INFORMATION TECHNOLOGY THAT SUPPORTS ROBUST MANUFACTURING

MANABE Yoshitoshi [*1]

As a result of each individual's improvement activities founded on basic New Yokogawa Production System (NYPS) principles, our company has met QDC (Quality, Delivery, Cost) requirements which are directly reflected in enhanced customer value. However in recent years the prevalent environment of global competition has resulted in a strong demand for even further advancements in QDC. To realize this, it is essential to use an IT-driven systematization based on an NYPS framework. This paper introduces an example of the improvements made using this NYPS-based IT-driven system to realize increased QDC in manufacturing.

INTRODUCTION

Our manufacturing method features made-to-order production in which production begins only after orders are received from customers. Additionally, it is one-piece-flow production in which production of small quantities of many products. In order to achieve customer satisfaction, it is essential to satisfy their QDC (Quality, Delivery, and Cost) requirements, making it mandatory to realize quality improvement, reduced lead time, and the elimination of waste at every stage of the process. Since introducing the New Yokogawa Production System (NYPS), we have realized major achievements toward the attainment of these targets by concentrating our efforts on the improvement of activities in the production field. However, the environment surrounding management has become increasingly severe, and we have entered an era of fierce competition in the global market. Thus, even greater evolution in the production field is essential, and to that effect we have been extending efforts toward the conversion of production mechanisms that have to date been reliant on manpower, to an information technology (IT) form.

This paper introduces the objectives of our NYPS-based IT-driven systematization, and our IT-driven large variety, small lot production lines. It will serve as the introductory chapter for the specific production technologies that support our core product technologies, introduced following this article.

*1 Sourcing and Manufacturing Business Headquarters

OBJECTIVES OF IT-DRIVEN SYSTEMATIZATION

IT-driven systematization has been implemented with the following three objectives in mind.

Enhanced Cooperation in Production, Sales, and Technology

To achieve increased speed in business, it is important to secure cooperation among production, sales, and technology. Figure 1 shows an overall view of our backbone system. In terms

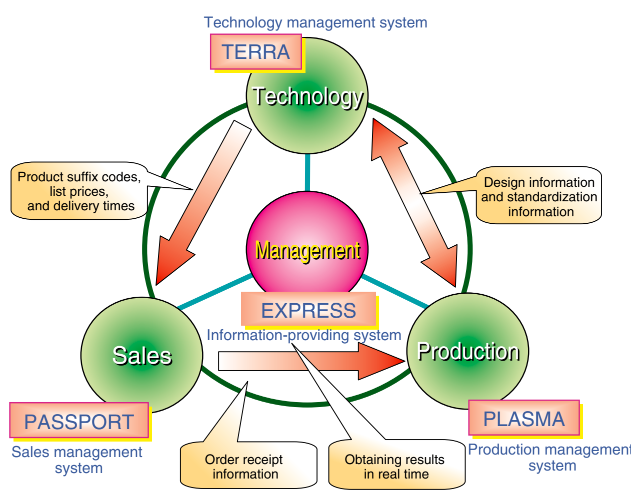

Figure 1 Overall Image of Our Backbone System

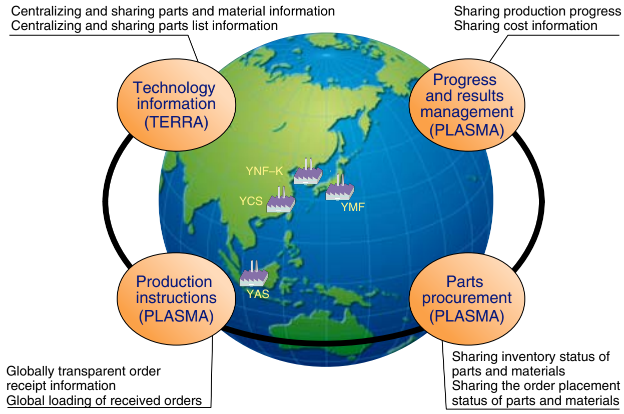

Figure 2 Globalized Production Management

of the cooperation between technology and production, design information from the technology management system TERRA is sent to the production management system PLASMA, with PLASMA sending standardization information for manufacturing to TERRA. Sales and production cooperation entails the order receipt information from the sales management system PASSPORT being sent to PLASMA, while technology and sales information, including product specifications, list prices, and delivery information from TERRA are communicated to PASSPORT. These interactive information systems realize an environment in which data can be exchanged in real time, enhancing cooperation among production, sales and technology and significantly improving total business efficiency.

