

Role of Information Technology for Regional Corrugated Box Manufacturers

Dr. Wang Ming, Dr. George Q. Sun, Mr. Huang Su

CIMTEK Pte Ltd

151 Chin Swee Road, #16-02 Manhattan House

Singapore 169876

Tel: (65) 8342806 Fax: (65) 8342805, E-mail: cimtek@pacific.net.sg

ABSTRACT

After a decade of rapid growth, corrugated box manufacturers in the region face increasingly tough business environment. The challenge is how to control the cost of manufacturing while provide excellent customer services. To this end, information technology can play an very important part. This paper describes how information technology can help the corrugated box manufactures meet their new business objectives. It analyses how information technology can assist the industry reduce cost and provide excellent customer services; and highlights key issues in applying the technology.

1 NEW CHALLENGES FOR REGIONAL CORRUGATED BOX MANUFACTURERS

After a decade of rapid growth, corrugated box manufacturers in the region are facing tough challenges ahead characterized by.

1.1 Increasingly stronger competition due to overcapacity: Take Malaysia as an example. “In the 1980s there were 18 box plants, each profitable. Now there are 60 resulting in lower profitability for the industry generally and major overcapacity”[1]. In Singapore, although the number of box plants has not been increased, the market for corrugated paper products has been shrinking all the time due to relocating of manufacturing plants out of Singapore, for instance, textile and toy industries in 1980s and consumer electronic manufactures in recent years.

1.2 Increasingly higher customers’ expectation. The rapid industrialization in the south east Asian has led to tremendous changes in demand for paper packaging products. Electronic industry which hardly existed ten years ago has become a major industry for both Singapore and Malaysia. It is common for the electronic industry to use boxes with items like nesting, layer pads etc, so called delivery-in-set products. Even for traditional industries like food processing, printing requirements have become more colorful and sophisticated. Together with increasing product variety and complexity is smaller order size and/or Just-in-time delivery (i.e. blank order with multiple call-off deliveries). For instance, one electronic company demands corrugated box suppliers to make one delivery every two hours from 6:00am to 12:00pm, and every delivery is made directly into their production lines. In practice, the box manufacturer’s delivery schedule is more difficult, because some customer companies demand JIT from their suppliers but fail to practice JIT themselves.

1.3 Increasingly higher production cost: Both labour cost and land cost have been increasing significantly. The paper-roll cost has been fluctuating in the past few years. The recent currency turbulence has almost wiped out the operation profit for many corrugated box manufactures in the region.

2 NEW MANUFACTURING STRATEGY

It has become clear that, for corrugated box manufacturers, the task is no longer simply producing of corrugated boxes but combining production and services, with services being increasingly important. The new challenges require corrugated box manufacturers to re-examine their business environment; and to establish a new manufacturing strategy with emphasis on Offering value-added products & services to customers and Lean Manufacturing.

2.1 Offering value-added products & services to customers: In any service, knowledge and information play important roles. For corrugated box manufacturers, it means that: (a) the capability to advice a customer on product specification or to provide a customer with a packaging design; (b) the ability to give a customer the accurate information on how a particular order is being fulfilled such as order status, production status, delivery status, finished good stock and free stock with ease; (c) ultimately fitting into the customer's supply-chain management and synchronizing production with the customer's business plans. To offer such services, a company must equip itself with:

- 1) **Design capability:** Traditionally a corrugated box manufacturer would regard the customers' requirements as specifying their product and process. As products become more complicated, one must *design* the product and process specification according to the customer's requirement. Furthermore, one must optimize the design through product and process standardization.
- 2) **Integrated information system** with maximum visibility on how a particular customer order is being fulfilled.

2.2 Lean Manufacturing: Under intensive competition, few company can charge their customers above-market-price, even with distinct value-added services. Profitability is more and more dependent upon whether a company can establish lean manufacturing practice, which means:

- 1) **Low paper wastage:** It is known that the paper cost counts for 50-70% of the total cost. Thus 1% reduction in paper wastage equals to a significant saving and profitability. It is necessary to establish an effective way to monitor and control (a) paper-roll loss; (b) corrugator loss; (c) converting loss; and (c) finished good store loss.
- 2) **High machine utilization:** Two factors affect the machine utilization: changeover time and changeover frequency. For corrugators, the changeover means paper-roll changes. For flexo and die-cut machines, the changeover is from one job to another. The machine utilization is determined by how often this machine stops and how long each stop lasts (not how fast this machine can run). It is common that, for flexo and/or die-cut machines, an average run-time/set-up time ratio less than one, meaning that overall less than 50% of machines' scheduled working hours are spent on the value-added operations. The control over the changeover time and changeover frequency is key to the high machine utilization and therefore efficiency.
- 3) **Short lead time:** A short lead time means the ability to take smaller order and the fast response to customers' demand. The lead-time consists of :-
 - Pre-production processing time for tasks like mastercard design, order entry, generation of a production request (or production order);
 - Production cycle-time, for all processes. It includes queuing time, set-up time, run-time and waiting to be transferred and transferring time;
 - Post-production processing time for store receiving, store transferring, store issuing, loading, generation of delivery documents, lorry transportation, handling returned delivery documents and/or goods from customers.

