain it by following the signal. We can say that a boat race is about how good or bad the eight oarsmen are at keeping balanced.

So, what would happen if one of the eight oarsmen said, “I’m strong, and I have the skill, so I’m going to row with a pitch of 60 strokes!” and then he started rowing faster only by himself? His original intention was to increase speed, but that resulted in their balance crumbling, and they became slower instead.

In other words, the total force of the eight people which is moving the boat forward went up a little, but the effectiveness dropped. Not to mention, if the eight oarsmen were to row randomly at their full power, the boat wouldn’t move forward. Therefore, in a boat race, the most effective method would be for all members to maintain the pitch thoroughly; and having an individual row faster is as bad as having an individual rowing slower.

The way production works in the workplace is very similar to a boat race. The pitch is the production takt time, and by maintaining it while producing, the overall efficiency would go up.

If one operator or one line were to ignore the takt time and increased their production speed, the calculated individual efficiency may go up, but the overall efficiency would drop.

Let's consider this by concretely applying it to the factory. The smallest building blocks of a factory consist of the individual people and each piece of equipment. When they are gathered around a part or a process, a

production line is formed.

Furthermore, when several lines gather together, along with the surrounding departments such as transport, inspection, and maintenance, as well as the engineers and the staff, they form a factory.

When considering efficiency with the goal of reducing costs, it is necessary to improve efficiency at all levels. That's because every single worker and every single process throughout the whole work site are very closely connected in all directions, and there's almost nothing that stands independently.

One person's method of working could affect somebody else, and one line's production method could often restrict the preceding and/or the subsequent processes, as well as transport operations. When discovering unnecessary activity, and pursue its cause to eliminate it we often reach the issues in the preceding, subsequent, or transport processes.

It is not just about an individual, or their own process, but it also shows us how this has a great influence on how good or bad the efficiency of the subsequent and the preceding processes would be. In this sense, even if efficiency improvement leads to cost reduction, an efficient way must be done at all levels.

In this section, we will briefly discuss increasing the efficiency on each level.

Efficiency of the Work of Each Individual

The important point at this level is the idea of "value added ratio". The ratio of work which increases the value-added, throughout all the work the person performs; which means that the greater it is, the higher their efficiency would be.

For example, work such as trans-shipping goods, unwrapping, and folding wrapping paper over, is originally unnecessary work. By omitting those, and only picking up work that's essential, the ratio of the work that increases the value added within one cycle of work would go up.

As related to this section, TPS has the following idea.

The Difference between Work and Activity

in Toyota, it could be said that we were more active than the Westerners. And yet, we were behind when it came to labor productivity.

We may have been more active, but we were producing less value adding work. The effectiveness of our work was lacking.

For example, we are working (working) in production activities for 7 hours 30 minutes a day, but there's too much time that's not considered work within the production activities.

In TPS, only when processes progress, and the job is fulfilled (when the value-added goes up), can we say that work has been done. Work is movement coupled with human knowledge, and we can also say that it's when the people are provided with their supervisor's knowledge.

On the contrary, we don't refer to operations which bring no harm when they are omitted (ones that don't increase the value-added) as work, but rather, as movement.

