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The Problem of Pricing Strategy in Shipbuilding

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Abstract

The demand for new ships is known to fluctuate widely, due to both external political factors and to market forces. In these circumstances the pricing strategy adopted by a particular shipbuilding company has a profound effect not only on the profitability of the company, but also on its growth prospects and stability of operation.

This paper suggests that the problem of designing a strategy for a company may be regarded as a problem in the design of a suitable management control system, set up to meet given management objectives. This type of system design problem may be most effectively studied by means of the techniques of system dynamics.

1. Introduction and scope of the study

In the paper we have chosen to study the problem of pricing strategy design for a hypothetical company involved in the construction of standard dry cargo tramp ships.

The choice of tramp shipping as a field of study was governed by the fact that market mechanisms, generating demand for new shipping are perhaps better understood for this field than for many others. As we shall see the restriction to consideration of standard vessels has the effect of simplifying the analysis somewhat, without altering the form of the problem significantly. It is expected therefore that results from the study should be applicable without major changes to shipbuilding companies in other fields.

2. The demand for new shipping

In his study of oil tanker freight rates, Zannetos (Zannetos 1966) showed that observed fluctuations in oil freight rates in the short term could be explained in terms of the market structure for shipping services and the expectations of buyers and sellers in that market.

Zannetos showed that orders for new tankers are placed by shipowners during periods of rising freight rates and also that, as a group, shipowners showed a consistent propensity to over-invest in new shipping.

The inevitable fall in freight rates, caused largely by changing expectancies of buyers and sellers of tanker services is then exacerbated by delivery of this new tonnage.

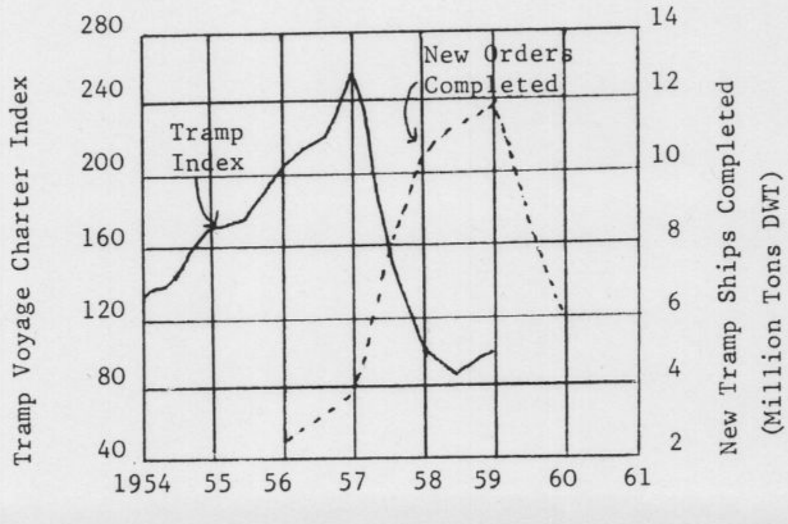
By means of this theory, Zannetos was able to explain the well known pattern of short booms followed by prolonged periods of depression in both order rates and freight rates for oil tankers.

Perhaps the most striking difference between this industry and the dry cargo tramp shipping industry is the greater diversity of routes operated and cargoes carried by tramp ships. In his study of tramp shipping Metaxas (Metaxas 1971) shows that with the exception of certain localised markets (such as that operating on the Great Lakes) a rise in freight rates for one particular route and cargo causes rises in rates for other routes and cargoes. Tramp freight rates therefore tend to act in step with each other over the various trading routes.

It seems then that the assumptions used by Zannetos as the basis for his theory are equally valid for dry cargo tramp shipping and that therefore Zannetos' theory could be adapted to explain the similar phenomena arising in that industry. Metaxas indeed makes use of such an explanation but perhaps lays greater stress on the influence of political factors in determining the detailed pattern of order and freight rates.

Applying the work of both authors to the tramp shipping industry it is clear that the tendency for both order rates and freight rates to fluctuate widely is endemic to this market system.

A typical pattern of such fluctuations is shown in the diagram below; data for the diagram is taken from Metaxas' book which in turn is based on information contained in Westinform Shipping Report 280. It should be noted that the diagram shows world completions of tramp ships, order rates may be expected to lead this by roughly two years.



