ELSEVIER

Computers and Chemical Engineering 24 (2000) 1625–1631

Computers & Chemical Engineering

www.elsevier.com/locate/compchemeng

An investigation on integration of aggregate production planning, master production scheduling and short-term production scheduling of batch process operations through a common data model

B.P. Das *, J.G. Rickard, N. Shah, S. Macchietto

Centre for Process Systems Engineering, Imperial College of Science, Technology and Medicine, London SW 7 2BY, UK

Abstract

A prototype system has been developed by integrating two higher-level hierarchical production planning application programs (aggregate production plan (APP), master production schedule (MPS)) using a common data model integration approach into an existing planning system for short-term scheduling and supervisory batch management which was originally proposed and developed by Rickard, J. G., Macchietto, S. & Shah, N. (1999). Integrated decision support in flexible multipurpose plants. *Computers & Chemical Engineering, 23*, S539–S542. The hierarchical production planning system has been modelled and validated around an industrial scenario concerning multi-site, multipurpose batch process operations making household chemicals from start to transportation to regional warehouses. This preliminary work suggests that the idea of integrating software applications through a common data model, which was originally described by Stanley, G. M. (1994). The emerging trend towards knowledge-based frameworks for computer-integrated manufacturing. *Advances in Instrumentation & Control, 49*, 1121–1133 and further developed by Rickard, J. G., Macchietto, S. & Shah, N. (1999). Integrated decision support in flexible multipurpose plants. *Computers & Chemical Engineering, 23*, S539–S542 is feasible. However further research work, improvements and validations are required using varieties of industrial batch process operations and distribution problems to prove its viability. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Integration; Planning; Scheduling; Batch process; Production

1. Introduction

Traditionally production plans in any manufacturing organisation are developed through three stages, aggregate production plan (APP); master production schedule (MPS); and short-term production schedule. The APP implements the long-term business policy of an organisation by allocating the type of product to be made on a monthly basis over a horizon of 1 year or more considering only the overall constraints of the business (Chase & Aquilano, 1989). It may be operated over multiple sites.

The MPS develops the overall manufacturing plan of a family of products based on anticipated demand of variants and sub-variants of family of products either on a weekly or monthly basis by disaggregating the information generated by the APP.

On the other hand, the short-term production schedule provides the feasible manufacturing plan of end items based on the information generated by the MPS over a short planning horizon such as 1 week to 1 month.

These three stages of production planning are highly inter-linked within the business organisation. For example MPS provides the vital link between sales, marketing, distribution, suppliers and the manufacturing operations of the business. The short-term production schedule provides the link to the plant level in order to facilitate the last minutes changes to the plan as well as to absorb unforeseen events. In order to run a business organisation efficiently as well as to maintain good

* Corresponding author.

E-mail addresses: b.das@ic.ac.uk (B.P. Das), julian@psenterprise.com (J.G. Rickard), n.shah@ic.ac.uk (N. Shah), s.macchietto@ic.ac.uk (S. Macchietto).

0098-1354/00/$ - see front matter © 2000 Elsevier Science Ltd. All rights reserved.
PII: S0098-1354(00)00437-3

customer credibility, these three stages of production planning must be able to communicate to each other both at the planning stage as well as execution stages. Currently, most of the world class manufacturing organisations are driving their systems towards this goal by various means.

A literature review (Reklaitis, 1992) shows that for some reason or other, these three distinct stages of production planning are not very common within the chemicals processing sectors particularly within the batch processing area. Noticeably, the MPS stage is missed out or not reported. Therefore there is a need for investigating any potential benefits of including it.

Further review (Saad, 1990; Pekny, Venkatasubramanian & Reklaitis, 1991) also suggests that most of the work relating to long-term production planning and short-term production scheduling of chemical batch process operations are based on a 'stand alone' approach, where the two planning systems have been developed independently. There is hardly any evidence in the public domain of systems, which are developed in an integrative manner. Most of the commercial work in this area is confidential in nature and not available in the public domain except as sales brochure published by development houses. Therefore there is a need for investigation particularly on integration aspects of the three planning systems mentioned earlier. These observations prompted the authors to initiate the work described in this study, particularly to explore the ways these three planning systems can be integrated for effective communications.

In this study the authors have proposed a coherent integrated production planning system under a common computing environment and data model taking into consideration various software packages developed by the Centre for Process Systems Engineering (CPSE) in this area.

Section 2 contains a brief description of the problem, which is used for this investigative work. Section 3 briefly deals with integration approaches for software application systems. Section 4 gives brief description of the system developed using common data model approach. In Section 5, the system has been validated by solving the problem described in Section 2. Finally, in Section 6, some conclusions are made highlighting the areas where further investigations are required.

2. Problem description

An organisation has three geographically distributed highly flexible batch processing plants which can make varieties of products. The capacities of these plants are different, but each plant can make all the products. Briefly, the process operations include mixing, intermediate storage and packaging in a range of equipment. Batch plant produces two main base products and each base product is of two types, 'concentrate' and 'dilute'. Each type of product can be made in five varieties, for example blue, red, white, yellow and green. Again, each variety of product can be packed into two different types of containers such as bottle and carton. Finally packaging at the processing plants is done in five different sizes of bottles and cartons such as 1/2, 1, 2, 3 and 4-l size, which are despatched to distribution outlets via three warehouses. Considering the type, variants and container type and size each of these plants can make at least 288 varieties of products in terms of final stock keeping units (SKU).

The company has set up eighteen distribution outlets at various locations for servicing the local distributors. Based on a yearly forecasted demand of four types of main products, the company is keen to know (1) the best APP over a horizon of 12 months; (2) the best MPS over a horizon of 8 weeks; and (3) weekly feasible production schedules for the three batch-processing plants. Some of the important data relating to the problem are given in Table 1abc.

3. Approaches for integrating software systems

The most common commercial approach for integrating such systems is through 'standard relational databases' provided the data formats required for such applications are fixed. They offer flexibility, eliminate data duplication and also enable to modify programs easily contrary to other approaches such as the 'file based' application system (Kochhar, 1979). This approach is now fairly well established.

However, it has been observed that commercial organisations are sometimes reluctant to use this route due to the concern of losing control over the software systems built upon such third party facilities as well as possible escalation of the cost of maintaining such system in the future. This has led the authors to explore alternative approaches for integration. We have undertaken work on developing number of operations support tools that work at different levels of planning hierarchy, and now wish to continue effective integration of these methods.

The basic objective of this study is to integrate the two major process planning software systems into an existing planning system under one computing environment, where an user can select a particular option of the system and obtain a solution of a planning problem by presenting the relevant data to the system.

Recently Stanley (1994) has described a *common data model approach* for integrating various application systems. This approach ties systems not only to common data but also to a common model, whereby issues over how model objects in one model relate to those in

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات