“Managing Demand / Selling Time”

How to achieve optimised production schedules and profit maximisation in a build to order automotive manufacturing system

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Contents

Executive Summary.......................................................................................................................... 5
Key Recommendations On Managing Demand With Capacity In A Build To Order System............. 11
1 Introduction: Report Structure and Methodology..................................................................... 13
1.1 Report Structure.................................................................................................................. 13
2 Why Demand Management?.................................................................................................... 16
2.1 Seasonality and Risk Management of the Forward Order Schedule..................................... 16
2.2 Five Principles of Managing Seasonality......................................................................... 17
2.3 Non-Seasonality Related Distortions In Demand............................................................... 23
  Speculative Orders................................................................................................................. 23
  Lack of Manufacturer Knowledge of Market Demand......................................................... 24
  The Effect of Dealer Bonuses and Dealer Incentives......................................................... 24
  Order system responsiveness............................................................................................... 29
2.4 Increased speed of exposure to risk in the market?............................................................ 31
  Summary............................................................................................................................... 34
  Five Key Requirements of a Build to Order Demand Management System.................. 34
3 Revenue Management.......................................................................................................... 36
  3.1 Revenue Management: What is it?................................................................................ 36
  3.2 Case Study: Talus and Manugistics.............................................................................. 38
  3.3 How is Revenue Management Achieved?.................................................................... 41
    Daily Change from Base................................................................................................. 47
    Strategic Objectives And Priorities Of Revenue Management Systems.................... 49
  3.4 Integration of demand management and capacity planning........................................ 50
4 Applying Revenue Management to New Car Sales............................................................. 54
  4.1 Pricing against order to delivery lead-time.................................................................... 55
    Residual Values, Market Share and Future Sales Value................................................... 56
  4.2 Pricing against Demand................................................................................................. 58
  4.3 Pricing to the individual customer.................................................................................. 59
5 Sales Forecasting and Effective Use of Price Elasticity.......................................................... 62
  5.1 Forecasting Methodology and Availability of Price Information.................................... 62
  5.2 Recording Real Demand Data: Real Sold Order and Transaction Prices........................ 63
  5.3 Customer Expectation and Price.................................................................................. 64
  5.4 Effective Use of Price Elasticity................................................................................... 65
  5.5 Price Competition........................................................................................................ 66
  5.6 Customers and Demand Segmentation........................................................................ 67
  5.7 Customers, Segmentation and the Sales System............................................................. 68
6 Dealer Incentives and Payments: Rolling Future Targets....................................................... 70
  From Quarterly and Monthly Targets to Rolling Future Targets........................................ 70
7 Pricing and Costing Systems.................................................................................................. 73
  7.1 Offering alternatives....................................................................................................... 73
  7.2 Internal Optimisation: integration of ‘front-end’ and ‘back-end’ systems...................... 74
    Understanding Product Mix Richness and Demand Volatility........................................ 75
    Balancing Price against Capacity Flexibility................................................................... 77
    Optimisation Software and Forecasting........................................................................... 78
  7.3 A Combined Capacity and Selling System for BTO....................................................... 79
    Figure 47: Combined Revenue Management and Capacity Management System.......... 80
  7.4 Foresight and Competitor anticipation.......................................................................... 81
8 Implementation at the Retail Level: Agency Fees or Variable Wholesale?............................ 83
  8.1 Retail Model #1: Agency Fees....................................................................................... 84
  8.2 Retail Model #2: Variable Wholesale............................................................................. 85
  8.3 Retail Model #3: Variable List Price............................................................................. 86
  8.4 Which is the best retail model for a Build to Order System?........................................ 87
  8.5 Conclusions: Customer satisfaction and acceptance and understanding of selling systems... 90
9 Final Thoughts......................................................................................................................... 92
Appendix I: Volume Discounts................................................................................................. 94
Appendix II Additional Data...................................................................................................... 95
References................................................................................................................................... 97
This paper contains a technical assessment of approaches to revenue management. It draws on original research and the experience of other sectors. The paper does not attempt to address the degree to which particular approaches to pricing would fit with current or envisaged regulation for the car distribution sector. It aims to contribute to the understanding of the optimal system, from an efficiency viewpoint, which should be the first stage before an attempt to define the most suitable regulatory framework.
Executive Summary

