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TPS Manual - Chapter 1, Section 4

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> *Section 4 - Labor Reduction and Safety*

Safety First

There's a saying, "there is no use crying over spilt milk."

Various assets such as machines, even if damaged, can be restored by spending money, but human body is less likely to become fully recovered once injured. A fatal disaster, such as accident causing death, cannot be compensated with money.

Safety must be considered before everything else. There is no labor reduction where safety is not considered. We must consider safety as a foundation, and then think of all possible ways for labor reduction within that scope to reduce cost.

Sometimes we see cases where the improvement routine isn't allowed to proceed in the name of safety. At such times, we need to go back to the starting point and review the purpose of the work.

There would be no development or progress, if you think, "let sleeping dogs lie."

Relationship between Labor Reduction and Safety

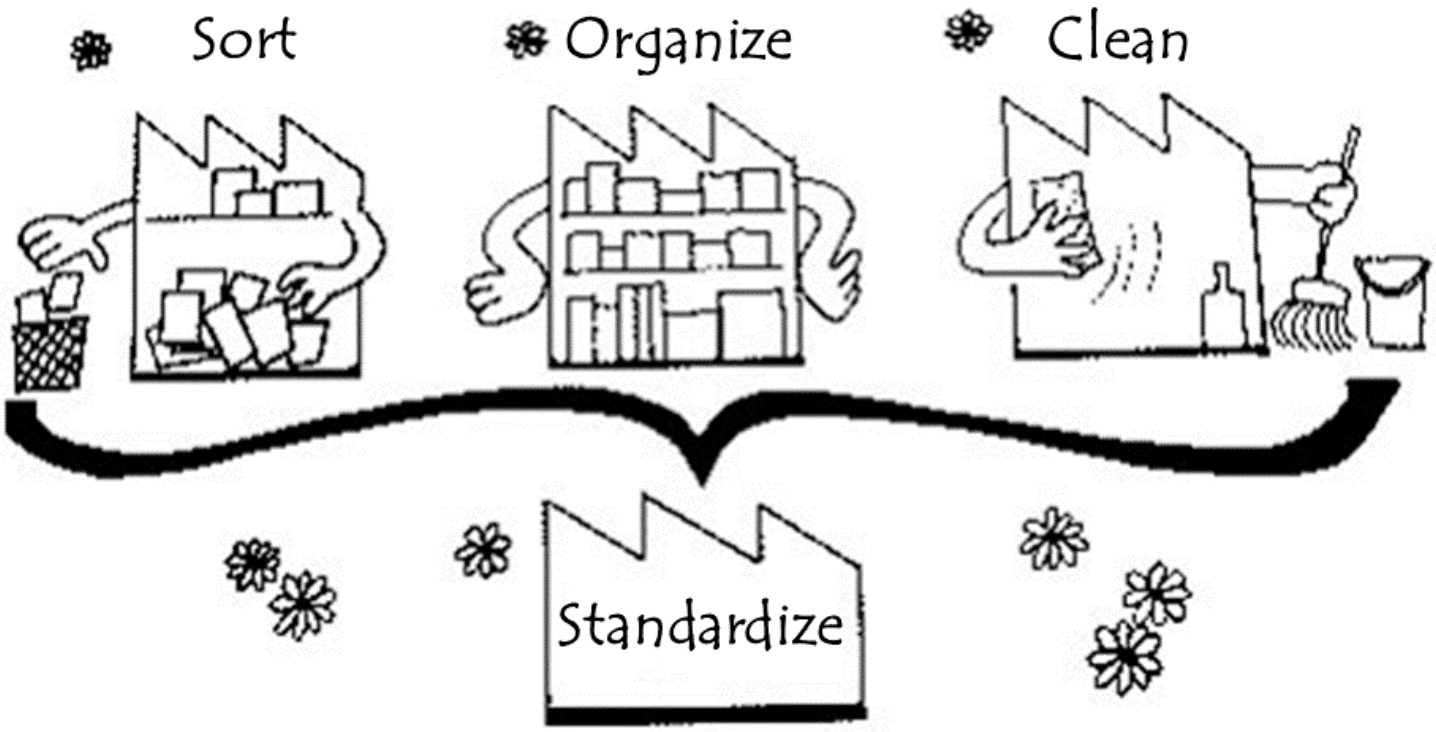
You will see that the seemingly conflicting values of safety and labor reduction are consistent with each other, because the labor reduction means also promoting the elimination of unnecessary, uneven, and unreasonable activities.

In other words, most of the accidents in production plants occur because of behaviors that can be thought of as activities that are unnecessary, uneven, or unreasonable.

We believe that doing or being made to do things that are unnecessary or things that are hard to do, leads to unnecessary activity, uneven, and overburdening actions which end up in injury.

We could use the Japanese characters for the word “Injury” to write “This is odd if I do say so myself”. Odd behavior that includes unnecessary activity, unevenness, and overburden is the cause of injuries, and eliminating unnecessary activity, unevenness, and unreasonable things leads to safety.

Workplaces where accidents are frequent, the day-to-day management is insufficient. These accidents occur frequently where the basic matters like 4-S, working procedures, and job instruction are not considered or even unrecognizable.



Workplaces that are passionate about their labor reduction and improvement routines, have fewer accidents. The more simplified the workplace is, the easier it is to manage. We emphasize 4-S as an aspect of safety management. 4-S is based on the people, materials, and equipment as they currently exist.

If the layout of the machinery and equipment is poorly designed; then practicing 4S will not achieve its purpose.

There's a limit to how much you can sort something when it's moving towards complexity. It should not be overlooked that people, materials, and equipment on site are not independent from each other but rather intermingled in a complex manner.

For example, this is the vicious cycle: there are too many people → too many products (accumulate stock) → more people needed for clean ups, loading and unloading, storage or rework is required → even more people.

In this way, increasing one thing increases other things accordingly. In the workplace, complexity is in direct proportion. It is important in advancing the safety management to hold off this tendency for complication as much as possible by labor reduction.

We will briefly explain 4-S; it refers to sorting, organizing, cleaning, and standardizing.

(A) **S**eiri - sorting

To divide things into needed and unneeded, and dispose of the unneeded things immediately.

(B) **S**eiton - organizing

Arranging needed things in an easy-to-use manner.

(C) **S**eisou - cleaning

To clean up and keep things tidy.

(D) **S**eiketsu - standardize

To maintain the state of (A), (B), and (C).

