A Sporadic Customer Order Processing Model and Case Study for the Consumer Goods Industry

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Abstract

This paper presents a reference business process model for handling sporadic customer orders in the consumer goods industry. We believe that handling sporadic customer orders due to private label actions of supermarkets as well as strong promotion actions has lately been risen to a major problem of consumer industries in their efforts to streamline their supply chain. Each one of these customer orders has specific packaging requirements and irregularity in demand which creates significant problems to the *production/marketing* interface. Usually there is difficulty in assigning a reliable delivery date, in pre-calculating customer order costs, and in production planning.

Keywords

Order processing, production planning, consumer goods industry

1 INTRODUCTION

Papoutsanis S.A. (PDP) is an industrial company producing and selling soaps, margarine oils and soft drinks in Greece as well as in foreign markets. Apart from distributing their *own brand products*, they act as *subcontractors* to a large multinational firm as well as they produce "*private label products*" for large super markets, shipping companies, hotels, etc. The company has a factory in Athens and two warehouses in Athens and Thessaloniki. They distribute 140 SKUs in about 2500 selling sites. While the production and distribution of own products can easily be forecasted and planned, the main problems in production planning come

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from sporadic customer orders in the form of foreign market contracts, private label products and one-off subcontracting for temporary customers.

Each one of these customer orders has specific packaging requirements and irregularity in demand which creates significant problems to the *production/marketing* interface. Usually there is difficulty in assigning a reliable delivery date, in pre-calculating customer order costs, in purchasing raw materials and in capacity planning.

2 OBJECTIVES AND METHODOLOGY

Objective of this study is to design a suitable *business process* for handling sporadic customer orders in the consumer goods industry, so that the production/marketing interface is facilitated and problems are smoothed.

The study uses *technologies for business processes* (TBP) in order to redesign the *sporadic customer order flow* in the consumer industry and produce a reference model for this critical business process. The GRAI integrated methodology is used (GIM), which produces a physical and functional view (using IDEF-0 diagrams), a decisional view (using GRAI-grids and GRAI-nets) and an information view (using entity-relationship diagrams). Since the described business process is mainly an *event-driven* decision-making process, the emphasis is given to the functional view using an IFEF-0 activity model and to the decisional view using GRAI-nets.

The purpose of decisional view in enterprise modelling methodologies is to provide a *decision framework* of the basic decisional activities included in the customer order process together with a definition of their *objectives, decision variables, constraints and criteria*. The actual *solving* of these decision problems can be done using operational research techniques at a later more detailed level.

2.1. MRP -type vs. Cycled production planning

When a number of products are to be made on a regular cycle, one after another, on the same unit of equipment, it is called "*Cycled Production*" and is very common among the process industries. Usually in such cases the sequence of products in the cycle is determined by economy in change-over cost, depending on the equipment or product characteristics (Magee/Boodman, 1967). For example, the sequence depends on going through a regular sequence of carton or bottle sizes in a bottling operation.

Other paradigms of cycled production in the discrete manufacturing environment are the PBC (Period Batch Control) system (Burbidge, 1989, Tatsiopoulou/Leopoulos, 1997) and the KUMERA OY system (Vollmann/Berry/Whybark, 1989). With multicycle ordering, like the MRP system, different components are ordered in different batch quantities and with different order frequencies. Depending on the demand profile and the products' structure this system may induce high amplitude surges in both stocks and load which are

unpredictable. As the peaks and troughs of the many component load cycles drift into and out of phase the total value of the load on the different work centers rises and falls, occasionally surging to very high values if the majority of the component load for a particular work center peaks drift into line, resulting a difficult production and stock control. With single cycle ordering like the PBC, there is a regular series of order dates and due dates. Any orders are issued at the beginning of a period for completion by the end of that period. All orders are issued in balanced product sets in quantities sufficient to cover the requirements for a specific quantity of products to be made in a specific assembly period according to the production capacity of the work centers.

The main decisions that have to be made when designing a cycled production system are:

1. The cycle length of the period.
2. The lot sizes of products
3. The sequencing of products in the cycle.
4. The consideration of variations in the regular cycle

This last decision takes place either when a sporadic order from an important customer has to be satisfied or when a product might not be made every cycle if its sales rate were low and setup cost high.