Dealing with Global Production Locations

Just as do production plants in Japan, manufacturing plants in overseas locations must have standardized production mechanisms and operations, share technological information and information about orders received, and ascertain important management information regarding such things as progress status, achievements, and so on. Therefore, PLASMA has been positioned as a global production management system and has been introduced to three overseas manufacturing locations (in Singapore, China, and Korea) to build a global environment in which production, sales, and technology information can also be shared among these manufacturing locations. This environment that uses the same system and interface enables the same duties to be performed even when products are shifted to any manufacturing location. This allows us to respond flexibly to global requests (Figure 2).

Further Improvements Using the NYPS-based IT-driven System

We have conducted QDC improvement activities mainly using manpower based on the basic NYPS principle; however, we have made efforts in converting three major areas into IT form, aiming to achieve even further improvements. Specifically, the first area we tackled was to make the commitment to one-piece-flow production for our main assembly lines. Because production instructions and parts setup and supply instructions are provided in concert with each other after the determination of work startup, the efficiency of a whole series of operations has been improved. Secondly, in-process inventory has been reduced to zero because work startup instructions are provided to parts production lines in synchronization with assembly lines due to our commitment to by-order production (order-based production) in the parts production line, the preceding process. Thirdly, an "electronic withdrawal Kanban" system has been introduced to the parts supply system from a store (parts shelves) to line-side stores (temporary yards) which significantly reduces parts supply time from physically distant locations. Efforts in these three fields have enabled us to thoroughly achieve "one-piece-flow production lines" and "synchronized production processes." This in turn has lead to the realization of increased operation efficiency, the reduction of in-process inventory, and reduced total lead time.

IT-DRIVEN PRODUCTION OF SMALL QUANTITES OF MANY PRODUCTS LINE: EXAMPLES OF IMPROVEMENTS

This section introduces examples of the improvements we have achieved by converting various production mechanisms that were previously handled by manpower to IT form, realizing by-order production and production of small quantities of many products.

Specifications Check and Delivery Calculation

Conventionally, operations were such that the sales department entered order information, then accurate order information was conveyed to the production departments after passing through the business affairs department, a special group that checked specifications and delivery times. Since information could be input