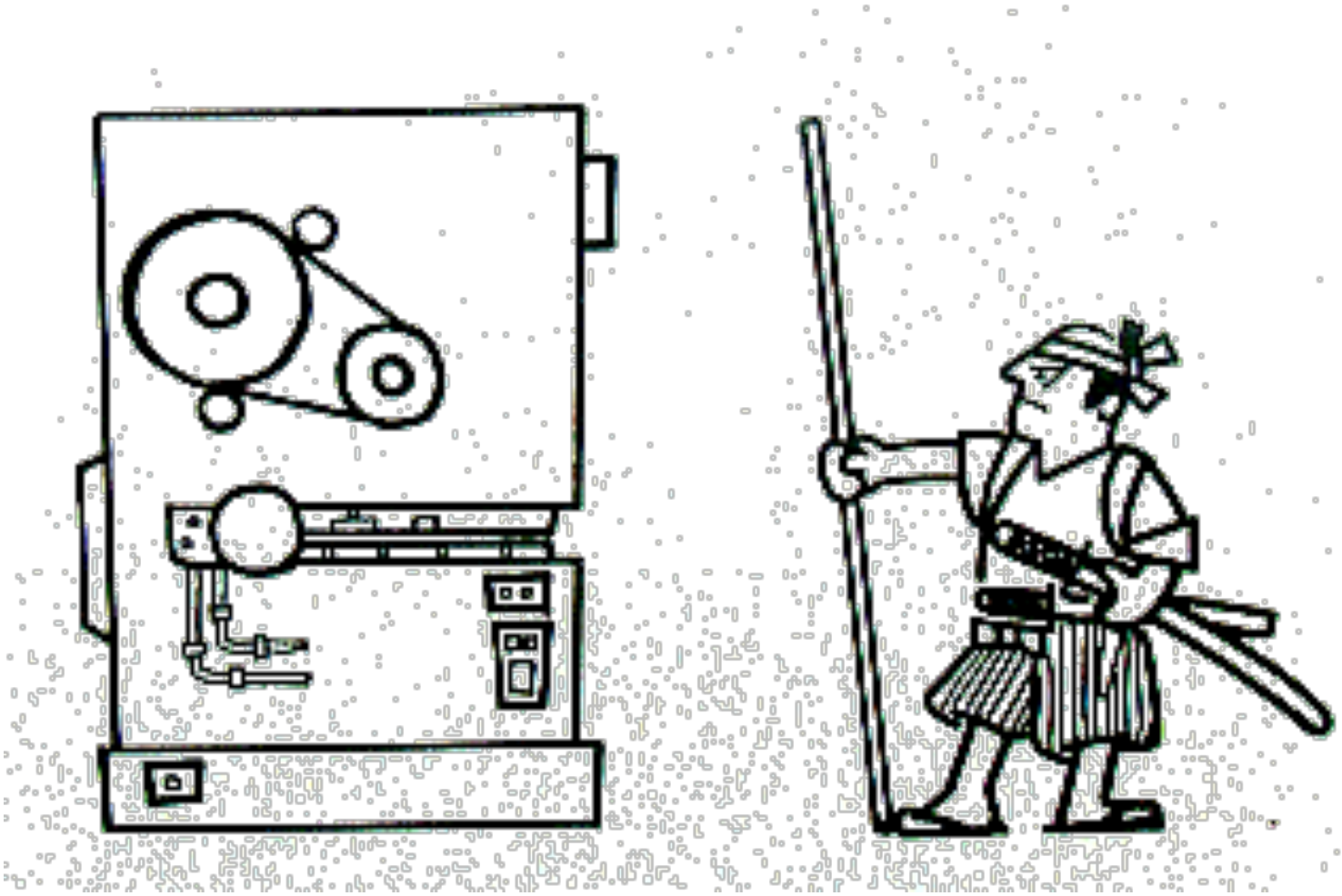
Labor Density

It is important for everyone to make efforts to convert movements to work, and conversion will lead to a reduction in labor.

In TPS, we perceive labor density as "work labor divided by movement labor", and when this ratio is high, it means that much of the worker's energy is allocated into an important job, which would be something favorable.

This is an easy-to-understand example as to what to emphasize on reducing labor, so I will open it here.

Automation and Autonomation[1]



Automated machines move even without people. But what is important as well as moving is to stop in case of abnormalities.

A machine that doesn't stop will keep producing defective products, and there's a high possibility of it breaking down because of working in vain when there's nothing inside or because of foreign matter contamination. Therefore, we must assign someone to watch over it no matter what. And this person doesn't do any kind of job that increases the value-added.

In TPS, we clearly differentiate between a machine that only moves (automated machine), and one that can automatically stop (autonomated machine) when it detects an abnormal condition.

This is the spirit of Jidoka which has been traditionally accepted since Sakichi Toyoda's invention of self-stopping loom.

When you spend so much money to achieve autonomation, there must be a befitting return (labor reduction). It would be a problem if we end up with automation instead.

We must apply an improvement after the other, and make effort so that we can bring it into the realm of autonomation.

Autonomation (自働化) includes human knowledge (a human radical 亻), while automation (自動化) includes no human (亻), so it needs someone to watch over it, so we can remember them like that.

We must carry out autonomation, even in processes which contain a lot of manual labor, such as final assembly conveyors, by making an interpretation of these concepts.

In this case, the "character for 'self自'" refers to the person, and it means allowing the person themselves to stop the conveyor if they ever think "this isn't right!" or "this is a defective product!" throughout the work they are performing.

If we were to put it in an extreme way, every single person would be carrying a line stop switch, and the moment they think something is odd, little as it may be, they would stop the line immediately.

Producing defective products or products that don't pass that standards, won't be considered as doing one's job. It won't be considered as work, and this, as well, is one more viewpoint of autonomation.

Efficiency of Work in the Production Line

There are two important things at this level:

Balance between Processes[2]

In other words, this means production according to the takt time and avoiding overproduction.

When some workers set their own high efficiency as their aim and produce quickly, products will pile up in front of the workers of the subsequent production stage, and the work of sorting these out will increase. They might start to have a feeling of impatience, and mistakes will increase. If you look at the whole production the line, the efficiency will decrease instead.

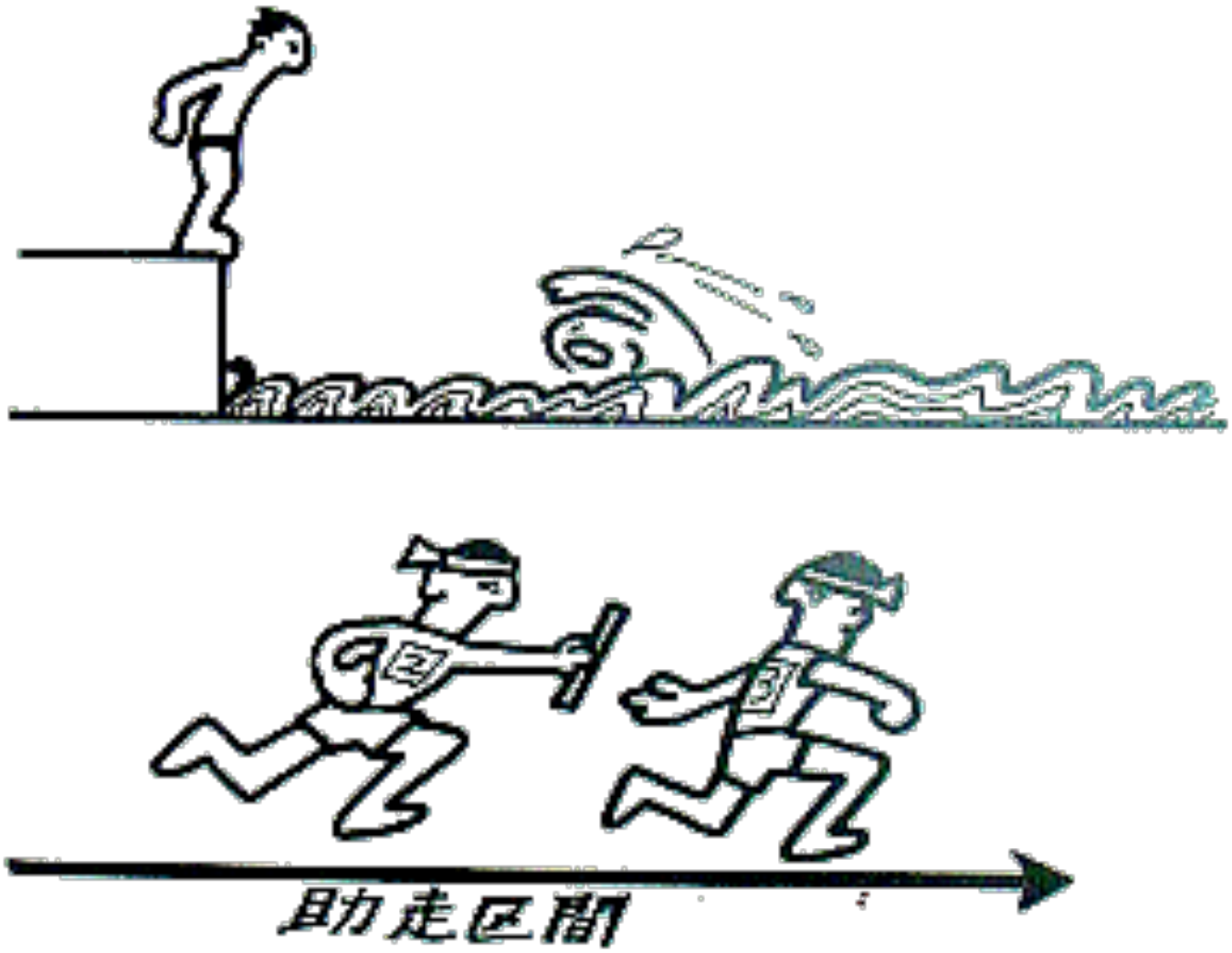
Generally, when there's work that's done by several people in order, there's always a production stage that is considered the bottleneck, and it represents the capability of the line.