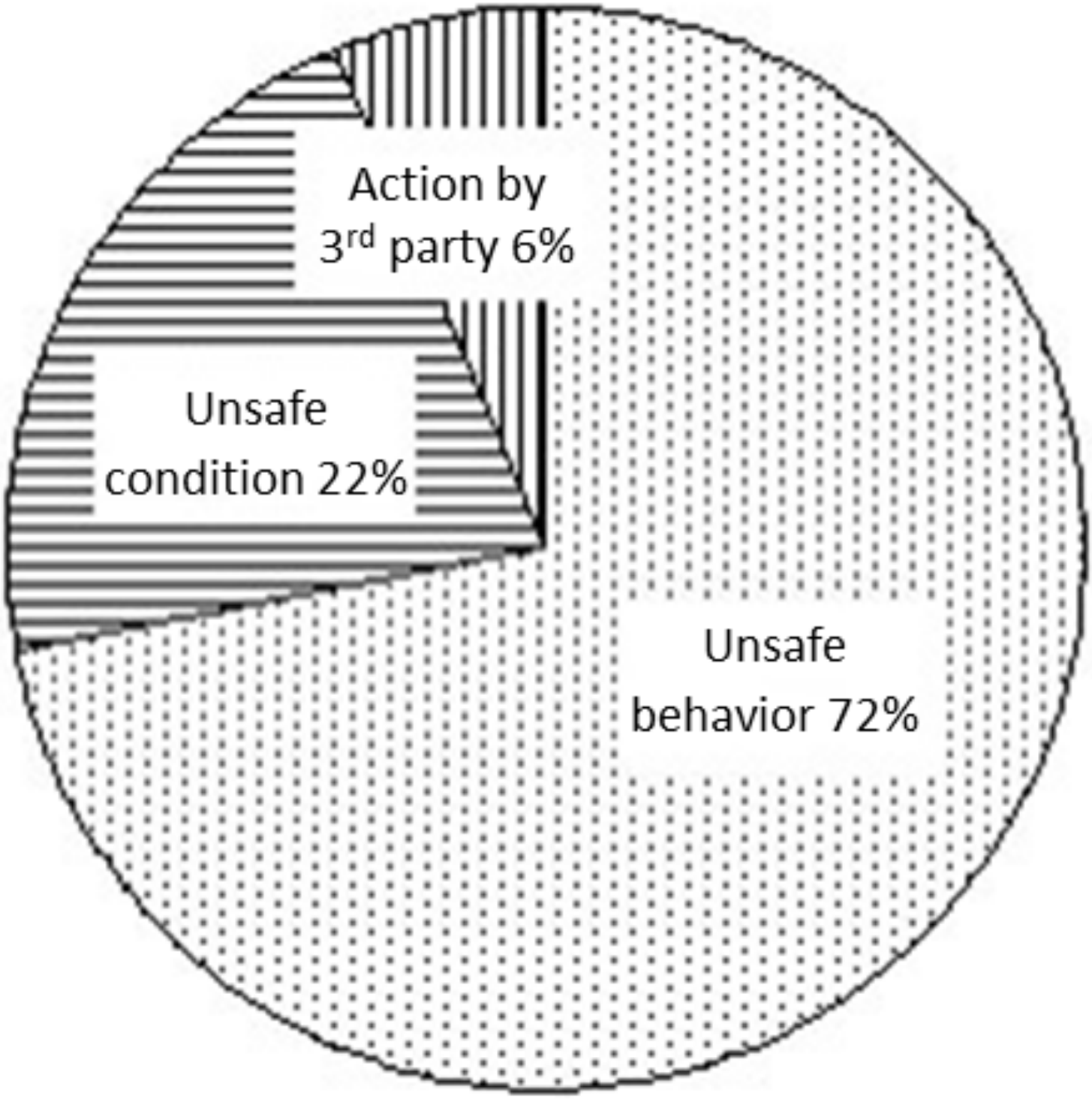
The status of accidents in our company

Looking at our company's accident status, we find that there were more than 800 occurrences of accidents per year. These accidents can be considered as just the tip of the iceberg.

There may be even more workplaces which are in similar conditions to ones where accidents took place, as well as ones that are continuously exposed to danger even though accidents fortunately haven't occurred?

Two years ago (1971), 878 accidents took place. If we consider Heinrich's law[1], there are probably an even larger number of people who experienced near-accident situations, even if it did not end in one. Such dangerous situations cannot be left unimproved.

Figure 2

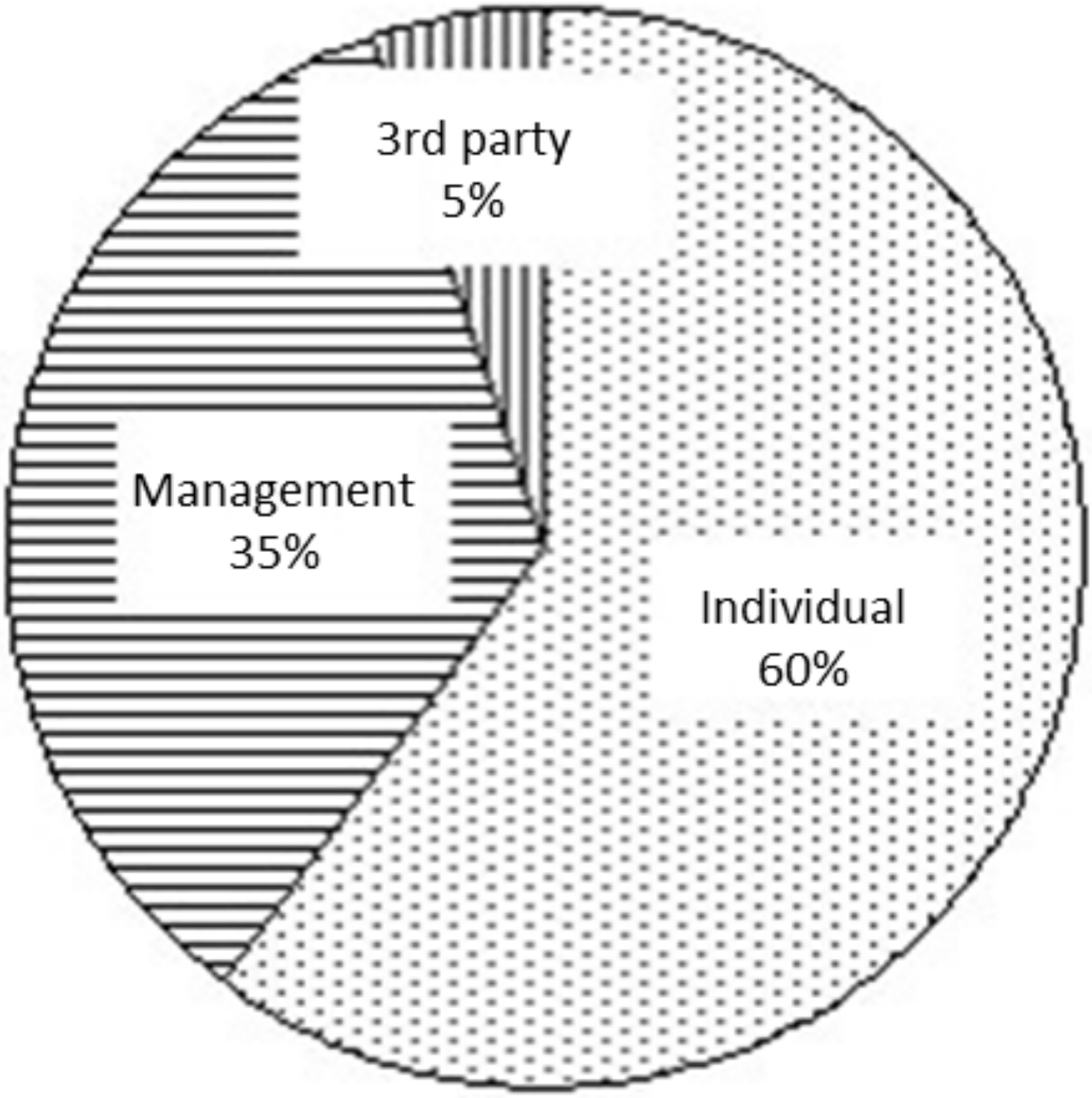


Accident Cause

Analysis of the main causes of accidents, as well as the risk conditions of the cause itself, we find that there were 142 incidents where safety wasn't taken into consideration; 77 incidents where maintenance adjustments weren't being made, and 14 incidents where there was no safety switch. These indicate that there is much room left for improvement.

If you look at the accident report of 1970, it shows many management responsible injuries linked to machine problems (20%); and the most frequent factor of accidents were forgetting to turn off the machine before working on a problem is (30%).

Figure 3



Accident Responsibility

We have a problem in our current way of preventing recurrence of equipment issues, and in our accident preventive maintenance systems.

One problem behind all of this; equipment issues are all left for the production worksite to handle. It is necessary to address the problems not only within the worksite but also with management.

The pie charts in Figure 2 and Figure 3 show the number of accidents grouped by main factors and the responsible party. At 72%, “unsafe behavior” is the major factor for accident cause. Individual behavior is the dominant factor when we look at responsibility.

Within a simplified workflow, there are almost no unnecessary, uneven, or unreasonable movements, thus it becomes easier to perform. It is also easier to manage. In this sense, the more simplified the work becomes, the less risky behavior there will be.

This gives birth to the necessity of “visual management” for leaders. They need to be able to immediately recognize when people do unsafe, unstable actions. This is how simplification is connected to the safety aspect in labor reduction routines.

The first step towards a safe production site

Safe work environment requires a company-wide deployment. The first step is to create a site that is free from the unnecessary, uneven, and unreasonable activity. We need to create an environment where it is easy to discover the unnecessary, uneven, and unreasonable activities.

(A) Under what conditions will work be carried out?

(B) What kind of procedures will be performed?

(C) What length of time for performing activity?