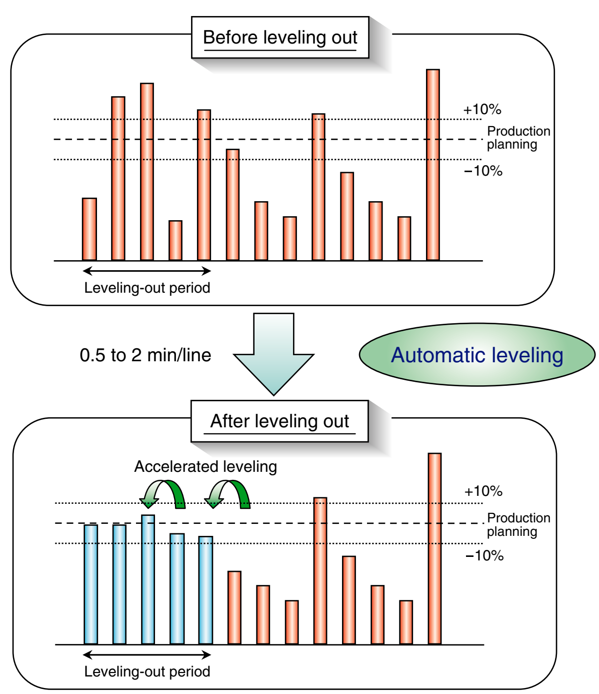

Figure 3 Concept of Leveling-out Processing

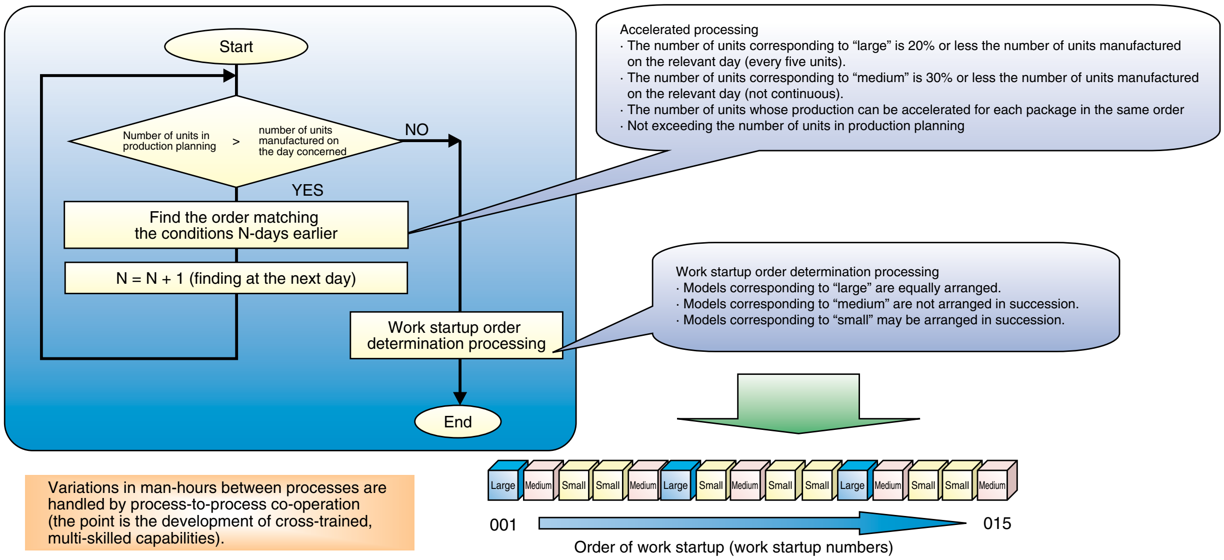

Figure 4 Example of Automatic Leveling

as order information without restraints, there were shortcomings such as a consistent 20% inadequacy rate in the specifications, the convenience of production taking precedence over customer-requested delivery times, and the fact that order information took three days to be processed. These aspects have been improved such that the specifications are automatically checked at the time of order entry and limitations are imposed on free information input. Moreover, delivery time is calculated automatically, taking production and logistic lead time into account in accordance with the specifications. As a result, specifications inadequacy has been drastically reduced and information processing lead time substantially shortened to just one or two hours.

Order Management and Production Leveling Out

Order information was previously controlled using a visually based control system that consisted of arranging instruction sheets (containing specifications, delivery times, serial numbers, etc.) in order on a dispatching board (a delivery control board using production line number units). Thus, modifications had to be made each time specifications or delivery times were changed, which sometimes required half a day's work when there were frequent changes. This work is now managed using an electronic dispatching board with the system, allowing dispatch processing to be automatically performed in real time and order management to be conducted on the system itself. Then, automatic production leveling is performed that determines the order of work startup for