2.2. Combined lot-sizing and scheduling

The usual scheduling tasks in the above industrial environment are at the mid-term level to determine the working time and the quantities (lots) of all products to be produced at each cycle, given the external demands of end-products. The short-term level is concerned with scheduling jobs comprising a sequence of operations on a set of resources in the shopfloor. The size of each job, the lotsize, has been defined at the upper level.

There is a great variety of multi-product dynamic capacitated (lotsizing models) that have been developed in the last 10 years (Potts/Van Wassenhove, 1992). Typical models aim at minimizing costs for inventory holding, production, setups and overtime. Various fast heuristic solution procedures for large size problems have been proposed. However, exact algorithms for smaller problems and methods for calculating bounds on the objective value are needed in order to evaluate the quality of heuristic solutions.

Scheduling problems, which are perfect examples of hard combinatorial optimization problems, have attracted researchers for 30 years. But only today's information technology is able to provide on-line data to the models and on-line results in graphical form at the shop floor, thereby facilitating the practical use of a rich theory of scheduling, which has developed rather far from practice for a long time. Recent remarkable advances are based on the use of new global search techniques such as Shifting Bottleneck procedures, Simulated Annealing, Tabu Search, Genetic Algorithms and Artificial Intelligence.

However, research for models and procedures at the two decision levels takes place in mutual isolation. To gain acceptance of planning procedures in practice, there is a strong need for consistency of decisions at both planning and scheduling levels. For instance, naive aggregate capacity constraints at the lotsizing level may lead to infeasible problems at the scheduling level, or to unnecessary delays and/or a high level of work in process.

The interdependency of lotsizing and scheduling is a recent research topic of primary importance as mentioned in recent surveys. First approaches to the integration of lotsizing and scheduling decisions in practical procedures are promising. In lotstreaming procedures for complex multi-stage production structures, the original lots are split into smaller sublots so that the overall performance of the scheduling level is greatly improved. Some combined lotsizing and scheduling procedures have also been developed (Fleischmann, 1994).

In the case of process industries, where a great number of products are processed on a few automated production lines with tight capacity, the shop floor needs, instead of single jobs, a complete schedule of every line for a cycle, which has to be based on combined lotsizing and scheduling. This problem is complicated by the arrival of *sudden sporadic customer orders* which have to be accommodated within the current production cycle or shifted to a future cycle.

3 PDP'S ORDER PROMISING PROCESS

3.1 Contract and order placement

The existing processing of an order coming from a sporadic customer is as follows (Figure 1): The customer contacts the company and declares the interest to collaborate. The marketing manager (MM) arranges a meeting with the customer. During the meeting the customer gives an estimate of the amount of orders he is interested to place.

The MM examines the quantities and decides whether PDP is interested to respond. The PDP's policy is to avoid undertaking small contracts. In the case of positive decision the MM presents to the customer the products the company produces or sells. The customer decides the products he is interested in and / or the characteristics of new products he wishes.

The MM and the customer negotiate the price for every product and the conditions of the agreement (payment terms, delivery terms, time between the order placement and the production, obligation of the customer to notify PDP its sales forecast). In the case of agreement a draft contract is written with all the above information. The contract is presented to the General Manager who decides about the possibility of PDP to produce the products the customer demands. Then the contract is signed. The customer in the frame of the contract places an order for the production of some of the products.

No sales forecast is possible for this type of customers. Additionally as these customers ask mainly for private label or *façon* they demand particular packaging and labels so no production to stock is possible.

Figure 1 The contract agreement process of PDP.

3.2 Production planning

When the order has been confirmed the purchase and production departments are notified to order raw materials and plan production. The reason for this delay comes from the fact that sporadic customers are not bound in any way from the contract to place an order and they actually may never do so. The planner receives the order and checks the existence in stock of the necessary raw materials.

1. The raw materials exist in stock. This is the normal case for a product asked by the customer which is a variation of the fast moving products of the company. A small amount of the raw materials for the fast moving products is always in stock mainly because of the lot-sizing practice. In that case the order can be immediately introduced in the production plan of the actual month.