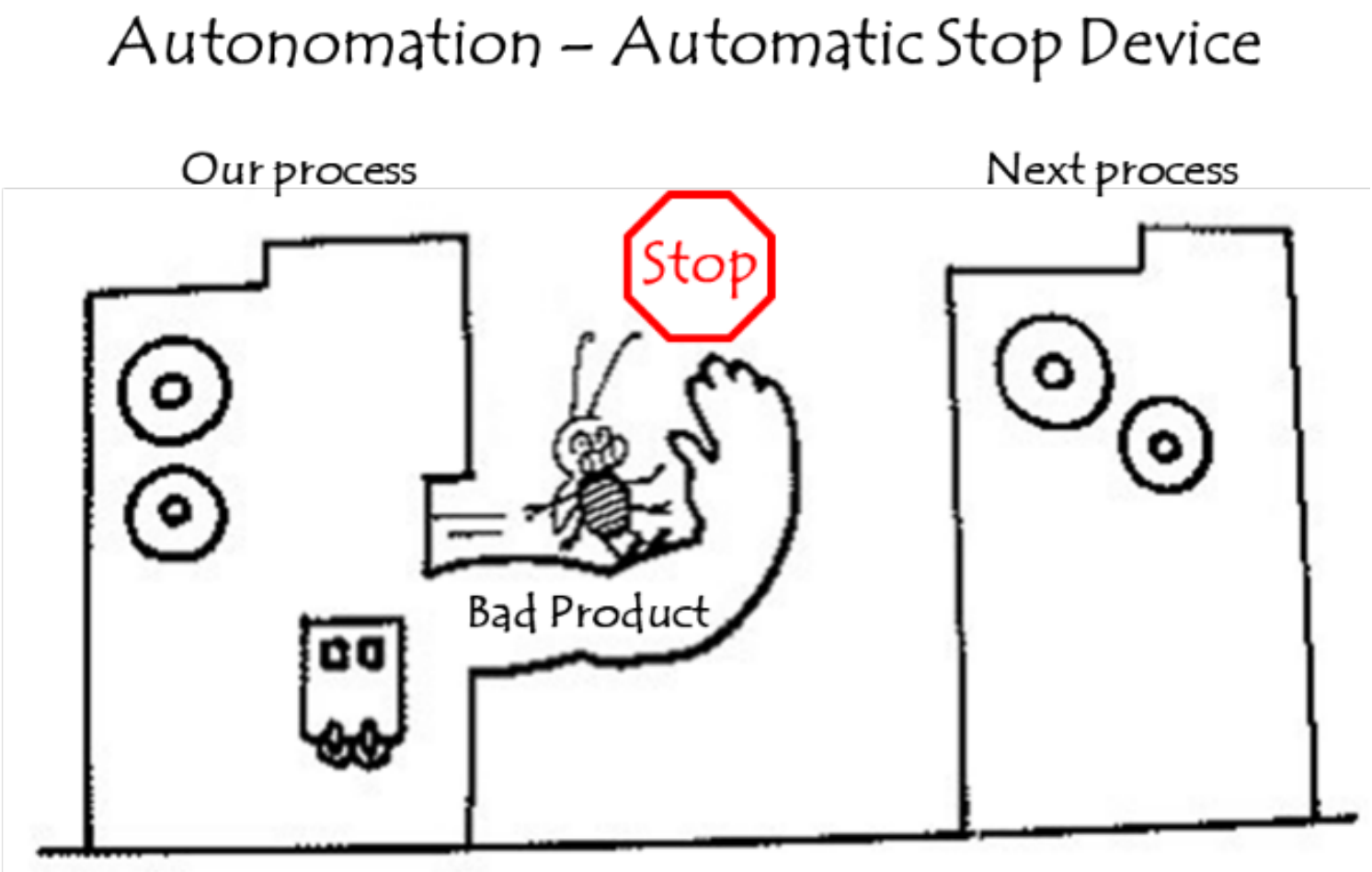
A job instruction manual that specifies these A, B, and C, should be defined (and maintained). Following effective job instructions will lead to creating a safe production site.

Our conclusion is promoting labor reduction will also lead to safety. To create a safe workplace, we should continue to expand our labor reduction activities.

