Operation Management System for Blanking Processing Facilities

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OKI's Mechatronics Systems Plant in the Tomioka region produces such products as ATMs, cash processing machines and automatic ticketing machines. The plant's parts processing department is responsible for the manufacturing of high-mix low-volume parts (variety of products: approx. 100,000 items/average lot: approx. 50 pieces/daily production: approx. 500 items). When producing such products, use of dedicated press molds is rare. Instead, in many cases, blanking processing (processing the desired shape from a sheet metal) using a common mold with NC data is performed. In blanking processing, highly versatile machines such as punch-laser combination machines or turret punch presses are used. These processing facilities are expensive, and how to raise production efficiency is the challenge.

Although speeding up the blanking processing facilities contributes to improving production efficiency, other measures to operate the processing facilities efficiently are required. Therefore, as a tool to identify the current issues that need solving to improve production efficiency, an operation management system was built and tied to the improvement activities.

This article provides an overview of the operation management system and examples of its use in contributing to the improvement of production efficiency.

Issues with Operation Management based on Colored Indicator Lights

Typically, operation management is carried out based on colored indicator lights provided as a standard function on the processing facilities with red meaning stopped and green meaning operating (**Figure 1**).

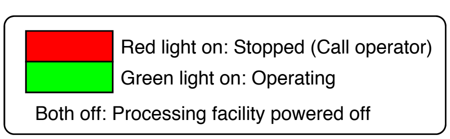

Figure 1. Indicator Lights

Figure 2 is a case where operation management is based on colored indicator lights, and it shows the one-day (24-hour) operation states of a processing facility. At first glance, it seems the operation rate is high. However, it must be noted that the green indicator light does not necessarily mean the facility is processing parts. This is because the indicator lights were originally installed to draw the worker's attention. For example, while the processing facility is preparing for the next operation, the facility is not processing any parts, but the indicator light is green. Such times of operation are defined as non-value-added actions, and it is distinguished from value-added actions where the facility is processing parts.

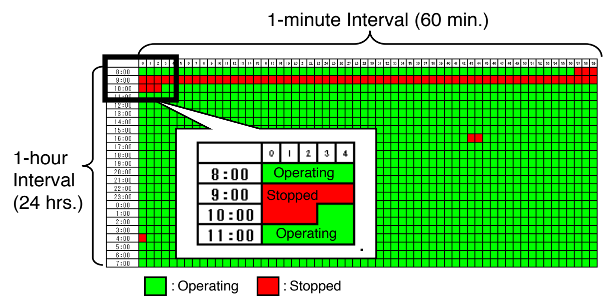

Figure 2. Current Operation Display (Daily Summary)

The following two tasks need to be addressed to improve the production efficiency of processing facilities.

(1) Increase value-added actions

In the operation of the processing facilities, six actions shown in **Table 1** are performed. Of these, the punch and laser processing are value-added actions, and the rest are non-value-added actions. In increasing the ratio of value-added actions, it is considered effective to identify which state should be reduced through analysis of the non-value-added actions and then devise a measure.

Table 1. Processing Facility Operation States

Operation State	Action
Punch Processing	Value-added Action
Laser Processing	Value-added Action
Workpiece Feeding	Non-value-added Action
Workpiece Discharge	Non-value-added Action
Punch Change	Non-value-added Action
Parts/Debris Discharge	Non-value-added Action

(2) Reduce stop time

As **Table 2** shows, eight main causes bring a processing facility to a stop.

Among them, the alarm stop states require the operator to confirm the stop state of the processing facility before attempting recovery. Hence, there is variation in response time. It is effective to analyze the stop time by cause and take measures against the cause that will return the highest effect.

Even with the facility stop states, the stop time can be reduced by speeding up maintenance work and reducing failures of the processing facilities.