To increase the efficiency of the whole line, you must help the people of this bottleneck production process; however, since those who can work fast keep producing, items keep piling up in front of this bottleneck process. This will hold everyone back instead, and will cause efficiency to decrease.

To prevent this, you must clearly decide the standard operating procedures and accordingly, you must make everyone abide by the standard in-process stock, the takt time, and the work sequence, and since by doing that there will be waiting, you must do compositional changes and keep the balance.

For steps that involve working in a row like presses, it's essential to modify them such that the conveyor stops when a part enters within the reach of the worker's hand.

Mutual Cooperation (relay races of swimming and track)



In the above-mentioned manner, it is often that it is impossible to completely balance the people. It's unavoidable to have little unbalance in the work of a production line that has several people.

In this case, it's possible to increase the efficiency of the whole line, by having those who finished earlier aid those who are still behind.

Even if you have already allotted the production processes, it's desirable for the boundaries between them to be flexible to allow for mutual cooperation.

For example, if the previous process is completed a little earlier, you should devise a way to put the product in the jig of the next first step.

As for this way of thinking, please refer to the way of swimming and Baton Pass of the Relay Race as a reference.

In the relay in swimming, after the first swimmer touches the pool side, the second swimmer jumps in. In track, there is a 20-meter baton pass zone, and handing over the baton anywhere inside this zone is acceptable.

In swimming the slower individual and the faster individual must do 100m each, while in track, it's possi-

ble to use the “strategy” of having the faster individual run 120m, while the slower one runs 80m.

The work done in the actual site must be a relay of track. It’s desirable to create a baton pass zone so that the supervisor can have a “strategy” that increases the efficiency.

Efficiency of the Whole Factory

Sometimes we come across examples where the efficiency of the factory doesn’t increase in companies that put a lot of effort in increasing the efficiency of every individual.

Despite the manual labor of the people being splendidly fast, the inventory is piling up in the factories, and this requires many people to sort out everything, and as an overall result, let alone cost reduction, this will lead to the cost going up.

This is because productivity only applies to the work speed of the individuals, while ignoring the overall condition. The efficiency of people, same as the efficiency of the line, and the efficiency of the factory, all affect the cost greatly. It is essential to give the most priority to increasing efficiency on the level of the entire factory. To improve the efficiency of the factory, certain rules are necessary.

This is not something that can be done by one supervisor or one staff member alone. For everyone to move in the same direction, standards of thinking become necessary. The standard is "leveling production" in TPS.

In the case of teamwork, it must be a track relay. The supervisor is advised to create a baton touch zone so that "strategy" can be created to improve the efficiency of the team.

Production Leveling

For a production site, the more the flow of products varies, the more unnecessary activity occurs. That’s because equipment, people, inventory, and everything else must meet the necessary production peak and be prepared accordingly (capacity planning to meet peak demand).

If it is built in such a way as to disturb the pace in any step, unnecessary activity occurs and the efficiency decreases, which is not only a problem, but it has a serious influence on the preceding and subsequent process, in particular the preceding ones.

To explain this in an-easy-to-understand example, what would happen if a final assembly line was concerned only with the efficiency of its own process, and decided to go with producing sedans today, hardtops tomorrow, and vans the day after that?

The production line of preceding process that’s working on sedans has work to do today, but the line working on the hardtop or van parts, have no work until tomorrow, or the day after respectively.

Having no other choices left, they reschedule their production plan so that they have work to do day by day using their inventory, but even if they do so, they will at least need inventory that equals 3-4 times of what they would have needed if the assembly line assembled the average amount day by day.

With such a thing, it is unexpected that efficiency improvement etc. Leveling production is this meaning.

Leveling includes reducing the variance of types of goods and eliminating variations in quantity, as well as reducing the lot of transportation and eliminating variability.

Small Lot Production

Manufacturing processes of automobiles have many processes ranging from casting, forging, rough shapes such as presses, machining, welding, intermediate processing, painting and assembly.

To what extent leveling can be accomplished, including all these steps, is just how far we can improve the efficiency of the whole factory.

For instance, metal-casting (die casting), forging, presses, and heat treatment are process that leave no choice but to be done using lot production, and for a long time, there has been many cases where they have been treated as a separate matter, despite being processes that need to receive the most efforts when leveling.

In other words, lot production components are excessively fixated on SPH (amount of production per unit time) and the setup times, and they think that having excessively large lots leads to increasing efficiency.

As explained earlier, enlarging the lot confuses the process before and after (in this case not the lot production), it generates excessive inventory and a lot of unnecessary activity. Consequently, regarding lot production components, it is important to make the lot small and make efforts to level production.

Section 3 – Increasing Efficiency by Eliminating Unnecessary Activity

Waste of Capacity

If we were to sum up what we have discussed in sections 1 and 2, we will end up with the following:

(A) Improving efficiency is meaningful only when it leads to cost reduction.

