Implementation of Real-time Integrated Platform for Producing Food Packaging Container

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Abstract

This study proposes a plan to construct an integrated platform that reduces manufacturing costs and efficiently produce by integrating the systems of main producers, production subcontractors, and raw material subcontractors for the production of food packaging containers. The production plan of food packaging containers and raw materials is established in real time between the main producers, production subcontractors, and raw material subcontractors in consideration of the demand characteristics of each product. It establishes basic information that all processes from the production planning stage to the forwarding stage of the product are linked to each other. The progress of each producer of interlinked processes is shared in real-time to improve productivity and quality of food packaging containers and raw materials and reduce manufacturing costs. By monitoring the system of the main producer and the production subcontractor in real time, the production of food packaging containers is performed in a timely manner, thereby improving productivity. The application of the plan-do-check-action (PDCA) process, which includes planning, execution, evaluation and improvement in the production operation processes of the main producer, production subcontractor and raw material subcontractor, enables improved production compliance rate. The contents of the main producers, production subcontractors, and raw material subcontractors are managed in real time, then a converged production management system is established through the platform proposed in this study to ensure timely supply and demand of raw materials without delay in ordering.

Key Words: Food Packaging Container, SCM, Intelligent Production Management, ERP

1. Introduction

Presently, various food packaging container manufacturers and raw material subcontractors are seeking to diversify in line with changes in many industries and the era of the industry 4.0. However, SMEs(small and medium-sized enterprises) are making great efforts to establish a production information management system with IT companies, while they are trying to grow into leading SMEs by reinforcing their corporate competitiveness[1].

Manufacturers that produce food packaging containers using plastic (PET, PP, PS) and biodegradable

resin (PLA) are classified as chemical manufacturers in poor industries, while the lack of research and development costs and professionals makes it difficult to establish a production information management system for them. As a result, manufacturers that produce food packaging containers using plastic and biodegradable resin are in desperate need of faster adaptation to the environment of rapidly changing digital information, thus especially it is required to eliminate unreasonable factors in the production process, improve quality, and reduce manufacturing costs.

In addition, food packaging containers are required by consumers as a decisive factor in high-functioning, high-quality products and services due to the increase in consumers' income and changes in their perception of food hygiene. As demand patterns change rapidly in accordance with consumers' food tastes and packaging methods due to global warming, demand for food packaging containers is also changing to demand for small quantities of multiple varieties. In order to cope with unspecified order production and urgent orders, the necessity of maintaining adequate inventory of packaging containers produced before ordering, securing raw materials, and rapid changes in production processes is gradually increasing. There is an urgent need to establish a changed supply chain management (SCM) system that can respond quickly[2].

In the case of large enterprises, supply chain management systems are established and operated to strengthen their corporate competitiveness. Supply chain management systems operated by large enterprises are not applicable to the production of small quantities and multiple varieties to cope with rapid changes in climate and seasonal factors and preferences, rapid changes in packaging and demand, and to plastic and biodegradable resin orders. Since each individual company has a different production management method, it causes problems for main producers and production subcontractors producing the same or different types and sizes of food packaging containers, and raw material subcontractors in the same industry who supply raw materials for food packaging containers not being able to share system resources with each other.

Platform systems through collaboration between intelligent production management systems and manufacturers have little problem if they produce all products only based on order or if they are all consigned to the same product in an original equipment manufacturing (OEM) manner. However, the product is made up of small quantity and multi-products, and new demand for pre-production of products before ordering is frequently generated due to changes in climate and seasonal factors[3].

In this study, establishment of a real-time integrated platform for the production of food packaging containers is proposed for the followings; establishment and sharing of food packaging containers and raw material production management plans for the production of small-scale multi-variety food packaging containers between major producers, production subcontractors, and raw material subcontractors in relation to the production of food packaging containers, monitoring and sharing of food packaging containers and raw materials production progress for timely delivery according to changes in unspecified demand due to climate and seasonal factors, warehousing and delivery management to minimize the storage warehouse that the main producer, production subcontractor, and raw material subcontractor must secure for the storage of produced food packaging containers and raw materials, and enhancing productivity of food packaging containers and reduce production and logistics costs by sharing production management information.

