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Development of a Quality ID System Using ICT

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Abstract

Quality reliability improvement is the most important problem in producing products. Production ability improvement is urgent business while a change of generation advances. Under environment of such situation, we developed a quality ID system and the quality information computerization system which utilized ICT (Information Communication Technology) for the purpose of high-quality improvement. This technique is fused in PDA (Personal Digital Assistance) and a sound identification technology. The quality ID trouble maintains 0 cases after beginning to use, and this system achieves productivity improvement. In addition, this system wins Nikkei manufacturing award in 2007.

1. Introduction

In the manufacture of steel plates that widely vary in size, the improved reliability of quality control is of prime importance. On the other hand, considering the ongoing generation change, the reinforcement of manufacturing capacity, including the improvement of productivity, is an urgent necessity. Under those conditions, in order to enhance customer trust, suitable measures must be taken to completely eliminate complaints from customers about product quality. At the same time, to further raise the rate of product availability, the efficiency of individual production processes requires improvement.

In this paper, we shall describe the quality ID (size recognition) and electronic quality information systems that have been developed using information communication technology (ICT) and the improvement in customer satisfaction and conditioning process productivity that was made possible by these systems. In addition, we shall briefly describe other operation support systems that have been recently introduced.

2. Problems in Offline Finishing Work

In each plate plant, several offline finishing processes such as gas cutting, straightening, and conditioning are utilized to meet the many diverse customer specifications. Unlike the online processes that have been automated using automatic measuring instruments, etc., however, offline processes largely involve manual work (e.g., measuring and recording). In addition, with the ongoing generation change, there were times when unskilled workers sharply increased in number. At such times, qualified inspectors had to help with the operations performed by the inexperienced workers. Overburdening of the qualified inspectors was probably the reason for an increase in the number of customer complaints about ID/size in the inspection work in offline finishing processes. Under these conditions, there was a growing need to automate the offline finishing processes so as to enhance the efficiency of operations. The abovementioned automation systems were developed with special attention being paid to the inspection work that is particularly burdensome and can result in customer complaints.

Figure 1 shows the change in the number of customer complaints at the plate mill of Kimitsu Works in recent years. The number of serious complaints regarding inaccurate ID/size identification increased when the generation change began. **Figure 2** shows the

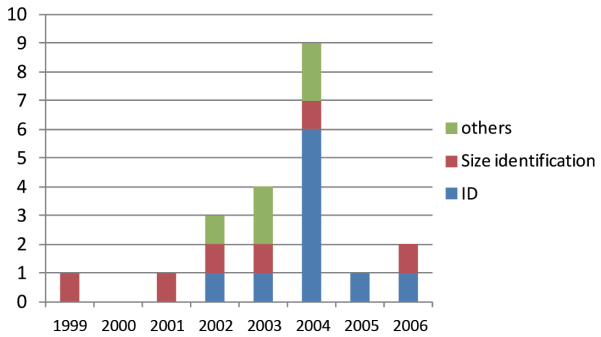

Fig. 1 Number of claim and complain

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breakdown of complaints by process, and **Fig. 3** shows the breakdown of complains by reason. The reasons for complaints are seen to be inaccurate ID (53%), inaccurate size identification (18%), and other (29%). With respect to the processes, 24% of complaints are ascribable to the automatic conveyor lines (A-line, line inspection, and ultrasonic inspection) and 76% are due to offline finishing processes, with the gas cutting process accounting for 23%.

A review of the measures taken to reduce customer complaints in the past shows that major emphasis was placed on reinforcing on-the-job training and revising work standards while ensuring a strict observance of them. Thus, the measures taken were focused on field operators and could not be said to have lasting effects. Therefore, we have developed two systems: the quality ID (size identification) system, which is aimed to completely eliminate customer complaints ascribable to the gas cutting process and improve the productivity of the process, and electronic quality information system aimed to improve the efficiency of process operations.

Table 1 shows the former gas cutting process flow and the new flow after introduction of the system.

3. Concept of Quality ID (Size Identification System)

The ICT developed and introduced for size measurement comprises a personal digital assistant (PDA), digital micrometers, digital length meters, data transmission equipment, and a voice recognition device. These four devices have been put into practical use in the following ways.

(1) For size measurement, the digital micrometers, digital measures, and data transmission equipment are used in combination.
(2) For camber measurement, a voice recognition device is used.
(3) The measurement results are automatically checked by the PDA for tolerance, and the results of the check are announced by voice.
(4) IDs of the PDA and business computer system are identified by the barcode printed on a worksheet and are used as the key.

Figure 4 shows the configuration of the quality ID system.[1] The PDA is a palm-sized, hands-free type manufactured by Sharp. The barcode reader is a built-in type. ID identification from the worksheet is possible. The digital micrometer is available in the market. The digital length meter shown in **Photo 1** was developed by our company.