To achieve that, we must move in the direction of “how do we make only what we need with few people?”

(B) When we regard efficiency in terms of every single person, as well as the lines at which they gather, and the whole factory which is centered on these lines, then we must proceed with ideas and viewpoints aiming to increase efficiency on each of these levels; the overall results must go up as well.

Next, we would like to consider what we should exactly do in a more easy-to-understand manner.

Let's take an example for a line. In this line, 10 people make 100 products a day. Based on this current situation, the capacity of this line is 100 per day, and the productivity per person would be 10 items a day. If you look closely at this line and the people, you will find overproduction or waiting time, or we can find variations depending on time and day.

Assume we applied improvement to these, and reduced 2 people’s worth of labor. In this case, the capacity would seem like it has gone up, compared to how it used to be. (If we don’t remove the two people, we will be able to produce 125 items/day, so it would seem like capacity has gone up by an amount of 25 items).

The truth is, we had the capacity to produce 125 items/day from before. But it's just that the 25 items worth of capacity was wasted by things like unneeded operations or overproduction. It is appropriate to think that we were able to make only 100 items a day because so much unnecessary activity was included.

Whether we're looking at it in terms of every single person or the whole line, if we consider what really needs to be done as their jobs, and anything other than these as unnecessary activity, we would have the following relationship:

Current Capacity = Useful Work + Unnecessary Activity

The more we get rid of unnecessary activity, and increase their jobs in an equivalent amount, the more we will approach the "true capacity" (100% value adding work as the true capacity). When we do that, we will make more products with the same line configuration.

We must not make more than the required amount. Reduce the number of people to reduce excess capacity to make exactly what you need. This is the same when it comes to each person, to the production line, or for the whole factory.

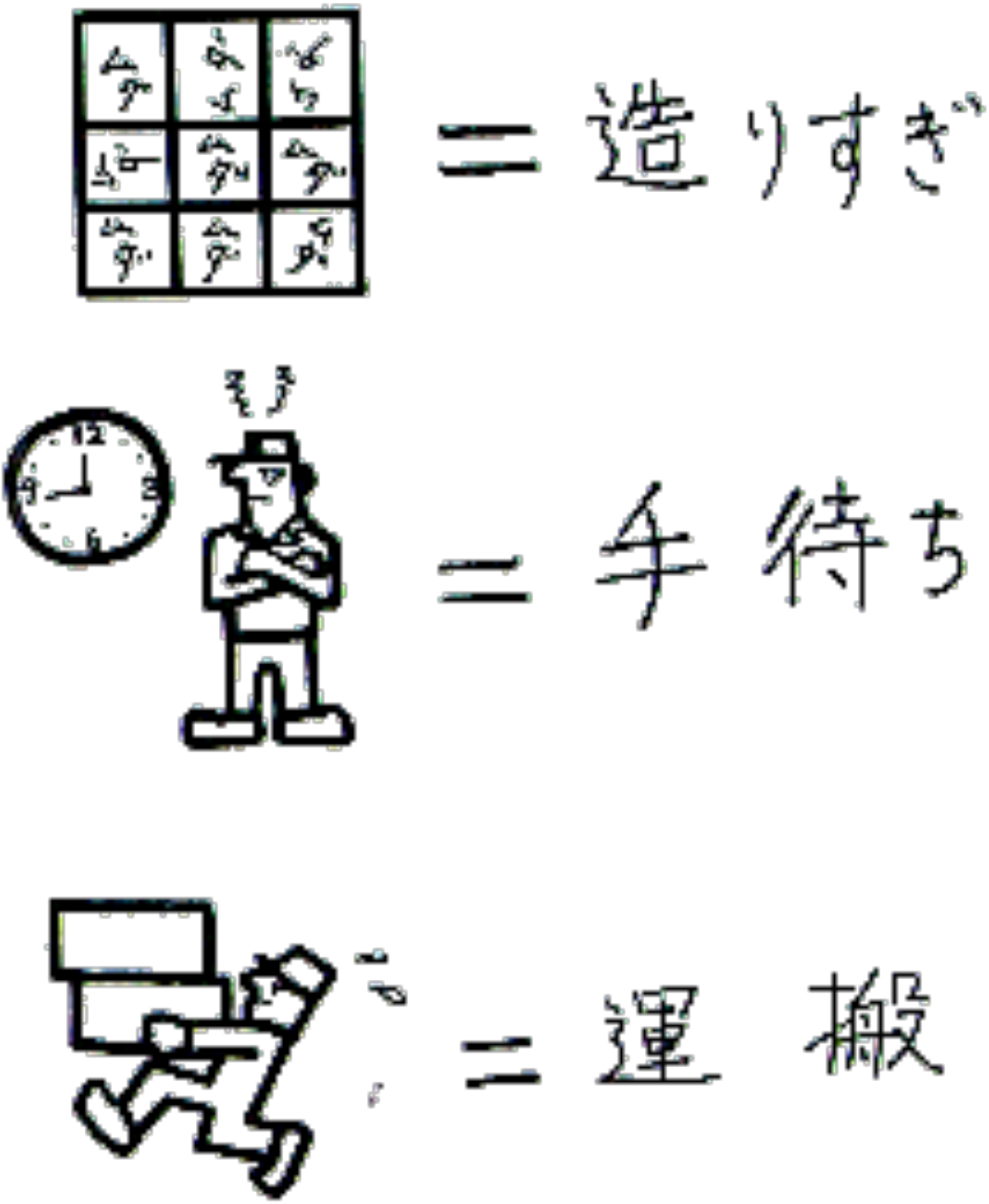
For each person, we focus on the work that adds value and the work that absolutely is necessary in relation to it, and avoid other unnecessary activity. On the line, we allocate highly efficient work in order, and eliminate labor fractions (fractional person labor) by improvements. When it comes to the whole factory, we try to establish an overall balance around such lines, make the lots as small as possible, and prevent the emergence of extra transportation costs by carrying out production leveling.