3. The response by shipyards

From the point of view of a shipyard, it is clearly preferable that during the periods of boom the yard should obtain sufficient orders to last roughly up to the next boom. A yard failing to achieve this goal must compete between booms for the very few orders available or must face the prospect of significant reductions in production rates and therefore labour levels.

In the highly competitive situation between booms, orders for new vessels are frequently taken at very low prices reflecting little or no allowance for overheads or profit. For example a recent press report (Guardian 25/11/75) quoting Mr. Ross Belch, President of the Shipbuilders and Repairers National Association, stated that during the current slump Japanese yards "appear to be taking orders at prices which in certain circumstances only just covered the cost of materials with nothing for wages, establishment charges or profit".

Conversely, during the course of a boom, prices quoted by yards rapidly move up to economic levels. During the 1969 boom another press article (Times 1/12/69) quoting shipbrokers E.A. Gibson, stated that prices for a 200,000 ton oil tanker were rising at the rate of $500,000 every six months, the price in 1966 being roughly $63 per ton and in 1969 about $83 per ton.

Financially therefore a yard must aim to take its orders during the course of a boom when prices may be pitched at levels allowing for sufficient profit margins.

A second dimension of yard strategy emerges when we consider the question of delivery delay - a factor of some importance to owners wishing to take advantage of high freight rates. Zannetos shows that during the 1957 boom in tanker ordering, Japanese yards were quoting long delivery delays at the start of the boom, to leave space in their production programmes to accommodate, at relatively short delivery delays, the high priced contracts hoped for later in the boom. Although these orders may in fact have been obtained, Japanese yards were the first to show signs of weakness during the slump following 1960 - showing that altogether insufficient orders were taken. Again the Times (Times 1/12/69) commenting on the 1969 order boom notes that Japanese yards did not maintain their very high market share of previous years since they entered that boom with long order books and were unable to quote competitive delivery delays.

If we define a marketing strategy as a plan whereby a yard consciously adjusts the terms of its tender to meet its need for orders, it seems that yard management under some circumstances at least, already adopts a strategic attitude towards the setting of price and delivery quotations. From the examples given, relating particularly to delivery quotations, it is clear that the adverse effects of adopting an unsuitable strategy can be long lasting. The problem in designing a suitable strategy is to synchronise the operations of the yard in a sense with booms in order rates, so that the yard obtains sufficient orders during the course of one boom to maintain production levels as far as possible until the next.

In the following section we examine briefly the other dimensions of marketing strategy with the aim of setting the factors of price and delivery into their proper context.

4. The role of price and delivery delay in shipyard marketing strategy

Up to now discussion has concentrated on price and delivery delay as aspects of marketing strategy. Before considering other aspects of marketing strategy, we consider briefly the way in which a shipowner assesses a tender.

Before placing an order with a yard, a shipowner will generally request tenders for a suitable vessel from a number of yards. In assessing the financial aspects of these owners typically use discounted cash flow methods to evaluate their investment decision. These methods provide a convenient way of evaluating price plus credit facilities and possible inflation insurance, together with operating costs (dependent on projected routes and their own wage rates), their expectations of freight rate movements and taxation. (See Booz Allen Report Chapter 6). It is clear from this that the balance between different tenders can be seen differently between owners from different countries and between owners with different operating requirements.

The financial aspect of a tender is however only one of a number of other factors affecting an owner's decision to order from a particular yard. In an industrial marketing situation such as this various factors may act to offset the effects of purely financial considerations.

The Booz Allen Report mentions a number of such factors including, quality of the vessel and its design, the yard's reputation (particularly for timely delivery) and the effects of customer loyalties. The importance of factors such as these in modifying price effects is well known, see for example the article by Sampson (reproduced in Taylor and Wills 1969).

Our conclusion then is that in the general case of marketing ships, a large number of factors, whose magnitudes are unknown to the yard can act to modify the effects of the financial terms of a tender.

In the current work we have attempted to restrict the effects of these factors somewhat by considering the simplified situation in which an owner is seeking to purchase a standard vessel of a given type. The effect of this restriction is to re-emphasise the role of price and delivery delay factors. For convenience, in future sections of this paper we shall use the term 'price' of a ship to mean the sum of the net present values to the shipowner of actual price, credit terms and subsidies of all types forming part of the tender offered to the shipowner.