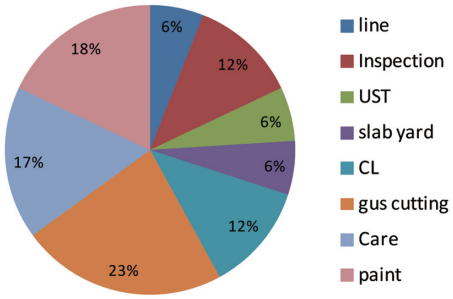

Fig. 2 Claim outbreak process

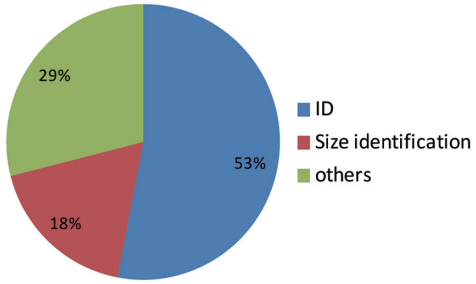

Fig. 3 Claim outbreak reason

Table 1 Old and new work flows and development ICT in gas cutting line

Work procedure	Work item	Conventional work contents	Claim and complain	Development ICT	New work contents
1	Placement plate	Locate a plate			Same as on the left
2	Number confirmation	Confirm the number of the plate and write the number on the paper			Same as on the left
3	Work instructions vote output	Output a work instructions vote with the number that he wrote on the paper		Bar code, sound identification equipment, data transmission equipment	Distinguish the number automatically and receive the plate information to a PDA
4	Marking, cutting	Marking and gua cutting			Same as on the left
5	Number confirmation	Identify the number of the work instructions vote	○	Bar code	Distinguish the work instruction vote in bar code
6	Thickness, width, length measurement	Measure and write result of a measurement on the plate	○	Digital thickness, width, length meter and data transmission equipment	Transmit result of a measurement to a PDA and check clearance automatically and inform a result by a sound
7	Record of the result of a measurement	Transfer the number to a work instructions vote	○		–
8	Business computer operation	Input the number into a business computer	○	Bar code	Distinguish the work instruction vote in bar code
9	Clearance check	Check clearance after input	○		–
10	Quality information	List quality information by handwriting		Digital pencil	List the quality information with an digital pencil in a workflow

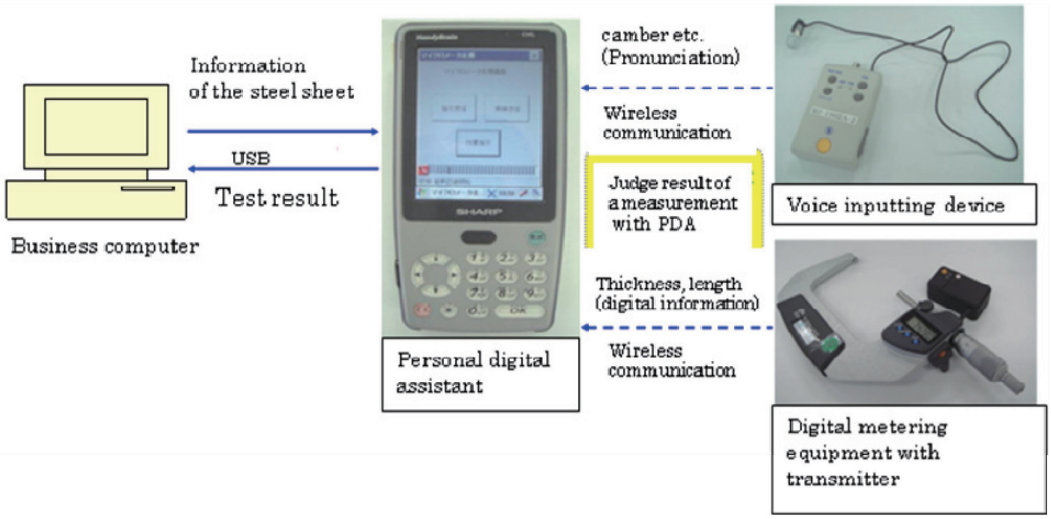

Fig. 4 System constitution

Photo 1 Digital length meter

3.1 Measurement data transmission equipment using Bluetooth

Cables were the conventional means of transmitting measurement data, although the measuring instruments could be connected to a PC/PDA. Even via wireless means, a PC was required to be within the radio range. Therefore, we developed a wireless transducer to allow for Bluetooth transmission. As a result, instantaneous data transmission to a portable PDA even in an environment without a PC and easy data upload from a PDA to a PC after the completion of work is now possible. The developed transducer is equipped with an application program that permits checking of the primary tolerance in the field and inputting and displaying the measurement data without uploading it every time a measurement is made.

