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Int. J. Production Economics 71 (2001) 221–233

international journal of
production
economics

www.elsevier.com/locate/dsw

Multi-level approaches to demand management in complex environments: An analytical model

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Abstract

Recent studies have shown that as demand becomes irregular and complex (i.e., lumpy), a possible approach for managing such uncertainty is to collect information directly from customers. This implies that the sales units have to move closer to customers, analyse their likely requirements, and collect quantitative and structured data as well as qualitative and subjective insights. However, as integration with individual customers increases and data collection capabilities improve the organisational configuration of most companies becomes ever more complex and the aggregation of forecasts more difficult. This paper discusses two approaches to managing demand uncertainty in complex environments. In the first (termed decentralised order overplanning), sales units are responsible for forecasting the demand of each customer and defining requirements. In the second (termed centralised order overplanning), forecasts provided by sales units are aggregated and further elaborated by manufacturing to define item requirements. By means of an analytical model (which describes the forecasting and planning process as a Bayesian–Markovian process), we show that the centralised method out-performs the decentralised approach by virtue of the ability to exploit the additional information provided by commonalities between customers requests. However, this advantage has to be balanced against organisational costs. Since the centralised method splits responsibilities for forecasting and slack control between sales and manufacturing units, major conflicts are likely to arise, the focus and commitment on forecasting accuracy may be compromised, and information may be lost when individual forecasts are sent to the manufacturing unit.

Keywords: Demand uncertainty; Demand management; Inventories; Forecasting

1. Introduction

The demand for end items and modules is becoming more and more irregular or lumpy (i.e. the demand pattern shows various periods of zero or low demand followed by peaks). This trend is due to increasing requests for customised products, and to mergers and acquisitions that reduce the number of potential customers. In the past, such irregularity was associated to certain demand and make-to-order (MTO) manufacturing. In MTO environments, requirements are irregular and sporadic because of high product customisation, but customers are also willing to accept a delivery lead time (DLT) that exceeds the manufacturer's total lead time (TLT).

In today's turbulent markets, however, customers are asking for ever shorter delivery lead times. Though firms often try to reduce their TLT,

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0925-5273/01/$ - see front matter
PII: S0925-5273(00)00120-1

firms in many industries can no longer make to order (e.g. telecommunications apparatus, textile machines, tooling machines, machine control systems, etc.). In these industries the demand is both lumpy and uncertain. Firms therefore seek to forecast future requests precisely in order to meet customer requirements.

Researchers have proposed various techniques to forecast lumpy demand (see for example [1,2]) on the basis of past trends. Unfortunately, the inherent extreme variability and unpredictability of the demand process make these methods ineffective [3].

A possible solution is to reduce demand uncertainty by extending the information base [4]. In this respect, an interesting approach is to anticipate future requirements by using early information generated by customers during the purchasing process. This method, which involves a Bayesian use of information, has already been implemented in more stable environments [5–7] or when dealing with seasonal demand [8–10]. However, application in contexts with uncertain lumpiness shows substantial peculiarities and therefore requires a specific method called order overplanning [11]. Order overplanning is a consistent set of forecasting and planning rules based on over-stated forecasts of future orders from each customer. Consequently, the method differs from classical techniques, since it forecasts future customer orders rather than future levels of demand for an item. Past research [12] and various case studies have proved that in complex markets, suppliers continue to gather information about future requests from their customers. In other words, since past demand data provide very poor information on future requests, firms tend to gather information about future demand from their (few) customers. In these markets, the product is generally complex and expensive, and a long and informative purchasing process precedes the order release. During this process, the customer evaluates the offers and specific proposals of various suppliers, who, in turn, can evaluate whether and what the customer is going to purchase. The customer purchasing process is therefore a relevant source of information for the supplier's forecasting and planning process.

Past research has shown that order overplanning performs reasonably well when facing lumpy demand [12]. Nevertheless, previous models leave some relevant questions unanswered, especially as far as the organisation and management of the forecasting and planning processes are concerned. Indeed, in order to sense market requirements better, firms in these environments have complex organisational structure including a manufacturing unit (for each product family) and various sales units focused on different customer areas (see Fig. 1).

It is clear that the information needed for forecasting and planning should come from the sales units. Furthermore, the information will obviously be incorporated in planning decisions by the MPC unit. We will examine who should manage the *uncertainty* in demand and how this task should be performed. The objective of this paper is to discuss the organisational issues related to the collection and use of information from the market, and to investigate whether the manufacturing or the sales units should manage demand uncertainty [13].

The structure of the paper is as follows. Section 2 proposes two organisational alternatives, while Section 3 briefly illustrates the methodology we use to compare their performance. Section 4 presents the results of the analytical model, and Section 5 discusses the organisational costs and problems associated to the two solutions. Finally, Section 6 draws some conclusions and highlights future developments in this area.

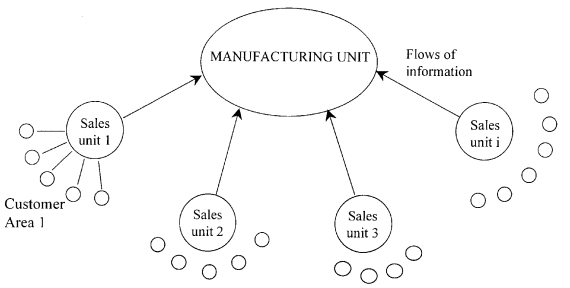

Fig. 1. The flow of information between different organisational units.