Table 2. Stop Causes of Processing Facility

Stop State	Cause of Stoppage
Alarm Stop	Light barrier detected
	Parts discharge alarm
	Punch change alarm
	Other alarms
Facility Stop	Power off
	Repair due to failure
	Maintenance work
	Operator standby

Operation Management System Overview

As described in the previous section, analysis of the processing facilities' operation states and stoppage causes/frequencies is indispensable for improving production efficiency. However, presently for both operation and stoppage cases, motion analysis requires the operation of the processing facilities to be recorded on video, then the recorded videos must be watched to take measurements of the time required to perform work or remedy an alarm. Such analysis takes an enormous amount of man-hours to perform. Therefore, an operation management system was to be developed to collect the necessary information from the processing machine so that motion analysis can be performed without video. The information required for detailed operation management was to be output in form of a signal. Specification for outputting the signal was created and a request was placed with the processing facility manufacturer for modification. As a result, necessary signals can be extracted every second from each processing facility. All the extracted signal information is output to a text file on a daily basis and stored in a dedicated management database. **Figure 3** shows the hardware configuration of the operation management system.

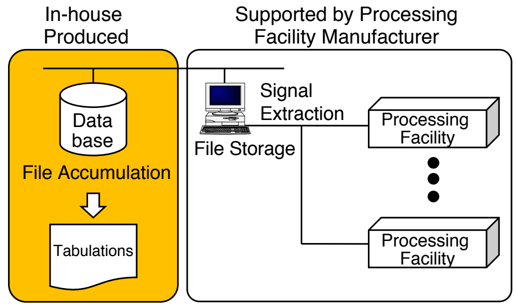

Figure 3. Hardware Configuration of Operation Management System

In order to display and analyze the detailed operating states of the processing facilities from the accumulated signal information, a tool was created to perform the following two tabulations.

- Tabulation by operating factors according to the format used in the current operation management system (daily tabulation)
- Tabulation to display a list of operating states for each processing facility on a daily basis (monthly tabulation)

Figure 4 shows examples of the tabulation results displayed by the created tool.

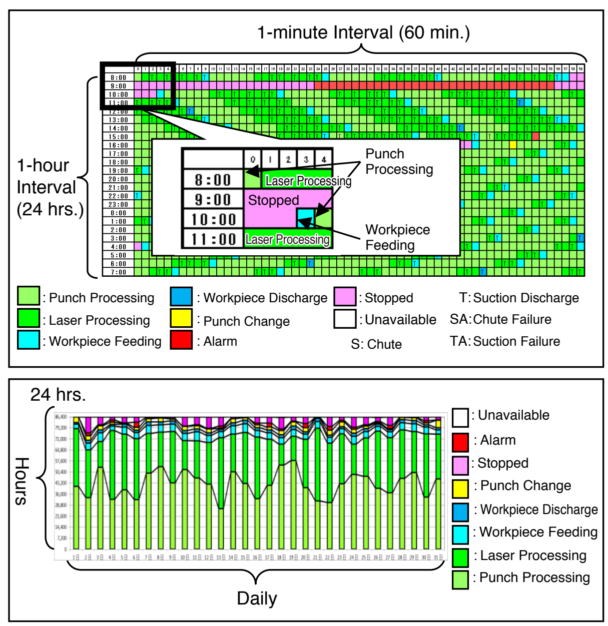

Figure 4. New Operation Display (Top: Daily Tabulation/Bottom: Monthly Tabulation)

Figure 5 shows the state of a processing facility tabulated by the old and new operation management systems for a particular day. Comparing the two results, about 13% of the old system's operating time was non-value-added actions, and among those actions, punch change was the most time consuming.

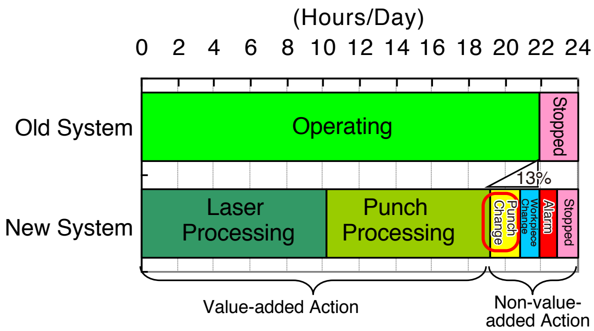

Figure 5. Comparison of Operation Management System Results

Figure 6 is the detail obtained with the new operation management system for stoppages caused by alarms. The alarm with the most stop time was the parts discharge alarm.