Traditionally, efforts have been put into improving machine run-time - a very small portion of the lead time. Now it is time to look at the ways of improving the system performance, i.e. how to manage the *flow*, or the system performance rather than individual machine.

- 4) **Minimum stock and WIP:** With respect to JIT deliveries, a company may have to have a certain stock - both finished goods and WIP - in order to balance high output of continuous processing machine (e.g. corrugator, advanced flex/die-cut machine) with delivery batches with small quantity. Therefore it is necessary to establish a clear stock control policy together with a system to track stock in terms of both quantity and location.
- 5) **Competent and flexible workforce:** The people are the most important factor. It is up to the people to create the system and improve the system continuously. The trend is to employ less but better educated/trained people.

3 ROLE OF INFORMATION TECHNOLOGY

Information technology provides corrugated box manufacturers with effective means of achieving their new manufacturing strategy. Figure 1 shows the framework of a computer integrated manufacturing (CIM) system for corrugated box manufactures.

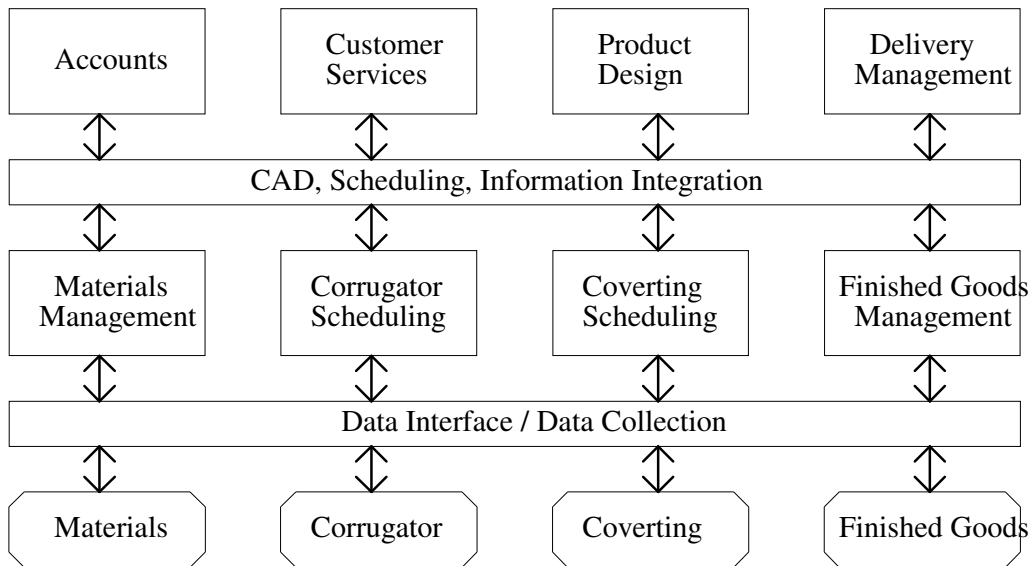


Figure 1 Framework of CIM System for Corrugated Box Manufacturers

While the early computerization mainly covered data processing functions such as accounting, sales order and delivery entry, the new wave of computerization will very much focus on the value-added activities such as product and process design, production scheduling, production control etc. For corrugated box manufacturers, the key areas of technology are:

3.1 Computer-aided design (CAD): Specialized design software have made it easy for corrugated box manufacturers to develop their own design capability. Product design consists of graphic design and box design (also called structural design). For graphic design, perhaps the most popular software is CorelDraw; whilst there are several packages available for box design, such as Artios, IPDS (Interactive Packaging Design System) and LaserComb etc, all of which also support different

brands of sample table. For most of corrugated box manufactures, the challenge is to establish their own design standards and procedures in order to make an effective use of the design software.