5. The role of pricing strategy in the dynamic behaviour of a shipyard

As a basis for future work and as an illustrative tool, a simulation model of a shipyard and its market environment has been constructed. The model is of the continuous simulation type described by Forrester (Forrester 1962) and Coyle (Coyle 1974). The validity of this type of representation is considered briefly in an appendix to this paper.

The model consists of three interacting sectors:

i) the shipyard under study, containing representations of production, labour, costing and marketing decision making.

ii) a competitor sector, representing an aggregation of the yards competing directly with the yard under study. The sector contains representations of production and marketing decision making.

iii) a market sector, representing the decision making processes of shipowners. The sector has the effect of allocating orders either to competitors or to the yard, on the basis of their competing tenders.

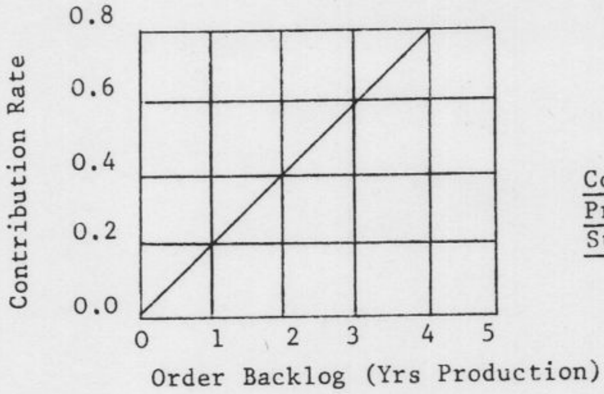
We describe briefly the results of two different types of model run, with the aim of demonstrating some of the possible implications of different pricing policies. Since data used in the model is largely hypothetical, no significance should be attached to the magnitudes of the figures shown in the diagrams.

Runs are made under comparable conditions in which

a) demand for new shipping is an exogenous input to the model and is a sine wave of period three years.

b) inflation is assumed absent for simplicity although its effects could readily be included.

c) the competitor adopts a price strategy in both runs in which his price quoted = direct cost of production X (1 + fractional contribution rate). The competitor's fractional contribution rate is based on his current backlog according to the diagram below - this in effect represents his price strategy.



Competitor Pricing Strategy

d) material and labour costs are assumed to be the same for both competitor and yard.

In the first run we describe, for which dynamic behaviour is shown in figure 1, the yard's fractional contribution rate is held absolutely constant. So that yard price quoted = direct cost of production X (1+contribution rate).

Although this is clearly an unsatisfactory competitive response, results are shown to exhibit the dynamic consequences of the policy.

Two points are of note from figure 1

a) Order and production rates are at very low levels compared to maximum production capacity of 150,000 grt/yr. Both also show a peaked oscillation pattern.

b) All the variables plotted show a steady decline.

Although financial variables are not plotted, the average profit margin per ton was £1.0 and the total orders taken over the 10 year period was 700,000 grt.

The peaked oscillation pattern is principally a result of the labour and production policies modelled; as demand rises the order rate rises and production rate is increased, at first by means of increasing overtime worked and later after a delay, by increasing labour employed. The immediate effect of this is to increase direct production cost and hence price quoted to such an extent as to arrest the rise in order rate. As competitor price quoted increases to the yard's new price level, order rate again rises until terminated a second time by the same process. By this time however demand itself has started to fall.

Although this peaked oscillation pattern is clearly possible in practice, whether or not it arises depends largely on the speed of response of the production system and the speed at which changing costs are reflected in changing prices.