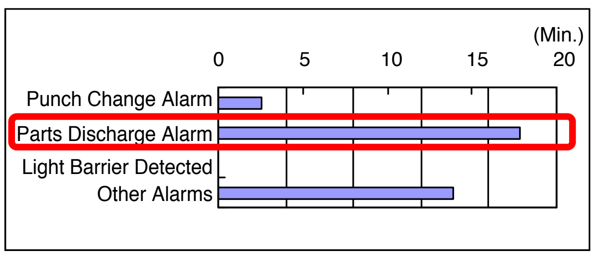

Figure 6. Alarm Detail (Stop Time per Day)

Application Examples

Introduction of the operation management system made it clear that reducing the punch change work and parts discharge alarm will greatly contribute to improving production efficiency. The measures taken to reach these goals are described in this section.

(1) Reducing stop time due to punch change

The stoppage caused by punch change is explained in Figure 7. About 300 types of punches are held in a rack for each processing facility, but in order to perform punch processing, it is necessary to set the punches on the turret. Although the change work is performed automatically, punch processing is halted while the work is taking place. The length of time the processing is halted is the stop time due to punch change.

The number of punches that can be set on the turret (about 50 types) is limited. Therefore, when processing NC data that exceeds the limit, punch change becomes necessary.

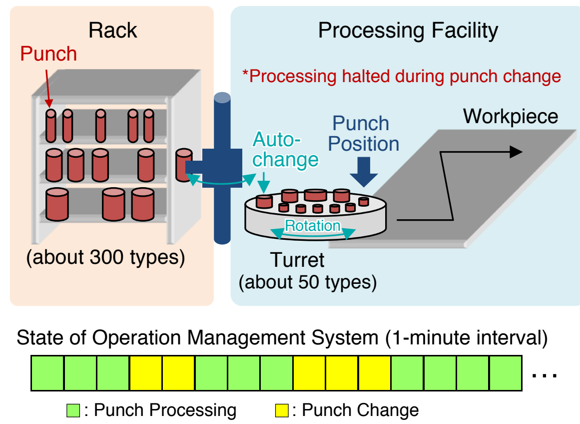

Figure 7. Stoppage due to Punch Change

Currently, the creation of NC data to be entered into the processing facility is automated using an in-house system. As work orders issued from the production management system vary day-by-day, parts combination is determined each time the NC data is created. Work orders are extracted according to the order in which the work order was placed and combined with priority given to arrangement efficiency, but the number of punches to be used is not checked.

This time, an optimum punch limit was set for each processing facility and punch change minimizing function was added to the in-house system (Figure 8). As a result, the punch change time was reduced by 24% while maintaining arrangement efficiency (**Figure 9**).