Building to order involves responding effectively to real demand in the marketplace; it allows optimisation of the supply system as a whole. The system that is most able to adapt and react to real customer demand in this way will win against competition. Existing systems aim to maximise production efficiency, which is fine for a build to stock system driven by forecast demand. But such a system ignores the potential benefits to the customer and to profits of only building sold cars.

Optimal performance in terms of profitability involves striking a balance between flexing capacity and managing demand:

- While the capacity of the supply chain should be responsive to market requirements, there remain constraints, and costs limits of flexibility;
- The capability to manage demand provides the second half of the equation.

A build to order system will not just react passively to orders received, but will actively influence the type and pattern of orders fulfilled, in order to optimise the trade-off between infinite capacity variation and lost sales.

This report examines the potential for managing demand in an automotive build to order system.

Managing the timing of Demand

Keeping production volumes relatively stable is desirable because the minimisation of the costs that would be incurred by excessive flexibility in capacity, effectively improving the utilisation of capital along the whole supply chain. However, seasonality and mix variation means that sold orders will not be constant. The fluctuations of demand currently seen in the order and registration data for the UK creates problems for order fulfilment in a build to order system. The aim of the management of plant and other capacity and volumes should be the maximisation of profitability of the whole enterprise through better forecasting and optimisation.

Variability in demand, and in particular the seasonal peaks in demand, presents cost barriers to profitable build to order. Certainly if all customer orders had a lead-time of 3 days then build to order with UK seasonality becomes difficult to achieve. However, it is not expected, or necessary, that all customers will have the same time requirements. Changes can be made to the way that the product is sold and marketed that can manage the flow of orders and sales towards a pattern more aligned to the needs of build to order manufacturing.

Selling orders further ahead of build date for delivery at the peak requires proactive pricing and marketing policies to level output for the manufacturing system to deliver. Pricing in particular can be manipulated to influence timing of order placement and delivery.

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1 This analysis will be detailed in a forthcoming report on demand variation
Cars are a capital good, used rather than consumed. A very small percentage of the parc is replaced each month, and only a very small percentage of that is obligatory because of scrapping or accidents. Timing of replacement is therefore very flexible. Some factors that influence replacement are outside the control of the supply chain, for example expectations regarding the economic cycle. Other factors are within the sphere of influence of the brand supply chain, for example price, waiting time and managing seasonality (i.e. plate changes).

However, competition adds a layer of inflexibility and risk. If you don’t sell today but sell tomorrow, that is OK. If you don’t sell today but a competitor sells today, then that is not okay. This also demonstrates the reason for the maintenance of the plate change. It may be that the simultaneous competitive advertising, marketing and sales effort is largely cancelled out. However, once in place, the plate change remains attractive to customers and sellers because of the effect upon residual values. The aggregate impact is a shift of the timing of purchase, and no individual brand can afford to opt out. Therefore, for manufacturers, shifting sales off peak must be given secondary priority to selling advance orders for the peak.

The feedback loop from market to production is much more immediate in a build to order system. This feedback loop enables real-time pricing adjustments. In fact, this is actually just a retiming of current price adjustments made through incentives, support payments and other ad hoc promotional or discount payments. By moving the price adjustments (or discounts) to before a car is made rather than after, the price adjustment can create the demand able to be delivered by the manufacturing system whilst delivering the product the customer wants.

Creating Demand

The aim is to build ‘the car you want, when you want it’. This does not mean that the manufacturer should not try to influence what the customer wants or try to improve the industry’s profit from each sale. The aim is to match the customer’s preferences with the constraints of production. The aim should be to keep production as stable as possible, to stimulate demand for profitable variants, and to discourage demand for variants whose capacity is constrained.