2. Related Studies

2.1 Intelligent Production Management System

The human resource management device detects the movement of workers for production activities and collects personal information by analyzing the activities from the detected movement. The physical resource management device detects the status of incoming and outgoing physical resources required for production activities and collects physical information indicating the status of physical resources. The facility information collection device collects facility information that shows the production results of the facility for production. The production system is determined by visually displaying the detailed work and sequence of operations for each production process. An intelligent production management system has been launched

that includes intelligent production management devices which provide process status information on all processes of the production system based on human resource information, physical resource information, and facility information[4].

The intelligent production management system plans and simulates the entire production process, and monitors each process status of the production system through RFID and sensors to solve problems.

2.2 Enterprise Resource Management System

ERP (Enterprise Resource Planning) system can provide corporate workplaces in real time to make decisions quickly and bring about business process transformation. Developing a system with an ERP system applied does not guarantees to apply all of the various business processes[5].

The ERP system shall be modified and applied in accordance with the business process. The productivity and maintenance aspects should be considered using UI development tools. It should also provide a standardized UI and make it easy to respond to changes in business processes [6].

3. Implementation for System Linkage between Main Producer and Subcontractor

The method proposed in this study is to allow the main producer platform system, one or more production subcontractor platform systems, and one or more raw material subcontractor platform systems to operate in one system in real time. The integrated platform system for the production of food packaging containers is equipped with integrated storage servers that receive and store information stored on the main server in real time. The terminal PCs for production equipment management and terminal PCs for warehousing and delivery management are authorized by the main producer client system to manage menu operations for production management information.

Table 1 lists the standard information for production of food packaging containers, master data for production of food packaging containers, customer information for food packaging containers, equipment information for production of food packaging containers, raw material information for food packaging containers.

Table 1. System-linked schematics for the production of food packaging containers

Main Producers and Subcontractors	Raw Material Subcontractor
Standard information for production of food packaging containers	Standard information for raw material production
-Master data information for food packaging container	-Master data information for raw material
-Account information for food packaging container	-Master account information for raw material
-Equipment information Food packaging container	-Master equipment information for raw material
-Mold information for food packaging containers	-Master ejector information for raw material
-Product information for food packaging container	-Master product information for raw material
-Raw material information for food packaging container	-Master production raw material information for raw material
-Packaging material information for food packaging container	-Master packaging material information for raw material

The account information for food packaging container includes; vendor specific packaging characteristics including food, fruit and general product packaging; customer unique code characteristics distinguished by container biodegradability; business name; surface treatment information includes silicone oil treated or anti-fog treatment on the outside of the container; purchase classification information that distinguishes the purchase method including regular, occasional and new.

The production equipment information for food packaging container includes; equipment unique code letters for each food packaging container production equipment classified by the characteristics of the production equipment including molding machine, hole punching machine, and trimming cutter; names of production equipment including molding machine, hole punching machine, and trimming cutter; names of mold used; and hole processing devices for molding machine.

The production mold information for food packaging containers includes; unique code letters for each mold classified by the production process of molding; names of mold; the number of cavities indicating the number of molds required to form molds; punching and trimming; the weight of scrap left; the duration and weight of raw material consumed for each molding in one cycle including combining and separating of molds in the production of food packaging container; the number of food packaging containers manufactured per molding unit; the operation time of the molding machine for one cycle of molding machine operation; and the holes or trimming process.

The raw material information for production of food packaging containers includes; types of raw materials including SHEET; raw material unique code letter classified by raw material supplier; raw material supplier name; names of the raw materials; quality and color of the materials; silicon oil or anti-fog treatment processed on the surface of raw material; the duration, width, and thickness of raw material consumed for each molding in one cycle including combining and separating of molds in the production of food packaging container; the weight for one roll of raw material.