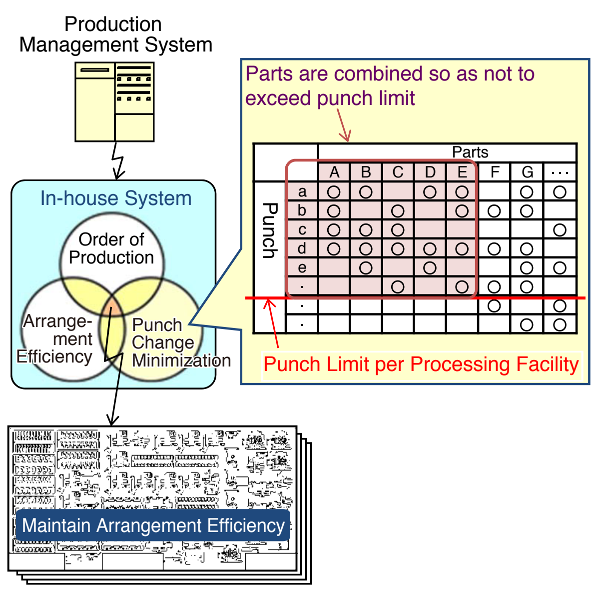

Figure 8. Punch Change Minimizing Function added to In-house System

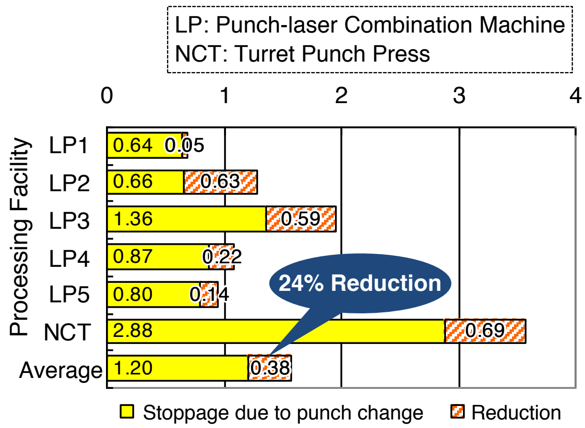

Figure 9. Punch Change Time (Hrs./Day)

(2) Reducing stoppage due to parts discharge alarm

A typical way to discharge parts is the drop chute method. In this method, a discharging device called a chute tilts after processing so that parts are dropped and discharged down the chute. During this time, a part may become caught on the workpiece due to its shape and fail to drop setting off a drop chute alarm (**Figure 10**).

The drop chute alarm accounts for more than 95% of the stop time caused by the parts discharge alarm.

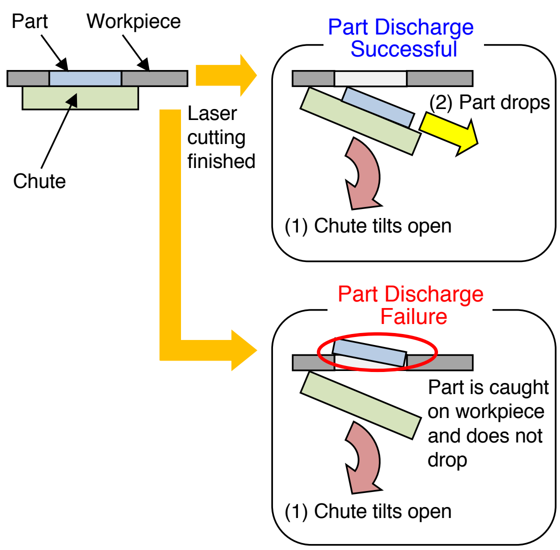

Figure 10. Drop Chute

For parts that frequently cause drop chute alarms, it is possible to prevent the alarm from triggering by cutting off the sections that become caught before the part is dropped. Until now, this measure was only taken as they were reported by the operators. With the new operation management system, the occurrence frequency of the drop chute alarm is known, so it is possible to take measures without omission. Furthermore, incorporating measures to prevent drop chute alarms into the NC data creation criteria enabled measures to be in place before parts with similar shape are processed.

Due to the taken measures, the punch change time and the alarm stop time were reduced extending the value-added actions. The effect of the improvements is shown in **Figure 11**.

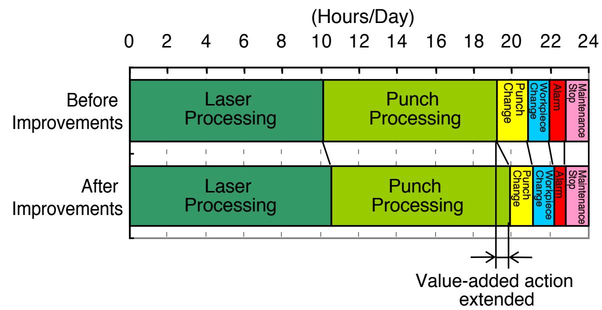

Figure 11. Effect of Improvements

Future Work

This time around, focus was placed on actions that greatly tie to the improvement of production efficiency, and appropriate measures were put in place. Now, the operation data that was obtained will be effectively utilized to seek out problems and measures for the other actions not yet addressed. Additionally, alarms that occur periodically will be identified and collated with repair records. This will lead the way to preventive maintenance in which facility components are replaced before failures occur. The aim of these efforts is further reductions in the processing facilities' stop time.

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