Available online at www.sciencedirect.com
ScienceDirect
Int. J. Production Economics 111 (2008) 793–801
international journal of production economics
www.elsevier.com/locate/ijpe

Customer driven production planning

H. Jodlbauer*

FH-Steyr, Wehrgrabengasse 1-3, 4400 Steyr, Austria

Received 28 February 2006; accepted 28 March 2007
Available online 27 April 2007

Abstract

A customer order driven production planning method is developed by combining the buying behaviour of the customers, i.e. the required customer delivery lead time, with the production capacity needed to meet the customer orders. The method can be applied in order to determine the WIP cap and the work-ahead-window of a CONWIP controlled production and can also be used to implement a new market driven production planning. In addition an a priori check is presented to investigate the ability to install a pure make to order system

Keywords: Make to order (MTO); Constant work in process (CONWIP); Market driven production planning

1. Introduction

The market is forcing production towards shorter lead times to ensure shorter delivery times. The favoured production system is a make to order (MTO) system with a production lead time shorter than the customer required delivery time. Wortmann et al. (1997) or Berry et al. (1995) stated that customer driven manufacturing is the key concept for the factory of the future. There are several strategies to decrease the production lead time and to change a production system from a make to stock (MTS) into a MTO system.

An important prerequisite is to reduce the inventory. Improvements in plant layout, processes, organization and production planning and control methods can lead to a decrease in inventory. In Kosonen and Buhanist (1995) for instance the change of a factory into a customer focused lean production system is discussed or Wisner and Siferd (1995) showed the advantages of process oriented manufacturing in order to meet customer requirements.

In the field of production planning and control systems, especially pull systems like KANBAN (see Ohno, 1988) or hybrid systems like constant work in process (CONWIP) (see Spearman et al., 1990) try to ensure low inventory and have a customer order focus. Hendry and Kingsman (1989) suggested developing more suitable production planning and control methods for MTO systems. He et al. (2002) developed optimal and near-optimal inventory control policies for MTO systems.

The approach developed in this paper is applied to a CONWIP system to determine the control parameters. Hopp and Roof (1998) developed an adaptive method called Statistical Throughput

*Tel.: +43 7252 884410; fax: +43 7252 884 444.
E-mail address: herbert.jodlbauer@fh-steyr.at.

0925-5273/$ - see front matter
doi:10.1016/j.ijpe.2007.03.011

Control for setting the control variable WIP level. Their goal is to meet target production rates. Framinan et al. (2003) present a good overview of operation, application and comparison of CONWIP presented. Evaluation of a CONWIP system, especially concerning quality, is discussed in Duri et al. (2000).

The main idea of the presented paper is a focus on a combination of the customer buying behaviour with the plant capacity. Some authors address similar relationships. For instance, Spearman et al. (1989) in their hierarchical architecture to control inventory have taken into account the capacity and demand. Chen and Wan (2005) compared two competing MTO firms concerning capacity and short delivery times, while Arslan et al. (2001) addressed expediting in MTO production systems and Ozdamar and Yazgac (1997) discussed capacity driven due date setting in MTO systems.

Market-driven production planning and control is also discussed in combination with deteriorating items or remanufacturing, see for instance Chen and Chen (2006), Souza and Ketzenberg (2002) or Yang and Wee (2001).

2. Model description

The model describes aspects from the market as well as from production. The market is characterized by multi-item customer orders and by fluctuations of the delivery lead time required by the customer. The production environment is multi-level with predetermined sequential routing.

To be more specific, we discuss a production system with $j = 1, \ldots, n$ final product types, $k = 1, \ldots, m$ machines, for instance machine cells or assembly stations and a known past sales data that is

x_{ij} $\cdots$ number of items of the i th customer order for the product type $j\left(i = 1, \ldots, n_j\right)$,

t_{ij} $\cdots$ planned delivery date of the ith customer order for the product type $j\left(t_{ij} \in [-T1, -T2[\right)$,

τ_{ij} $\cdots$ order date of ith customer order for the product type j,

n_j $\cdots$ total number of customer orders for the product type j. (1)

The planning horizon is defined by $[0,T[$ which is divided into T sub time periods $[0,1[$, $[1,2[$, …, $[T-1,T[$. The past horizon is set by $[-T1,-T2[$. For practical usage the sub time periods maybe described one day and the whole planning horizon is 1 month while the past horizon is 1 year.

3. Capacity or production view

The required capacity of a machine for producing a final product depends on the bill of material, the routing data, the applied set ups, respectively, the lot sizes and the standard processing times

$$c_k(z_1, z_2, \ldots z_n) = \sum_{j=1}^{n} z_j \eta_{jk},$$

$c_k(z_1, z_2, \ldots z_n) \cdots$ capacity needed at machine k to produce the final products $z_1, z_2, \ldots z_n$,

$z_j \cdots$ number of items of the final product type j to be produced,

$\eta_{jk} = \alpha_{jk}\left(p_{jk} + \frac{s_{jk}}{y_{jk}}\right)$ capacity factor for jth product at the kth resource taken into account bill of material, processing time, set up time and lot size,

$\alpha_{jk} \cdots$ number of required intermediate products of machine k for one final product j,

$p_{jk} \cdots$ processing time for one intermediate product at machine k for final product j,

$s_{jk} \cdots$ set up time for the intermediate product at resource k forfinal product type j,

$y_{jk} \cdots$ lot size of the intermediate product at resource k for final product type j. (2)

The number of required intermediate products in formula (2) is determined by exploiting the bill of material and taking the routing data into account.

In general the customer orders have high fluctuations. A time average operator is applied to formula (2) to smooth the required capacity at the machines with respect to the time

$$c_{k,h}(t) = \frac{\sum_{t_{ij} \in [t, t+h[}^{i,j} x_{ij}\eta_{jk}}{h},$$

$c_{k,h}(t)$ $\cdots$ average capacity needed at ressource k with respect to time t and work-ahead-window h to produce all customer orders with delivery dates during the period $[t, t+h[$,

h $\cdots$ work-ahead-window or the time period for the average$(h \geqslant 1)$. (3)