3.2 Computer-aided corrugator and converting scheduling (i.e. finite-capacity): The scheduling is the most effective control point on reducing paper wastage and increasing machine utilization. On the other hand, it is a measurement of information integration and quality of information. This is because the scheduling has to make extensive use of orders, product and process information as illustrated below:

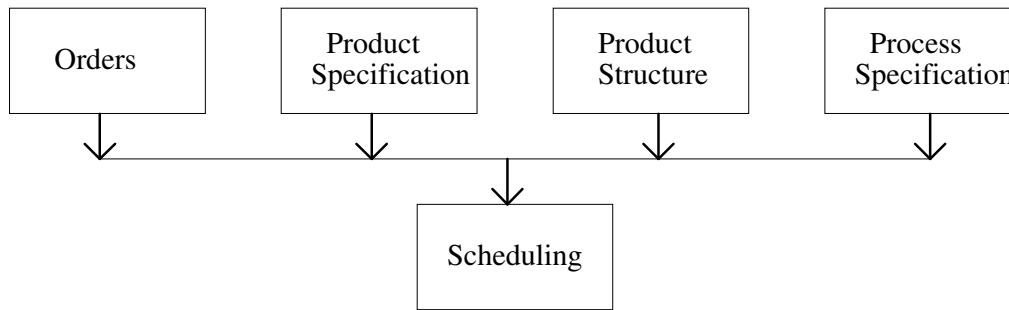


Figure 2 Information required by a computer-aided production scheduling system

An effective computer-aided scheduling system would provide the planners with a so-called Dynamic Planning Board - an environment for planner to create and edit schedule dynamically and intuitively. The impact of every change will be automatically calculated. A good schedule will help reduce work-in-process, shorten lead time and increase machine utilization.

The core of such a system is the scheduling engine to generate the schedule. There are three major approaches:

- Mathematical models such as linear programming, dynamic programming;
- Discrete event simulation technique;
- Rule-based (i.e. Expert system) approach.

The rule-based approach is more applicable than the other two to both the corrugator and converting scheduling in the local operational environment, characterized by small production lot and high disturbance to the schedule like urgent insertion and deletion. It means that a company should study the operation carefully in order to establish (and consequently review) rules for controlling the changeover, i.e. paper-roll changes at corrugator, setup at flex and die-cut machines.

3.3 Information integration: The essential part of the computer integrated manufacturing system is the Integrated information flow. The critical areas are:

- 1) ***Maintaining physically separated but logically integrated databases:*** It becomes increasingly difficult to find an application software which can meet all the requirements within a company. The best practice is to adopt the best fit specialized application software and then integrate them in such a way that, as far as the end-users are concerned, the various databases act as an integrated one, although they are physically separated. The net result is that the end-users do not enter the same data into the computer system more than once. This will significantly reduce human errors in processing sales orders.
- 2) ***Data exchange from CAD to other non-geometric database:*** The customer's requirement or specification can be transferred to CAD system to the product and process design. At the end of

the product and process design, some design data need to be transferred back to the mastercard database which will be used to support the scheduling and generate production related documents.

- 3) **Data exchange between Production Planning & Control and machine controllers:** The schedule, once determined, can be transferred into the machine controllers e.g. corrugator dry-end controller. On the other hand, the actual production data can be transferred back to the production planning & control system with respect to the schedule. The transfer could be done either in real-time or more practical in batch.

The integration brings a fast response to customers' demand with minimum human errors. For instance, a repeated order can 'flow' all the way from the order entry point to corrugator dry-end controller in a few minutes time.

The integration also means visibility on how a particular order is being fulfilled, information such as order status, production status, delivery status, finished good stock, machine capacity, paper-roll availability at one's fingertips.

3.4 Towards Supply-Chain Management: With the computer integrated manufacturing system and the latest information technology such as Intranet/Lotus Notes, it is possible to integrate the system with a customer business system through which the customer can directly enter/modify sales orders; carry out on-line enquiry on how a particular order is being fulfilled. As a supplier, the corrugated box manufacturer will be able to synchronize its activities with customer's business plan.

4 ISSUES AND PROBLEMS IN IMPLEMENTING CIM SYSTEM

4.1 Software selection: First of all, there is a choice between general and specialized MRP II/ERP software. The following requirements must be checked carefully when selecting a software system:-

- 1) **To reduce pre-production processing tasks and time to minimum.** The pre-production processing tasks include: (a) defining stock items; (b) creating BOM (bill of materials) and designing the component; (c) defining routine (i.e. process flow); (d) entering a sales order and then releasing it to Production. For corrugated box manufacturers, their products and processes are relatively simple. It is desirable to combine these tasks into one so that one person can handle all (except the complicated box design) in a very short time period.
- 2) **To schedule and re-schedule an order into production as soon as it has been entered into the system:** This requires to group and sequence jobs by paper width and substance for corrugator, to sequence jobs with the minimum ink station changes for flexo machines, to insert an urgent job into today's production schedule or to delete a job from the schedule directly. General MRP II / ERP software do not support finite-capacity scheduling and constant re-scheduling, or they are too expensive and time-consuming to customize.
- 3) **To support Just-in-Time delivery:** It requires
 - (a) Tracking of WIP status at operation level;
 - (b) Tracking of Finished goods in terms of quantity and location (most of inventory modules only track to depot level);
 - (c) Delivery scheduling capability for optimizing transportation resource;
 - (d) Flexibility in issuing Delivery Orders and Invoices to meet customers' practice (some customers require all the delivery items are grouped into one D/O, all deliveries of one day are grouped into one invoice, etc. in order to minimize the amount of paper work).