3.2 Simplification of aize input by voice recognition device

Formerly, a wired headset with good directivity was used for voice recognition. However, once moved away from the mouth, it failed to pick up voices because of background noise. The bone-anchored throat headset is less influenced by background noise, but it cannot always obtain quality sound because of an unstable contact. Therefore, we developed a mobile headset that is capable of capturing low-volume voices near the ear (via a ear microphone) when the uttered micro voice enters the ear tube and vibrates the eardrum, thereby making it possible to stably pick up voice (background noise reduced by up to 90 dB) and transmit the data to the PDA via Bluetooth.

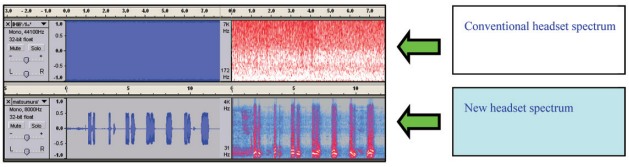

Fig. 5 Result in old and new head systems

Figure 5 shows the difference in voice recognition between the old and new headsets in the presence of background noise. It can be seen that the new headset appreciably eliminates the background noise.

4. Concept of Electronic Quality Information System

The purpose of development of the electronic quality information system was to avoid human errors during transcription of data and shorten the handwriting time so as to improve the efficiency of work.[1)] Formerly, in each of the offline finishing processes, the quality information sketch was prepared by hand. Recently, we built a new business flow system using an electronic pen and E-mail to reduce the burden of field work. As a result, the quick utilization of quality information and improved rate of product availability are now possible. **Figure 6** shows the new quality information sketch sheet using an electronic pen and E-mail as compared with that of the old method. Thanks to the shortened handwriting time, the work efficiency has improved by 10%.

5. Conclusion

(1) For size measurement, wireless data transmission equipment and a mobile voice recognition device with a good resistance to background noise have been introduced.

(2) Formerly, the results of size measurement were used as the input to a business computer terminal in a local room, and their tolerances were checked. The newly established ID assurance system has made it possible to check the tolerance of the meas-

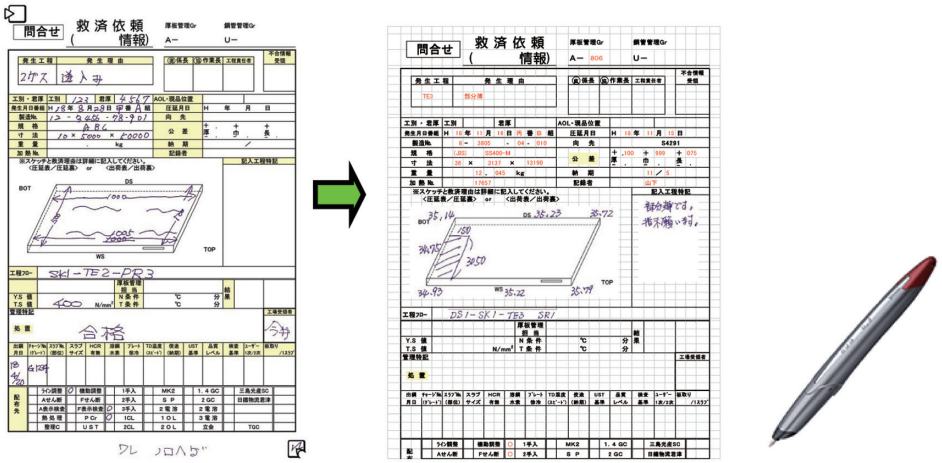

Fig. 6 Electronic pencil and quality information sketching sheet

ured product (field check).

(3) It has been made possible to perform automatic tolerance check in the PDA after the input of data to the voice recognition device and data transmission equipment. In addition, the need of confirming the data on the PDA screen every time a measurement is made has been eliminated by the voice response of the check results, allowing hands-free operations.

(4) The transfer of measurement data from the PDA to the business computer has been simplified by introducing a barcode printout on the ID worksheet.

(5) The time required for size measurement/inspection after the product is cut via the gas cutting process has been reduced to half.

In addition to the systems described above, we have developed and put into practical use an operation support system using ICT, an operation data filing system, an equipment inspection system, and a dangerous zone recognition system, among others.

5.1 Operation support system

This system displays the results of relevant operations in the past and the work instructions required to manufacture a new project product in order to prevent careless mistakes of the operators and improve the efficiency of operations.

5.2 Operation data filing system

Utilizing a newly developed image linking technology, this system displays field monitor images on a screen with the time axes of electrical and mechanical instruments, systems, etc. and permits the automatic recording of operation for several minutes before some trouble occurs.

5.3 Equipment inspection system

Comprising an administrative terminal, a PDA, and a voice recognition device, this system provides guidance to the operator with equipment inspection, registers field inspection results by means of voice or image processing, checks high and low limits, and implements trend management.

5.4 Dangerous zone recognition system

By applying image processing technology, this system recognizes the entry of any person into a specified dangerous zone and issues a warning.

Reference

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