Figure 1 provides production management information for the main producer platform, production subcontractor platform, and raw material subcontractor platform.

Each sub-production management information includes MDM (master data management), APP (aggregate production planning), MPS (master production schedule), MRP (metal request planning), SPC (Statistical Process Control), FOM (Facility Operate Monitoring), in-put operation, general logistics management operation, and Deport information.

Purchasing materials planning information, which is the sub-production management information of production management information, is transferred to the production subcontractor platform and raw material subcontractor platform.

The production subcontractor platform and raw material subcontractor platform then receive process management plan information, production equipment monitoring information, and general logistics management operation DEPORT information.

The production subcontractor platform receives purchase material plan information from the main producer's platform, and sends out the process management plan information, production equipment monitoring information, and general logistics management operation DEPORT information.

The information on purchasing materials plan of raw material subcontractors' platforms is transmitted, then the process management plan information, production equipment monitoring information, and general logistics management operation DEPORT information is received.

The process management plan information, production equipment monitoring information, and general logistics management operation DEPORT information is received from the client system of the main producer's platform and production subcontractor's platform.
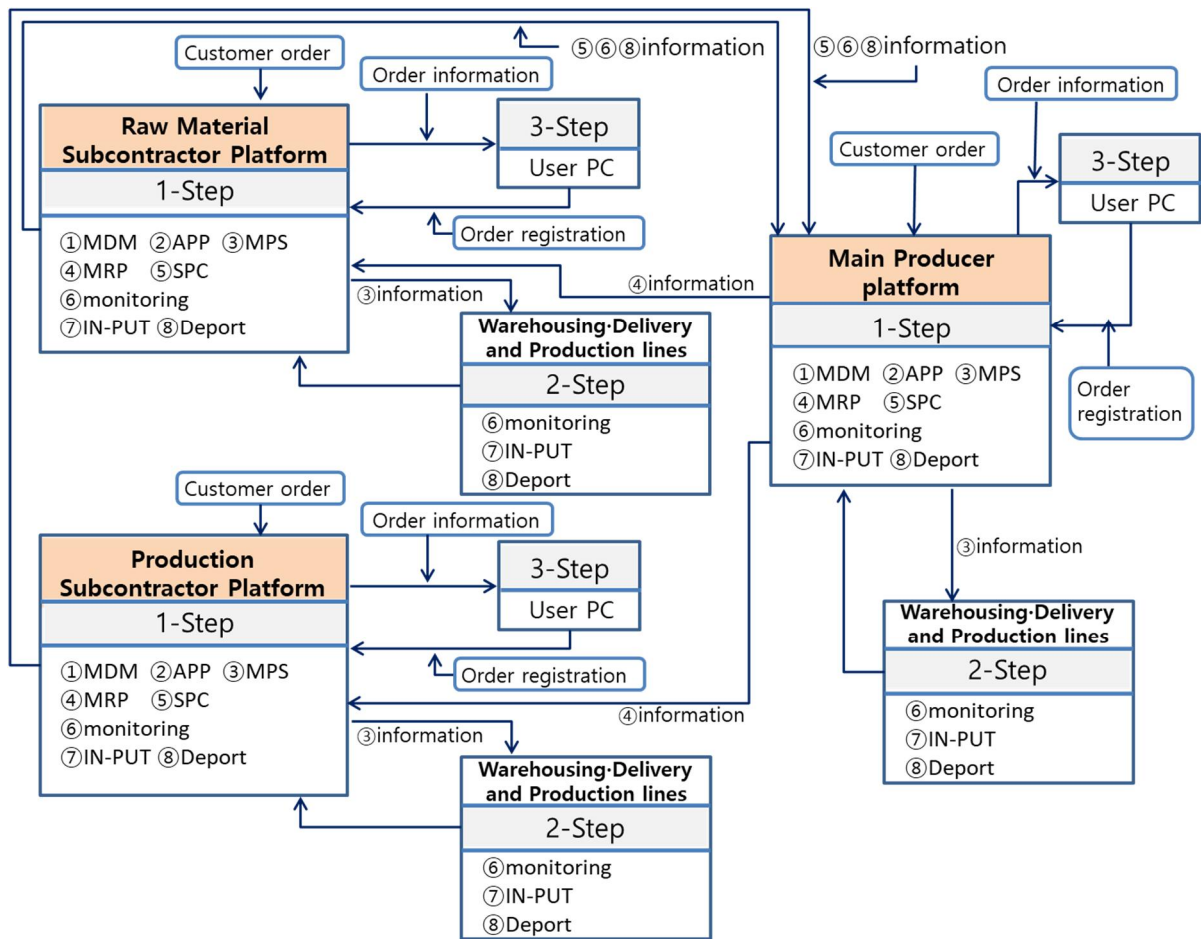
Figure 1. System processing flow chart for production of food packaging containers