Following this, we would like to consider the issues of autonomation (Jidoka) and one-touch activation.

Simplistic automation causes injury

Along with the increase of production in the past few years, the automation in our company has been rapidly developed. For the most part, the necessity of such automation has not been sufficiently questioned (i.e. there has been no thorough investigation regarding its unnecessary, unevenness, and overburden activities) thus, breakdowns occur often. To make it worse, there are high-speed machines without an automatic stop device, so it is extremely dangerous.



Because the automation was not designed as Jidoka (i.e. it was designed for labor-saving, rather than people saving), we still need to have someone to act as a guard, otherwise, it would come with the risk of the machine not functioning as required. “Autonomation” means that a machine is equipped with a safety switch, which stops the machine when an abnormality occurs.

This is important both from the safety perspective and from the labor reduction.

A machine that cannot automatically stop itself in the case of an abnormality, is at risk to bring about unexpected accidents.

The more expensive the automated equipment is, the more we worry about it getting damaged, which ends up in our assigning people to guard it. The people who guard it are rarely its

designers, or its makers, and are not even the ones who do its maintenance, this rather increases the risk of an accidents.

For example, let's consider the following:

Near a completely automated conveyor, we often see a signboard that says: "Turn off the switch before climbing onto the conveyor."

At first glance, it calls attention to the safely and looks as if the safety is assured; but above the conveyor, there's a platform on which there are often bars for moving anything stuck in the conveyor.

A person may not want to climb on it, but if the need were to arise, they might turn off the switch before climbing.

When the conveyor can't be fixed immediately (maintenance thinks it can wait, it is good enough if it just runs at 80%). And there is an expectation from management to ensure the production targets are met. Would the person still follow the rules and turn off the switch before climbing up on the conveyor?

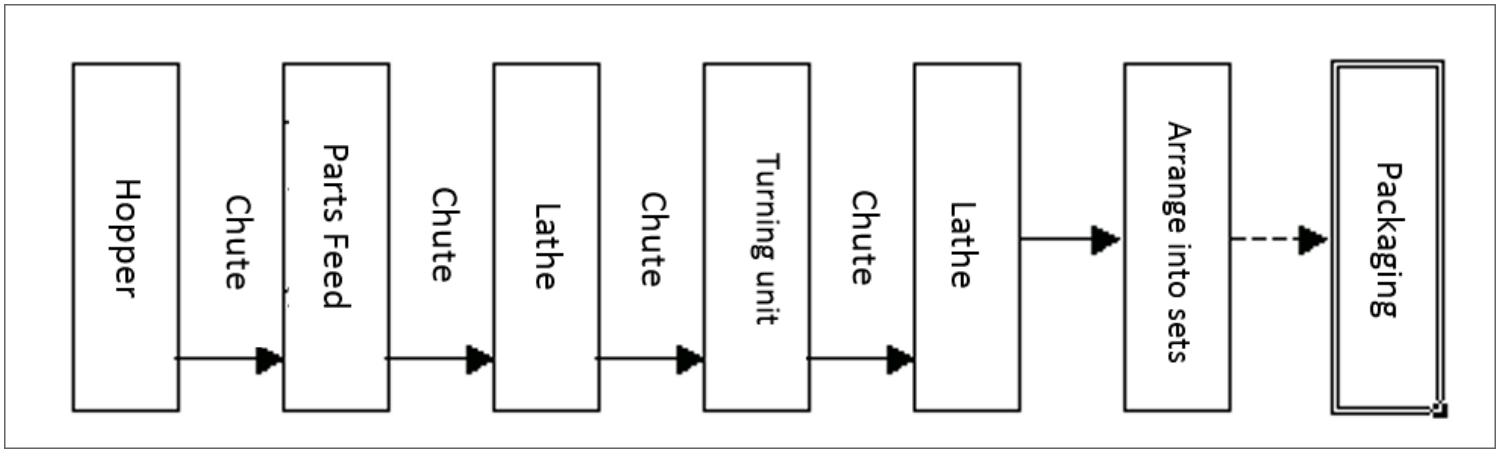
If an accident occurs, this will be reported that the **person** did not follow the rules. And the excuse might be given that the person didn't receive enough training. But the real reason is the presence of incompletely automated equipment that it was left as it is.