Results of Model Runs

Figure 2 : Yard Price Strategy

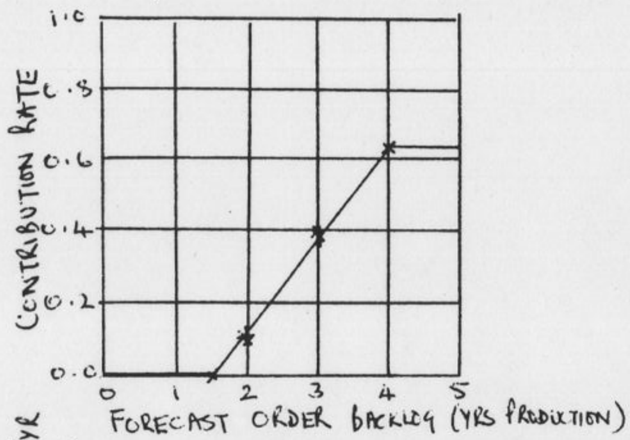
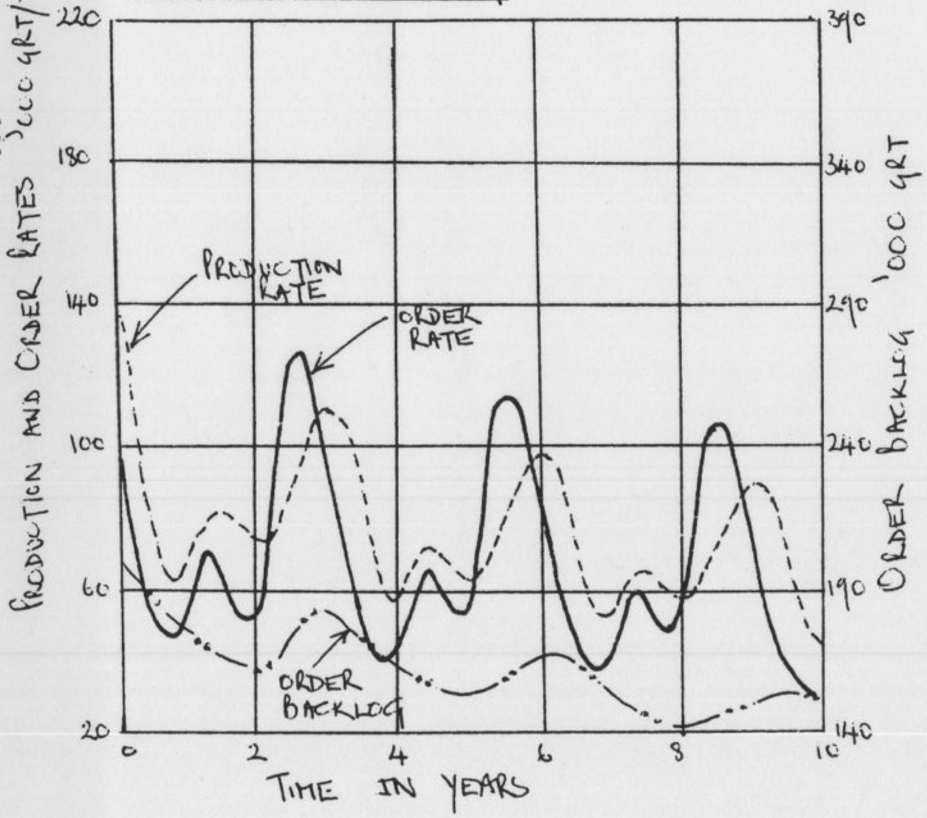