Simultaneously, we apply improvements that prevents the increase in the labor for investigations and readjustments due to frequent occurrences of defective items.

If such actions are taken, unnecessary activities will disappear gradually, so the people, the lines, and the factories, would be able to do an amount of their necessary jobs. In other words, their hidden capacities would come to light. If we carry out labor reduction now, the efficiency will go up as explained in Chapter 1, Section 3.

When we start thinking like this, we can see that raising efficiency means saving unnecessary activity. A thorough exclusion of unnecessary activity, this is the most basic thing that we must do.

Types of Unnecessary Activities



Within the TPS labor reduction routine, there are four categories of unnecessary activities we want to remove:[3]

(1) unnecessary activity of overproduction

(2) unnecessary activity of waiting time.

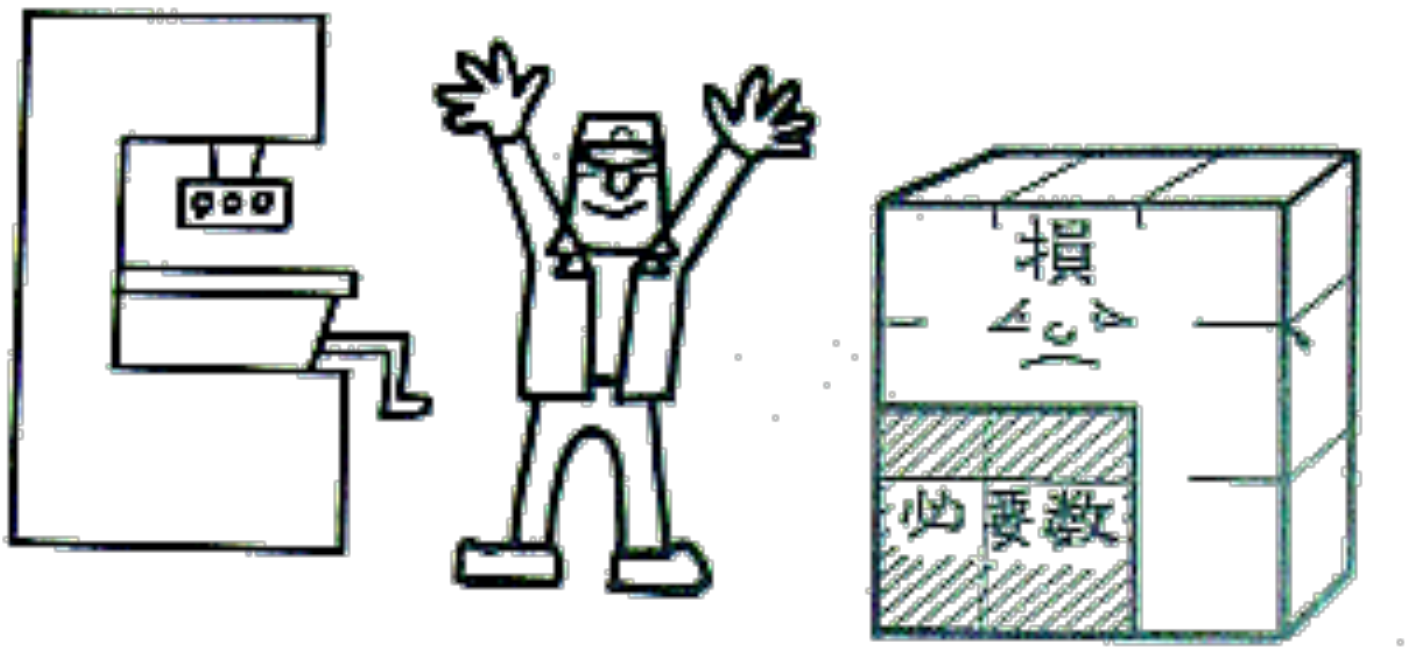
(3) unnecessary activity of transport.

(4) unnecessary activity in processing itself.

We will explain them one by one below.

Unnecessary Activity of Overproduction

It is unnecessary activity that occurs to make extra things. The unnecessary activity of this overburden is often caused by excessive progress of work in normal cases. Even though it is time that I must wait normally, I start the next task.



For example, the work of piling up and unloading that's seen between one person and the other, or in the connection of one process and the other, and these lead to the causes that increase unnecessary activity. These are the cause of unnecessary effort. Unnecessary overwork such as additional machinery, advanced use of materials, unnecessary replenishment of workers, interest burdens, wide warehousing and transportation expenses is not limited to self-process, but also causes other unnecessary activity. Even illusion is made as if it is working.

There are many causes for the unnecessary activity of overproduction other than this. We can think of the following examples:

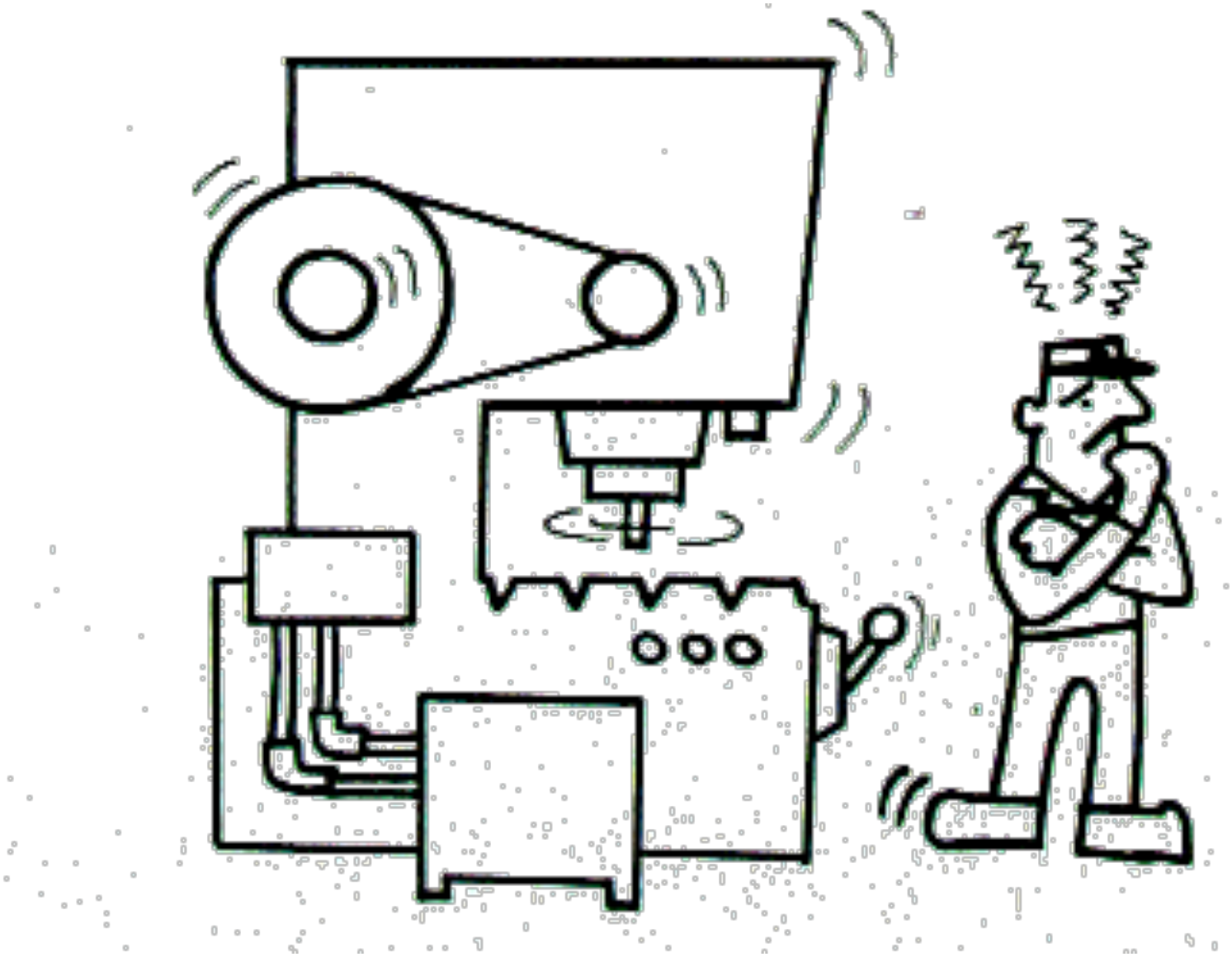
(A) When you allow for surplus in work, or when there are waiting hours, so as a result, work progresses more than required in this time.

(B) When production is accumulated just because there's still room for this regarding the capacities of the machinery (equipment).

(C) When the overall efficiency is ignored because of running after increasing the SPH (amount of production per unit time).

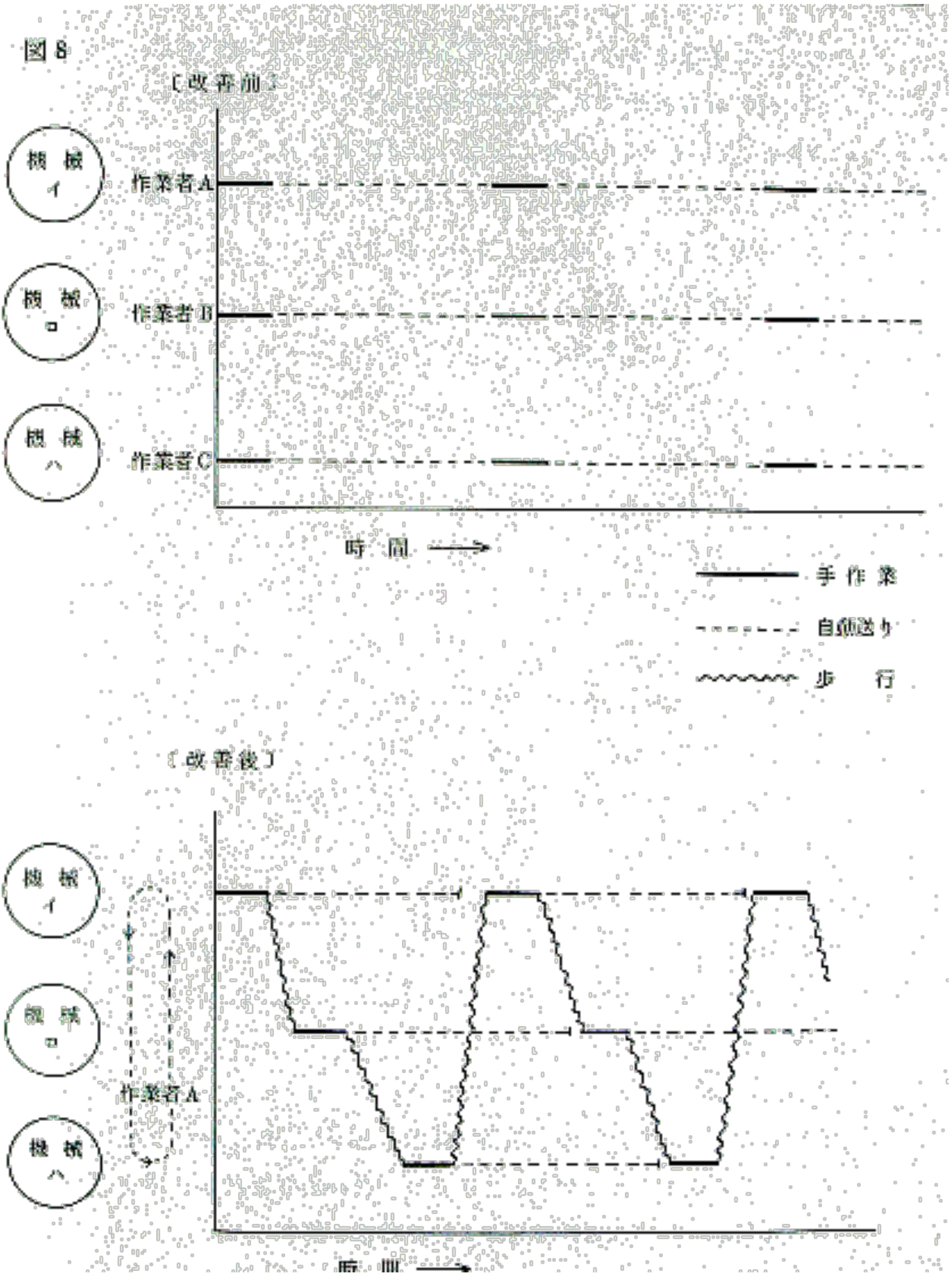
(D) When you adopt the false idea of "This machine is expensive, so if we don't increase its operation ratio, we won't be able to compensate for it."