The planner in order to be able to introduce sporadic orders, when developing the monthly plan, he leaves free a capacity of two shifts (*fast lane* approach). This buffer capacity will also be used in case of production delays due to absenteeism. If neither production delay nor sporadic order happens during the month the two shift buffer will be used in order to produce for stock one of the fast moving codes of PDP. Additionally for the orders of the permanent customers of the company for which due dates exist during the month a two days safety delay has been taken into account in the plan. As a result in that case even a very urgent order can be immediately satisfied.

2. *The raw materials do not exist in stock.* In that case the client is asked to accept a delivery date in the next month. If the client accepts, materials purchase orders are issued and the production is normally included in the next production plan.

4 ACTIVITY AND DECISION REFERENCE MODEL

The following is the activity index of the activity model for the customer order flow process. Part of the model in the form of IDEF-O diagram that concerns activity A12 (To agree the contract) is depicted in Figure 1. Part of the more detailed reference decision model that concerns activity A13 (To define the price and delivery date) is depicted in Figure 2.

Activity Index for the Customer Order Flow Process

- A0 Customer Order Flow Process
 - A1 To create a customer order (C.O)
 - A11 To precise the request
 - A111 To identify basic technical information
 - A112 To identify basic commercial information
 - A12 To agree the contract
 - A121 To study the feasibility of cooperation
 - A122 To present PDP products
 - A123 To define products
 - A124 To perform pre-costing
 - A125 To do pricing of new products
 - A126 To do pricing of existing products
 - A13 To define the price and the delivery date
 - A131 To negotiate date inside the company
 - A132 To negotiate date and price with the customer
 - A14 To confirm the customer order
 - A15 To process blanket orders
 - A2 To process the C.O. in the production dept.
 - A21 To release production orders
 - A22 To print work sheets
 - A23 To allocate raw material
 - A24 To order raw material
 - A3 To produce and pack
 - A4 To manage the delivery
 - A41 To prepare delivery documents
 - A42 To prepare transportation
 - A43 To deliver
 - A44 To follow-up the Customer Order

Figure 2 The reference decision model of the order promising process

5 CONCLUSIONS AND FURTHER RESEARCH

The above methodology has up to now produced the *particular model* (according to CIMOSA definition of genericity) of the *sporadic customer order flow process* in the environment of the pilot company PAPOUTSANIS SA. Next, the particular model will be extended to a full *partial model* of the process suitable for all the consumer industry sector. We believe that handling sporadic customer orders due to private label actions of supermarkets as well as strong promotion actions has lately been risen to a major problem of consumer industries in their efforts to streamline their supply chain. Therefore, a reference model as the described above will have a good potential for many of them.

On detailed decision modelling, further research objectives of the project are: to continue research at both lotsizing and scheduling levels, with particular emphasis being given to fast and efficient heuristic methods; to extend the recent research on integration and combination of lotsizing and scheduling to more complex and realistic situations, oriented towards the needs of industry and particularly to the need to handle *sporadic customer orders*; to test the concepts in real-life industrial environments; to implement the planning and control procedures into a prototype APS (Advanced Planning System), which will use the Cycled Production concept and will cooperate with a standard ERP (Enterprise Resources Planning) system.

6 BIBLIOGRAPHY

- BURBIDGE, J.L., Production Flow Analysis for Planning Group Technology, 1989 (London: Oxford Science Publications).
- FLEISCHMANN, B., "The Discrete Lot-Sizing and Scheduling Problem with Sequence-Dependent Setup Costs", *European Journal of Operational Research* 75, pp. 395-404, 1994.
- MAGEE, J. and D. BOODMAN, Production Planning and Inventory Control, pp. 67-72, McGraw Hill, 1967.
- POTTS, C.N. and VAN WASSENHOVE, L., Integrating Scheduling with Batching and Lot-Sizing: a Review of Algorithms and Complexity, *Journal of the Operational Research Society* 43, pp. 395-406, 1992.
- TATSIPOULOS, I.P. and V.I.N. LEOPOULOS (1997), A non-MRP periodic control system for flexible production lines in SMEs, in: Fichtner/Mackay (Eds), *Facilitating Deployment of Information & Communications Technologies for Competitive Manufacturing*, Esprit IiM Conference Proceedings, pp. 287-300, TU Dresden, 1997.
- VOLLMANN, Th., BERRY, W and WHYBARK, D.C., 1988, *Manufacturing Planning and Control Systems* (Illinois: Irwin).