Figure 2 represents the processing flowchart for the main producer client system. The main production platform system, production subcontractor platform system, and raw material subcontractor platform system respectively store in the main server the following information; food packaging container production standard information; raw material production standard information; client PC processed information from the main producer client system; production process information sent from the terminal PC for production equipment management; and the logistics management information sent from the terminal PC for warehousing and delivery management.

It has wired and wireless connectivity between the main server and the main producer client system. Each production management information is generated using one or more of the production criteria information, raw material production criteria information, client system processing information, production process information, and logistics management information.

The information is processed by sharing at least one lower level production management information of each generated production management information in real time. The main producer's client system, which controls and manages the authority, operates production equipment by wirelessly connecting to the user's PC and local controller, respectively, operating and managing menus for production management information according to the authority granted.

The production process information of the production equipment detected by the counter sensor collected through the controller is sent to the terminal PC for production equipment management that transmits it to

the main server. It operates barcode scanners and barcode scanners by connecting to barcode printers and barcode scanners respectively.
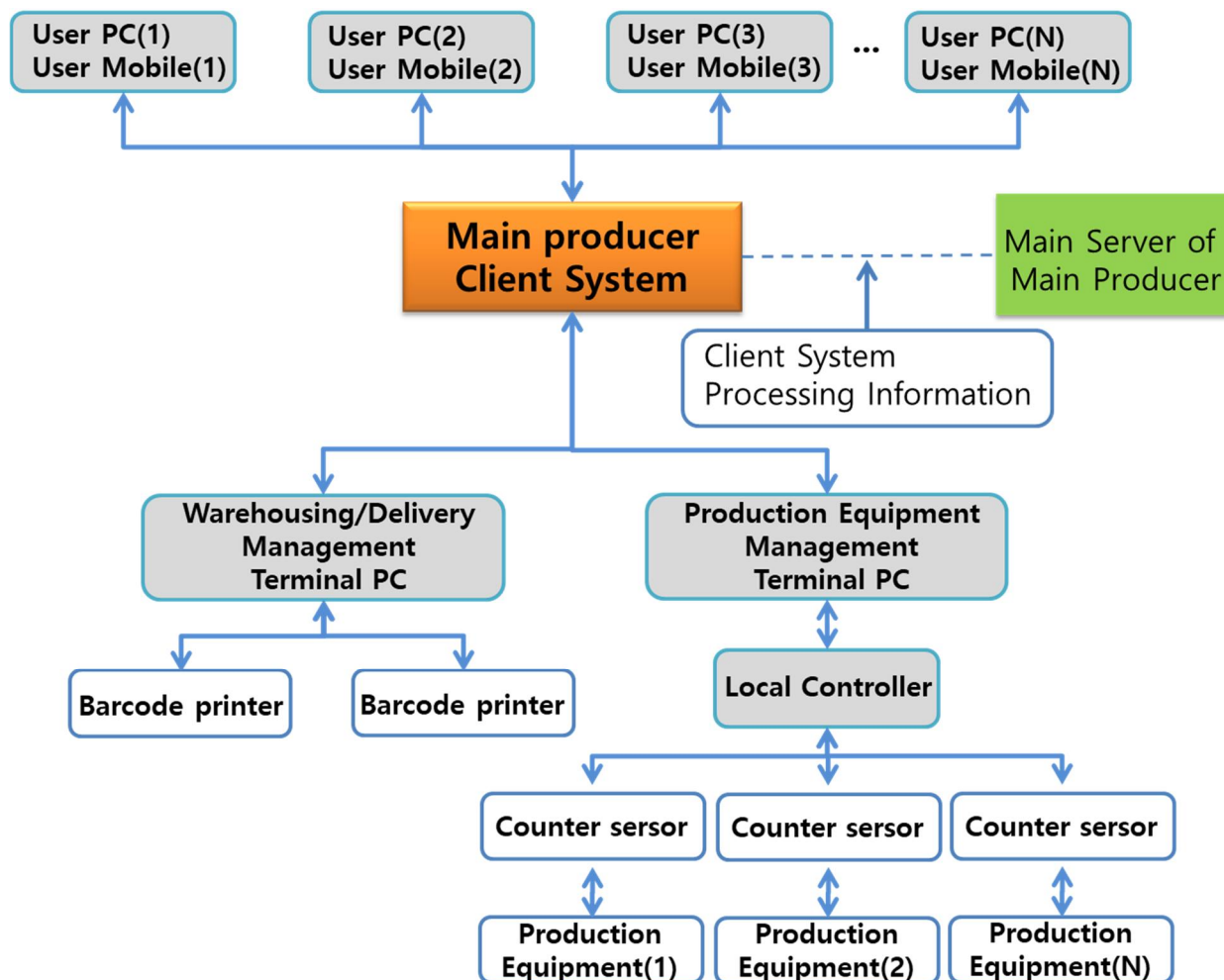

Figure 2. Processing Flowchart for Main Producer Client System

4. Conclusion

In this study, a real-time production plan is established for each company's product in relation to the production of food packaging containers and raw materials between major producers, production subcontractor, and raw material subcontractor, and the entire process from the production planning stage to the delivery stage is linked with each other, then the progress of each production company is shared in real time by