Unnecessary Activity of Waiting



When machines are processing automatically, people are just standing and watching machines, even if they want to work, the machine is running, and they cannot leave. It is about unnecessary inactivity that occurs.

For example, before doing improvements, one person has been assigned to each one of the machines (I), (II), and (III).



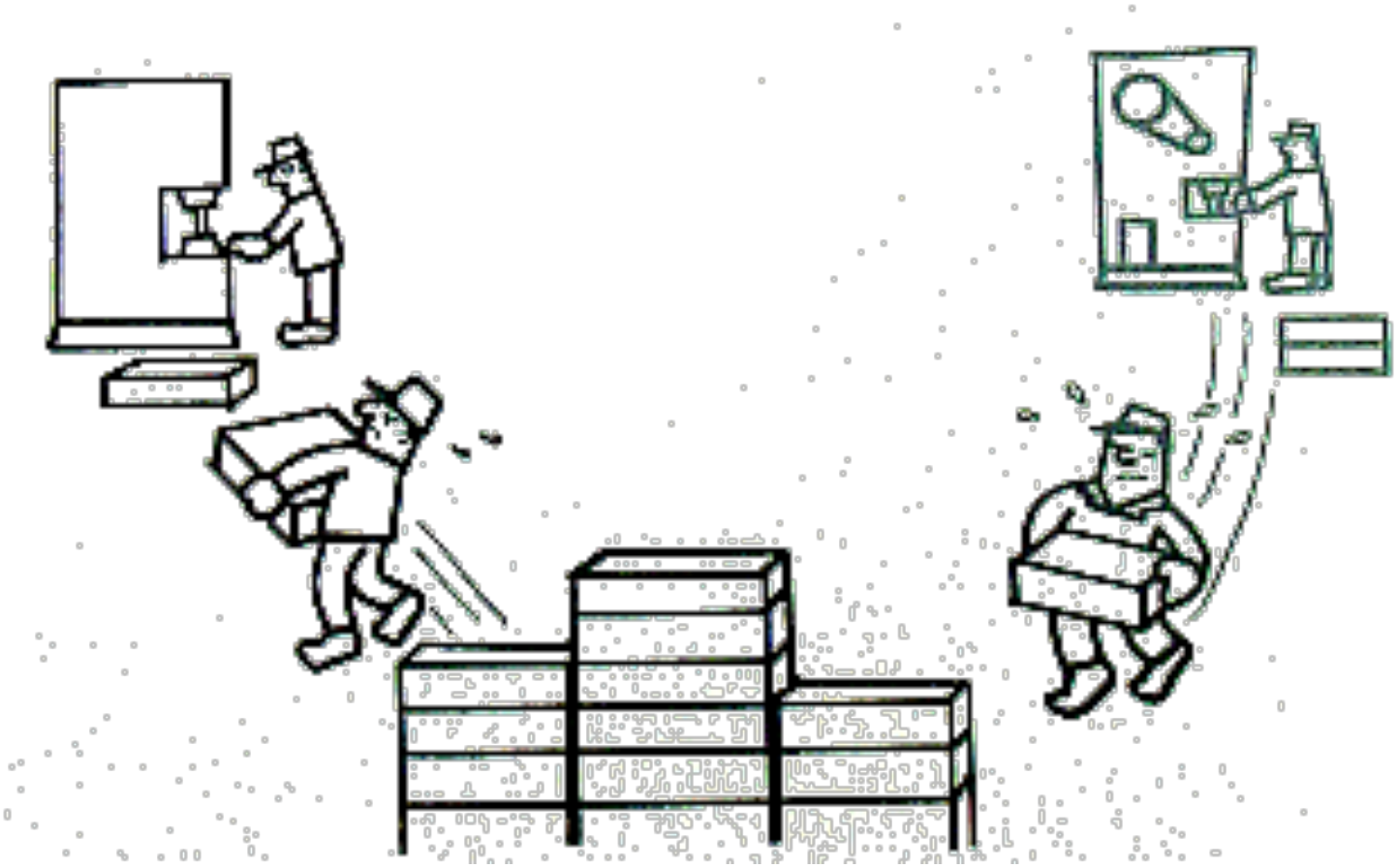
In such production processes, while the machines are doing the work, the people just stand idly, and can't do work even if they want to do so. The unnecessary activity of waiting time is taking place.

To eliminate unnecessary waiting, we decided to have one worker do the loading of all three machines in sequence.

Which means, operator A will install the materials for the machine, and after pushing the start button, they will move to machine (II). Then they set the materials for machine (II), and start it. After that they will move to machine (III), and set the materials in the same manner as machines (I) and (II), start the machine, and then return to machine (I). When operator A returns to machine (I), machine (I) will have finished its work, so operator A will be able to start working immediately, waiting time doesn't occur.