- 4) **To forecast paper-roll requirement accurately:** Because of long raw paper-roll purchasing time and short customer's delivery time, the material requirement is no longer order-driven but based on **forecast**.
- 5) **Capabilities to handle cases which are common to corrugated box manufacturers but exceptional to other industries.** These include:-
 - (a) Generating comprehensive mastercard data, such as quality code, flute, wall size, MD score, CD score and many more. It is necessary to apply auto-calculation to eliminate human data entry and therefore mistakes. Many data can be calculated according to formula, for instance, working length, width and height from internal length, width and height or vice versa; MD and CD scores; blank width, blank length and trim; unit area and unit weight.
 - (b) Handling delivery-in-set, for instance, one RSC box and two nesting must be delivered in set form.
 - (c) Handling combined components, for instance, one board is die-cut into two or three different models.
 - (d) Handling orders with the same board with different markings (e.g. expiry date), which is very common if customers are from food processing or furniture manufacturing sectors.
 - (e) Handling sheet board sales, which requires a fast data entry and job insertion.
 - (f) Handling blanket orders, i.e. one order with delivery schedule; delivery requests are subject to constant changes even after the production has started.
 - (g) Costing - Material cost, process cost, tooling cost etc. The unit of measurement should be in \$/MT, \$/SQM, \$/Pass etc..

4.2 Local support & vendor track record: The equally important factor is the support from the software vendor. By the technical support, it means the training, consultancy, customizing the software to meet particular requirements, and on-site trouble-shooting when problems occur. For instance, Malaysia has various tax exemption scheme (e.g. LMW, FTZ and CJ5). It requires tracking of tax exemption, validate the tax exemption before issuing an invoice and updating the tax exemption record after issuing an invoice; handling custom duty drawback, printing out custom claim form etc. An effective software must help companies handle those requirements satisfactorily.

4.3 Business Process Re-engineering (BPR): Any computer system, no matter how user-friendly, is pre-defined and programmed. By contrast, the operational practice is often informal and flexible. A company has to establish operational procedures compatible with the CIM system, i.e Business Process Re-engineering (BPR).

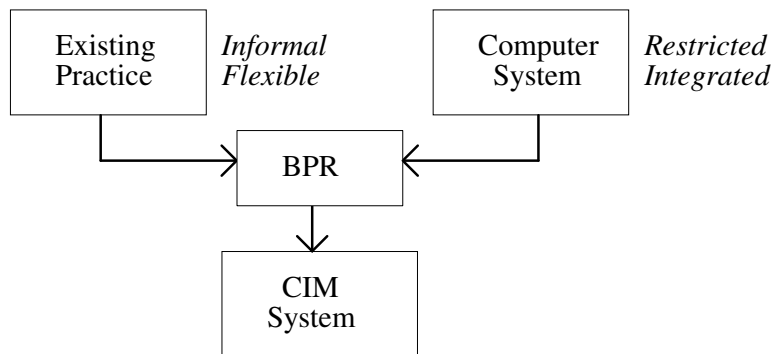


Figure 3. BPR - bridging the gap between the existing practice and the computer system

The major tasks of BPR are

- 1) Analyzing the existing operation and modeling major functions and information flows (also called business process mapping);
- 2) Proposing the functional structure of the integrated manufacturing system, which constitutes the foundation for the computer system;
- 3) Establishing operational policies and procedures in order to introduce disciplined and coordinated production environment, which is key to success of the CIM (computer integrated manufacturing) system.

5 CONCLUSION

Due to the increasingly stronger competition caused by overcapacity, increasingly higher customers' expectation, and increasingly higher production cost, corrugated box manufacturers in the region have to move away from the traditional role of simply producing boxes according to customers' specification, to that offering value-added products & services to customers, with a lean manufacturing.

The product design capability assisted by the specialized design software packages, and the fast, accurate and flexible response to the market and internal control on materials, production and delivery brought by the information integration with finite capacity scheduling functions, is the solution offered by the authors of this paper.

The ideal positioning of a corrugated box manufacturer is that, as a supplier, it will be fitted into the customers' supply chain management, allowing the later to directly enter/modify sales orders; carry out on-line enquiry on how a particular order is being fulfilled, thus synchronizing its activities with customer's business plan.

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