For truly automated, self- activated equipment, must be structured such that running at 100% functionality is considered as a given, otherwise it must have the structure that stops automatically in abnormal situations.

In other words, the 20% of the conveyor stops that were recognized as acceptable, should be considered as the cause that leads to injuries.

Example from a machine factory

The following case took place in a machine factory. Cases like this are common problems in automated work sites. Let's review the facts.



In the processes shown in the diagram, a person had their finger severed by a lathe.

Originally, the person's job was just to take the work that was automatically arranged into sets and pack it into boxes. Since there were about 10 lines like the line shown in the above illustration, one worker should have been enough to cover them. However, there were always three to four people on each line to improve the flow, otherwise scheduled production could not be met.

Because the flow through the chutes were irregular and the "No Work," "Pass Confirmed," and "Full-Work" switches were not properly maintained, when an abnormality took place, the machine wouldn't stop.

The accident occurred when the person's finger got stuck in a machine that was running "automatically."

For this example, a person observing that work site should question why one person could not do the job. Improving the flow on the chutes would achieve real labor reduction as well as creating a safer work site; and more importantly, an accident could have been prevented.

Is 'One-touch' activation a risk?

We have explained that the concept of labor reduction and the direction we are headed for do not go against safety, but rather, they coincide with the development of the various conditions required to promote safety.

At the end of this section, we would like to mention an example of a stamping press where labor reduction also resulted in safety improvement.

One-touch activation for machines such as stamping presses has begun to be adopted. In the machine shop, it has been utilized for quite a while. This is because of the concept that multi-machine handling is a matter of fact, and has brought out many innovations which consider safety.

If we go with a conventional type of activation that uses a two-hand “hold-to-run” button until the press reaches the bottom dead center, that time would be an unnecessary activity, and the extra walking time kills the benefits of multi-stage machine handling.

Why have the two-hand “hold-to-run” buttons been utilized up till now? They have been adopted to meet Labor Safety Regulations. According to the Labor Safety Regulations, “Machines such as presses must include measures to prevent entrance of body parts in the danger zone when using slides or cutters. However, this doesn’t apply to presses structured so that the slides or cutters can be immediately stopped when a body part enters the danger zone.”

The two-hand “hold-to-run” system merely complies with the latter part of this paragraph, but it does not fulfill the original purpose.

Even if it has a two-hand “hold-to-run” button, if a third person is involved, then it does not work effectively unless the person who did the activation noticed the danger.

The problem is not whether one-touch activation is bad, but is the machine structured so that it can make an emergency stop when a body part is detected in the danger zone.

Progress in the development of devices such as activation buttons with safety structures, where the machine immediately stops if something approaches it, reduces the risk associated with activation using a one-touch system. The machine must be stopped in the event of a fault of the safety device.

Even better would be a machine that people can use without putting their body parts near any danger zone. Such concepts have been gradually getting introduced in stamping presses and automatic welding lines.

For example, there is a 250-ton press that is equipped with the copper wire at the lower bottom of the shutter. If something touches the wire, the limit switch will stop the press.

There is a new type of automatic welding machine with a platform around it. It will not operate while a person is standing on the platform.

Both are examples where a push button was converted into a one-touch button. These are still elementary devices, with further improvement, we will probably be able to make all activation buttons into one-touch.

Even if you stop thinking about the rationalization of the work, convinced that there is no choice for the sake of safety, you may notice that there are several options of a safe and rational way of working, just by going back to the fundamental purpose of the work.

Continuous effort put into coming up with working methods, and systems for equipment or devices that lie within the margins of safety, while choosing the ones with the minimum unnecessary activity, will surely become even more important in the future.

[1] Heinrich's Law - In his 1931 book "*Industrial Accident Prevention, A Scientific Approach*", Herbert W Heinrich put forward the following concept that became known as Heinrich's Law: in a workplace, for every accident that causes a major injury, there are 29 accidents that cause minor injuries and 300 accidents that cause no injuries.

> *To be continued...*

Section 5 - Labor Reduction and Human Relations

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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