Currently, NSCs set list prices then provide a panoply of incentives in response to the daily levels of registrations and stocks. Dealers try to exploit the incentives to sell what they can get at maximum profit. The hope is that this sells the cars which have been produced at the least overall discount. The manufacturer therefore sets the macro pricing, with micro pricing set by the dealer.

It is well known that there are large price differences between categories of customer, with the highest volume purchasers obtaining 30% plus discounts from list price. Retail customers expect a maximum discount of around 12%. Within each category price differences are much more modest and customers will change their timing of purchase, or switch between brands, in response to relatively small price differences per unit.

Currently these incentives are used very flexibly but with little knowledge of their specific impact on each sale. Actual customer demand and transaction prices are not
reported back to manufacturing. Furthermore, these incentives are related to stock push and dealer targets, rather than the requirements of the manufacturing system. The differentials do not make economic sense in relation to costs per car. The customer who compromises and buys from stock in return for a discount or specification upgrade, pays less than the customer who has the car built to order, yet the latter costs less to the system.

With a stock-based system the natural focus is on registrations, and on dealing with excess or ageing stock. In a stockless build-to-order system the natural focus is on the flow of orders. Currently changes in the pattern or level of demand are reflected first in the level of stocks and then after some lag, in production. In a stockless system the feedback is direct to production. Existing pricing differentials could be redirected to optimise both the revenue from each sale, and the use of resources over time. With an immediate feedback loop from the market into future manufacturing, more accurate data on real demand and recorded actual transaction prices, better forecasts can be made and better offers made to the customer to manage the flow of orders.

Production and Responsiveness

For production the visibility of the orders booked according to delivery date allows analysis of cumulative past and future orders on a daily basis to adjust capacity, so that a trend can be identified quickly, and the targets for the future orders altered accordingly. The decisions made at the plant on capacity will able to be made far more frequently on the basis of real data; small decisions can be made frequently rather than large decisions infrequently, with devolved decision-making based upon set acceptable margins of change.

The systems required will be far more responsive and articulate in processing customer queries. They will also be able to capture lost sales and lost configurations, and this will feed into both product and price mix management. The process functionality from a sales and supply perspective will have to give definite answers and book guaranteed delivery dates, with a check on parts and production to guarantee exact product match.

Applying Revenue Management

Prices vary today in a build to stock system, where few customers pay the same price. Prices will continue to vary in a build to order system. One model of applying dynamic pricing is to quote variable list prices, with rolling target sales levels for future orders alongside volume bonuses/discounts rising on a continuous scale. This leaves the micro price management to the discretion of the dealer or NSC salesperson, which does have some advantages. The second option is to move to an agency system where the transaction price of the new car is set by the manufacturer, and the dealer is paid on a fee per order basis. This should allow a better flow of information on price sensitivity and therefore allow better demand management.

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2 This research and analysis will be detailed in a forthcoming report on current pricing and incentives.  
3 The potential opening up of pricing strategy to competition scrutiny requires careful management and use of sophisticated ‘game theory’ in a true revenue management system.
Choice of retail model comes down to a debate on whether a centrally automated revenue management pricing system is a more effective and profitable selling system than an incentivised salesperson who can judge pricing by customer. It will depend in turn on which is more acceptable to the salesperson and the customer. However, both approaches lead to a more centralised pricing system with more information available. The IT system employed will record transaction prices and allow a better coordination of the macro and micro pricing.

The aim of dynamic pricing is to maximise profitability whilst increasing predictability and visibility of forward orders in order to minimise variation in production capacity requirements. This effectively reverses the stock-push paradigm where production efficiency is maximised and the price management system attempts to minimise price and revenue deterioration based on what has been produced.