Figure 1
Dynamic Response of Yard to Constant Contribution Pricing



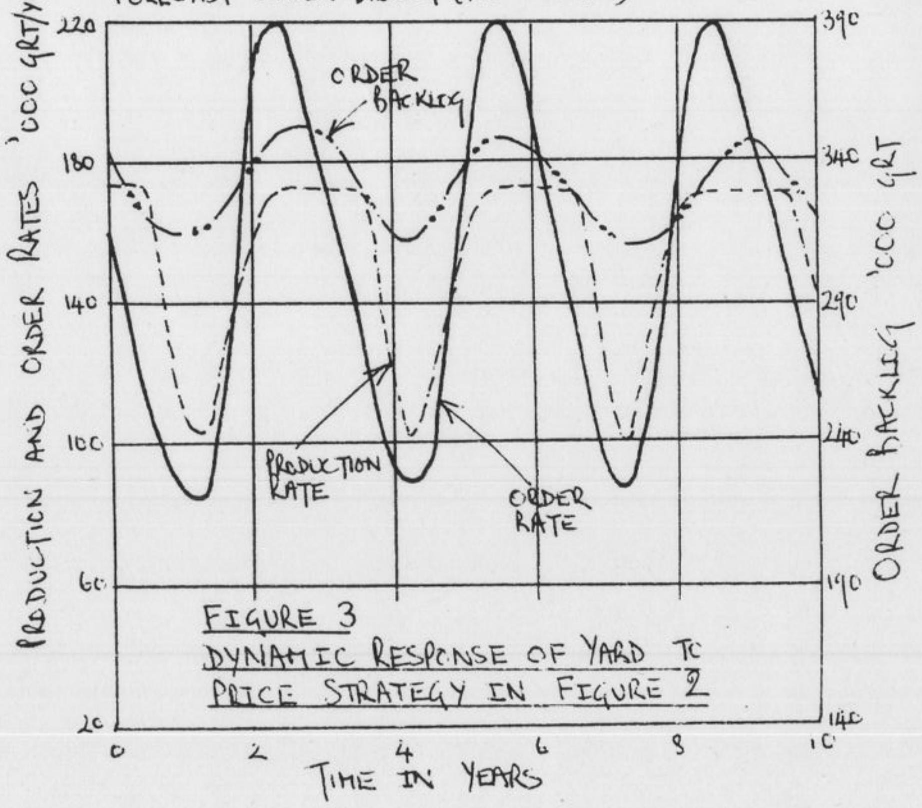


Figure 3
Dynamic Response of Yard to Price Strategy in Figure 2

The other characteristic of the run, namely the steady decline, is a consequence of the fact that price quoted by the yard is based solely on yard costs and is not used in any way to control any state of the yard (such as order backlog or production rate). In these circumstances the final state of the yard (about which yard variables would fluctuate steadily with demand) is determined by conditions both inside and outside the yard, rather than by yard management. Without entering into detailed analysis of the run, the behaviour shown represents essentially a progression towards this final state. Although only one run of this type is shown, the basic decline pattern is shown consistently for all runs of this type.

In the second run we describe, detail of which is shown in figure 2 and 3, price quoted by the yard is made dependent on a forecast of the yard's future order backlog. The strategy followed is thus rather similar to that followed by the competitor. Price dependence of this type is thought to be a typical form of strategy adopted by shipyards (see for example Geddes paras 43 and 141,and also Booz Allen page 69). Price quoted by the yard = current direct cost of production X (1+fractional contribution rate) where fractional contribution rate is derived from figure 2. All other data used in this run is exactly as in the previous run; a production capacity constraint, limiting production to a maximum of 150,000 grt/yr although present in both runs is effective in this only.

From this run two points are of note:

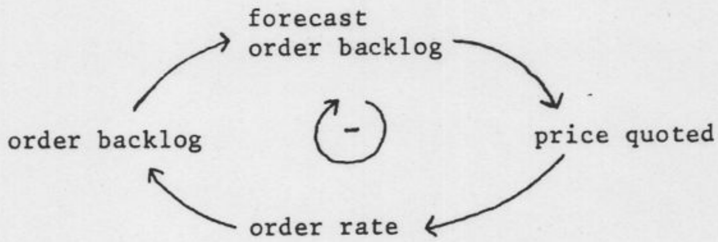
a) the peaked oscillation pattern of the previous run is not present

b) the decay mode of the previous run has been replaced by a more stable oscillation of the plotted variables.

In comparison with the previous run, the average profit margin per ton was £5.0 and the total orders taken over the 10 year period was 1,500,000 grt.

The disappearance of the peaked oscillation pattern is a consequence of the fact that yard strategy is such that until forecast backlog reaches a minimum level, quoted price is held to the level of direct cost i.e. a zero contribution. As demand rises and orders flow to both yard and competitor, the competitor following his strategy raises his quoted price at once, and faster than the yard's direct cost rises. The yard is therefore able to recoup its increased cost without sacrificing its competitive position. As we considered earlier the phenomenon arises from a too rapid increase in price quoted, if therefore this does arise in practice, its removal would seem to be a simple matter of changing production policies or pricing strategy.

Of rather more importance, this run is characterised by the fact that through pricing strategy, order backlog has been controlled and fluctuates about a steady value - chosen in effect by yard management through its pricing strategy and the action of the negative feedback loop:



This control has clearly acted to stabilise the yard system somewhat and to improve its performance. In the run, as price has been based largely on order backlog, we have therefore gained some control over this variable and limited its fluctuations. In itself this fact is of little significance to yard management since the function of order backlog in the yard is to buffer the production system from market fluctuations, order backlog can only perform its function correctly when allowed to vary freely. Our conclusion then is that this type of price strategy is fundamentally incorrect.

The lesson to be drawn from this run is that if pricing strategy is based on the wrong yard state, we may well gain good control over this state, but at the expense of other parts of the yard system. It is also clear that effort devoted to developing highly accurate forecasts of order backlog for these purposes would be misdirected.

In fact then, before we can consider the development of a pricing strategy, we have to consider which of the yard variables management wishes to control through the actions of its price strategy.