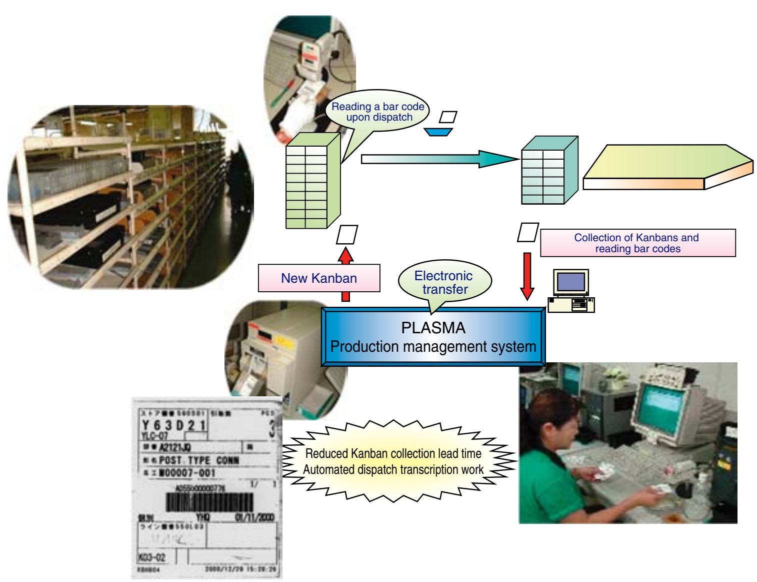

Figure 5 Introduction of Electronic Acceptance Kanban

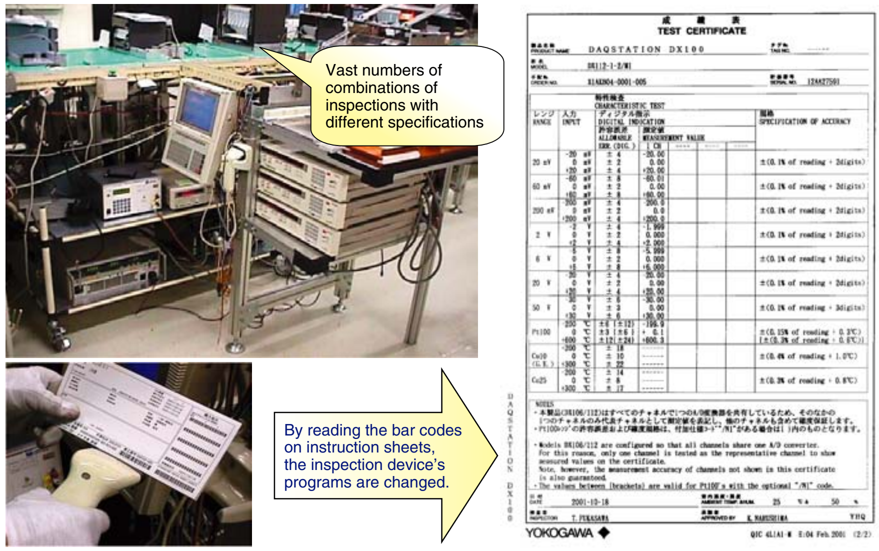

Figure 6 IT-driven Production Line

each production line based on this electronic dispatching board. Automatic production leveling is conducted focusing on the following four points: ① daily leveling out on the relevant day, ② observing the customers' delivery times, ③ leveling out of the term's (monthly) production planning in a range of ±10%, and ④ final decision making by individuals. Figure 3 shows the concept of leveling-out processing. The basic algorithm used for this automatic leveling is shown in Figure 4. The most important elements are accelerated processing and the determination of work startup order processing that takes model-basis combinations for manufacturing of many products into consideration.

Electronic Withdrawal Kanban

The supply of inventory replenishment parts to the production lines is achieved by using "Kanban" between the production lines and store (parts shelves, or warehouse). In the past, this "Kanban" was collected at the production lines and then delivered to a physically distant store. The supply of replenishment parts to the production lines was done on a daily basis. Therefore, the "Kanban" system has been changed to an "electronic withdrawal Kanban (using bar codes)." The conversion of parts dispatch information to an electronic format that can be conveyed from the production lines to the store has made it possible to reduce "Kanban" transportation time to a unit of a few hours. Moreover, dispatch control itself has also been automated (Figure 5).

IT-driven Production Lines

(1) Provision of Information for Automation with a Human Element Device

Multiple product types pass through many products, mixed production lines in a different order. Thus, each time a different product type was to enter a line, it was necessary for the operator to input new specifications to the adjustment and inspection devices, and to configure the creation devices used on the line to change inspection items and programs. It was inevitable that input errors occurred during these entry operations and program changes. To address this situation, we developed a common interface that enables PLASMA, our high-level production management system to provide specifications information for these devices. Specifically, the inspection device programs are automatically changed when the bar codes on instruction sheets are read, and inspection data is then gathered to create inspection reports as shown in Figure 6. As a result, the time required for program changes has been reduced and the quality of the inspection process has been improved. The problem of incorrect inspection reports has been alleviated.

(2) Conversion of Procedures into Electronic Format

Some product specifications can involve several tens of thousand items, depending on the production lines, and providing work instructions using hardcopy procedures resulted in complications, increased man-hours, and a propensity for errors. Thus, printed procedures have been converted into electronic format, and these are used in concert with work startup instruction information from PLASMA to display procedure information on a monitor. This allows the timely communication of work instructions to the operator. As a matter of course, the switching of the instructions displayed uses the bar code on the pertinent instruction sheet.

CONCLUSION

Ultimately what is most important in IT-driven production lines is to thoroughly improve the production mechanisms first, then to subsequently introduce IT-driven systematization. The mere introduction of an IT-driven system does not improve operations, and it is important to restructure operation flow and the arrangement of operation rules. In future we intend to proceed with further developments by improving QDC in manufacturing to enhance customer values. ◆