establishing a system being connected to each other. When integrated platform modules are used, the following effects can be expected. (1) Productivity and quality of food packaging containers and raw materials can be improved. (2) Manufacturing costs can be reduced. (3) Delivery time management for customers can be accomplished on a normal date. Delivery to customers may take place on a normal date. (4) Food packaging containers can be produced and delivered in a timely manner in response to changes in demand due to small quantities and various kinds and climate and seasonal factors. (5) By using the information on the production plan of each company for food packaging containers and raw materials in real time, it is possible to establish a production plan for each product that responds to the fluctuations in small quantity and multiple varieties and climate and seasonal demand. (6) As the accuracy and reliability of the production plan is improved, proper inventory of finished food packaging containers and raw materials can

be achieved. (7) By monitoring the current status of production subcontractors who produce food packaging containers after receiving orders from the main producer, the production of food packaging containers can be carried out in a timely manner. (8) A production management system that combines the contents of the main producer, production subcontractor and raw material subcontractor can be established in a timely manner without delaying orders for the supply and demand of raw materials for food packaging containers. (9) PDCA (Plan-Do-Check-Action) that includes planning, execution, evaluation and improvement of the production operation process of the main producer, production subcontractor and raw material subcontractor can be applied to improve production compliance rate. (10) The operation of work standard information on customers, products, production equipment, raw materials and production personnel can improve the matching rate of computerized and actual inventory of food packaging containers and raw materials.

Future research requires practical development of a real-time integrated platform for the production of food packaging containers, while verification of the research is required by applying it to the food packaging container site.

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