By eliminating unnecessary activity of waiting, two people can be reduced. Movement without which the "work" can still be done, such as lost motion, should be included in that. (Combining work will be discussed in detail in Chapter 3 the standard operating procedures)

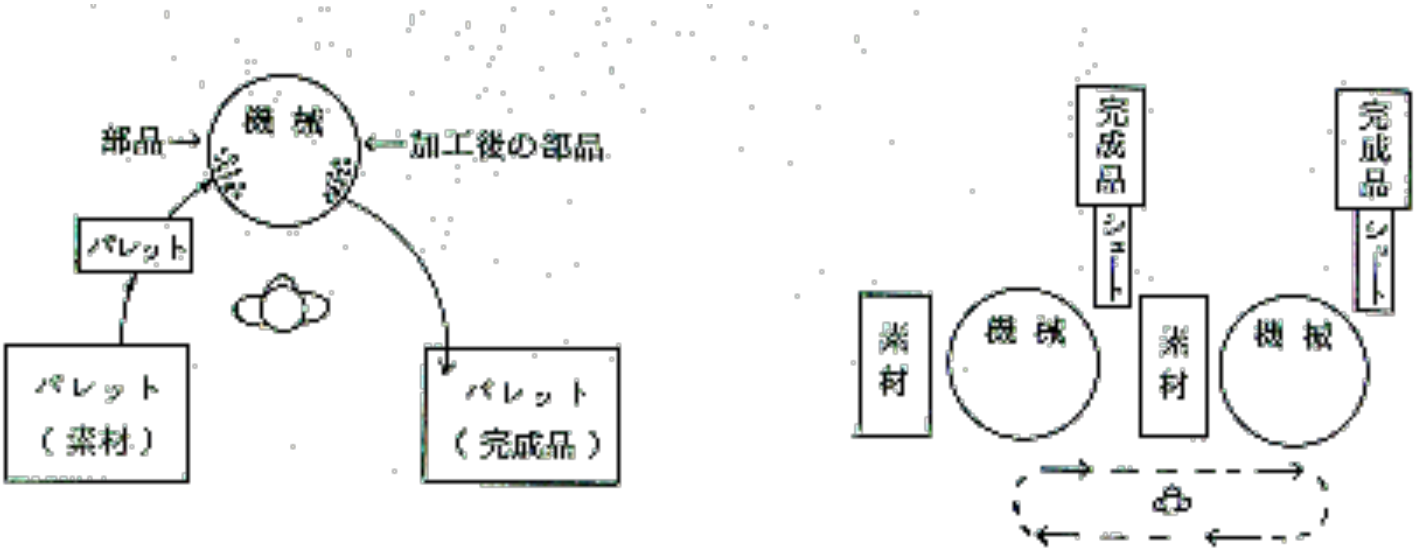
Unnecessary Activity of Transportation



The unnecessary activity of transport is an unnecessary transport distance, temporary placement, for trans-shipment and movement. It is about unnecessary activity that occurs.

To eliminate unnecessary activity of transportation, (A) You must keep the transport distance as short as possible. (B) Eliminate temporary placement.

As an example, parts were transferred from a large pallet to a small pallet, and furthermore temporarily placed on the machine (on the bed of the lathe) for temporary placement, but the pallet. By eliminating these temporary placements (eliminating unnecessary activity of transportation), we improved one machine so that one person can operate two machines.



Also, from shipping warehouse to factory, from factory to machine side, from machine side to operator's hands have been repeatedly transferred and moved, but these can also be said to be unnecessary activity of transportation.

Unnecessary Activity in the Process

For example, the work is done while the jigs are supported by the left hand, and for that reason the manufacturing of goods isn't progressing smoothly, and the wasted time is increased.

This is unnecessary activity of the processing itself. As an improvement in such a case, it is important to repair the jig as soon as possible.

Discovery of unnecessary activity is the first step towards increasing efficiency

We have already discussed how the TPS's central ideologies are all about elimination of unnecessary activity, and that unnecessary activity can be roughly classified into the four types in the previous section. When you consider each of these four, you can see that there are unnecessary activities that are easy to find, and some that aren't.

Few managers and supervisors let their people do unnecessary activities while being aware that it is not useful. In most cases, they regard it as necessary work, or just lack understanding.

No matter how much they think "Let's eliminate unnecessary activities!" if they don't understand where the unnecessary activity is, they won't be able to proceed with its elimination at all. Therefore, what really matters is making unnecessary activity visible to everyone.

That is the first step to increasing efficiency. In the previous section, the easiest unnecessary activity to find among the four types would be that of waiting time.

For example, within a three-minute takt time, a minute of waiting time emerges every cycle, not only the supervisor, but the person and the senior managers can tell that there's surplus.

If the operator moves around as if they are doing work throughout this minute, it will be hard to tell (unnecessary activity of transport and processing). If the next product is processed in this minute, nobody

would be able to tell whether it's an unnecessary activity or not (unnecessary activity of overproduction). All four types of unnecessary activities need to be changed into waiting time. That way, it would be relatively easier to put together countermeasures.

To do that, we consider methods like (A) Making the operator follow the standard operating procedures thoroughly, and not letting them do anything other than them. (B) Restricting them from getting far ahead, using a production system that utilizes Kanban. (C) Specifying a work space on the conveyer, thus preventing the operator from handling items ahead of time.

We will leave the detailed explanation of these methods to another chapter, but what's important here, is that we must be fully aware that to eliminate unnecessary activity, finding it comes first.

We must be aware that we should constantly maintain the work site so that any unnecessary activity is easy to find. These can be very minor matters at times, for example, there are times when the matter in question is just a single piece of inventory. Every increase in efficiency leads to cost reduction, it's important to think about why an item was made, even if it's a single item. Sometimes it is enough to think that this will serve as a clue for improvement.

In this section, we have discussed how increasing efficiency is carried out by eliminating unnecessary activities. We believe that there are still other ways to distinguish unnecessary activity, but the focus is that we should make an effort of changing the different types of unnecessary activities into waiting time, which is easy to see. We would like to repeat and emphasize that this is the first step to increasing efficiency.

[1] Also known as 'Jidoka'.

[2] Flow Principle #3 – Balance work content.

[3] These four categories were further expanded and subdivided into what is commonly referred to today as the '7- Wastes'. The objective of defining them was to make it easier for people to see where improvements needed to be made.

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··· 40m

Please share chapter 2 pdf. I have started reading chapter 1 already and it does give a different view and argu-

ments about the lean topics. I don't know if you have time to answer few questions related to them but I will send it to you if you can share your opinion about it. asfak_2011@yahoo.co.in

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