6. The goals of a price strategy

The Booz Allen Report found that responsibility for setting profit margins on tenders was generally assumed by the chief executive, who also approved any other important assumptions made in the calculations for the tender.

Implicit in this statement is the fact that the chief executive has available to him up-to-date information on costs and overheads. The main contribution of the accountant to the pricing decision is to ensure that these figures are available and that in the long run, full costs are recovered together with a reasonable profit margin.

As we have seen, there is evidence that shipyards do, under some circumstances at least, adopt a strategic attitude to the setting of price and delivery quotations. As a result of this and also of the partly stochastic nature of demand, it is necessary for other companies to follow suit and to pitch their quotations at market levels to meet their needs for orders. There is therefore a need for each company to develop a pricing strategy.

It seems clear that two goals of such a strategy should be:

a) to ensure long run profitability of the company

b) to ensure high utilisation of production resources. In the light of the model runs described we would add that the strategy should lead to smooth operation of the company, particularly with regard to production, and labour employed.

The problem facing the chief executive is how to set profit margins for each tender to meet these goals. Much of his decision rests on the results of forecasting procedures, for example forecasts of future demand, forecasts of competitor behaviour and of labour and material costs. Since forecasting in this situation is basically difficult and highly prone to error, a third requirement for the pricing strategy is

c) that behaviour of the yard system should be as insensitive as possible to errors in forecasts used.

7. An approach to the problem of strategy design

We have seen how changes in pricing strategy can affect the dynamic behaviour and profitability of the yard and how by basing strategy on a particular state of the yard we can gain some control over that state.

The problem of pricing strategy design can therefore be viewed as a problem in designing a management control system, acting on the market through the controls of price - and possibly also delivery delay, to achieve the goals set out in the previous section. By approaching the problem in this way, pricing strategy is viewed as an integral part of the whole shipyard management control system. Further by using the well known concepts of control theory and its applications to management systems through system dynamics, attention is rapidly focussed on the main determinants of system behaviour and these may be improved as required.

It has been the experience of the System Dynamics Research Group at Bradford University, over the course of many projects, that few management control systems have been designed according to the principles of control theory and that therefore very significant improvements can often be made by this type of study. For example, see the study on tanker chartering policy undertaken for a major oil company described in chapter 11 of Coyle 1974.

From a management viewpoint, such a study would focus on questions such as:

- what information from the yard itself should be used as a basis for pricing strategy?

- what other information, by way of forecasts and market models is also required?

- what is the effect on yard behaviour of errors and bias in this information and hence where should effort best be directed to improve the quality of decision making?

The study proposed would aim to answer these types of question by using an improved version of the simulation model already constructed, and as a result of this work to design an improved management information and control system. This approach has the overwhelming advantage, compared with others possible, in that very full implications of system changes proposed can be explored and can be presented in readily comprehensible fashion. Implications of any future system changes can also be investigated at low cost.

In our opinion this type of approach is both technically feasible and offers the possibility of significant improvements in yard performance.

Appendix

The validity of continuous simulation methods in modelling shipyard behaviour.

The model reported in this paper represents order rates, production rates and decision making as continuous activities. Clearly for a yard producing between 10 and 20 ships per year at peak rates, the approximation of continuous order flows and continuous production rates may not be very satisfactory. Although these approximations will not be made in later work, their use in the present work is justified mainly on the grounds of simplicity and the fact that numerical data used is probably not very accurate. System behaviour with discrete order flows is however expected to show significantly more variability than in the present model.

For the case of decision making, it is argued that the continuous approximation is not so serious, principally because of the length of the time scale of the model. Intervals between decisions of, say, less than three months are effectively continuous within this time scale, less frequent decisions could readily be made discontinuous if this were found to affect model behaviour.

Since decisions are frequently made on the basis of information received from the yard, it might appear that a discrete representation of order flows and production processes is necessary for these purposes. In fact this is probably not the case since, for example, a marketing manager would take decisions based not only on the number of firm orders received but also on his perceptions of the probability of receiving orders which are now advanced stages of negotiation. To an extent therefore he would smooth the order flow for the purpose of decision making. Some management processes such as forecasting and averaging act explicitly to smooth data and therefore to make the continuous approximation more appropriate.

By consideration of other management processes represented in the model, we argue that the approximation of decision making based on continuous variables is not unreasonable.

In summary then we regard the continuous approximation as useful for most of the model, and probably a good guide to behaviour, but where found to be inadequate it will be replaced.

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