**Moving to Dynamic Pricing**

The move to build to order requires a change in the culture of manufacturer and dealer to managing risk. Manufacturers need to focus on selling through channels, not to them, and sales channels need a more stable, less trading-based selling system. Fundamentally, selling activity needs to be integrated with production planning. The emphasis of risk is back with production, which must respond with the speed and agility that dealers have always had to respond to changes in market conditions.

Query, price quotation and order confirmation systems will have to respond in real-time in order for the decision making to reflect actual current production slot availability. For an advanced system, the order-booking engine will also handle the subsequent cost and pricing calculations. Without stock, all sales channels sell time and resource in the supply chain. Accounting systems will need to be designed that focus on ‘per unit marginal product cost’ and ‘per customer sales profit’ data. This is currently not attempted. Even under the current system, actual transaction price data would assist the manufacturer enormously in forecasting both real demand and potential effects of price or promotional activity. To implement a truly responsive pricing and production system, this costing estimation will need to be processed and relayed in real-time. There is also the scope for individualised price and other marketing offers through CRM, which will require better customer data.

It is important to recognise that there is not one capacity to be managed, but there are multiple capacities to be managed, namely at the manufacturer and at suppliers. This multiplicity of capacities must be built into the demand management. This will be achieved by building the necessary rules into the order query management system. The flexible capacity of the supply chain will be fixed at a point ahead of build date, after which the revenue management system will optimise sales based on that known capacity level.

Implementing real-time pricing will by necessity be an evolution, rather than a sudden step change. Significant IT investment aside, the first steps down the road involve moving to target pricing forms of revenue management, where target sale prices are given to dealers. These are effectively variable list prices; doing this is actually no

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4 The IT systems debate will be covered in more depth in a forthcoming report
more than a 'tidying up' of current payments and processes. The variable support payments given to dealers over time mean that effectively variable pricing already exists. The change is aligning these price changes to anticipated production capacity. The next stage is installing systems that can create variable individualised sale list prices, which the dealer can discount against. However, as stated, there are strong arguments for moving further and setting an actual price direct to the customer, although there may be challenges to overcome for this to work in all markets, although there may be regulatory issues that need to be taken into consideration.

Forecasting will by necessity have to become more sophisticated for effective revenue management and capacity planning. A major advance would be recording of actual transaction prices (and trade-in prices) and subsequent ability to understand price elasticity. Furthermore, forecasting will have to be more frequent, moving from monthly analysis to daily trend analysis allowing short-term forecasting; every day, every price quotation, every sale, and every production slot will shape the forecast and targets for the immediate future.

The cost of making each car varies in a complex way. Thus, for example, if overtime can only be run in units of hours but your stable level requires only 20 minutes, then clearly you would shift the production about to maximise utilisation. It may also be the case that it is too expensive to make all the cars demanded (for example, if because you have work on Sundays) then at this point it might be more profitable to raise prices to reduce demand than make these cars; either this or offers are made for alternatives, since there will have to be upper price limits to avoid damaging customer perception of price. Therefore the production planning and forecasting system needs to be integrated into the sales planning and forecasting process, from months prior to any build date. Revenue Management is essentially just forecasting and optimisation; the application of this mechanism should make the most of a build to order system. From a long way out to date of build, the sales forecast will need to be integrated with the production forecast, as shown in the graphic overleaf.

Near-Term Capacity fixing and Whole Enterprise Optimisation

A stockless Build to Order system opens the door on new opportunities for demand and supply management. Essentially, build to order utilising demand management and capacity flexibility is a means for achieving unified forecasting and optimised performance of the whole extended enterprise. Other tools such as mass customisation, late configuration and component design rationalisation will assist in this objective. Optimisation software is often deployed to maximise the performance of a particular business area, examples being target pricing or production sequence and schedule optimisation. The challenge for the long-term is building cross organisation forecasting, optimisation software, business practises and processes that can increase and decrease both capacities and prices in line with current demand. This moving with the market makes possible the optimisation of the returns for the entire system as a business network; currently optimisation methods are scattered and create ‘islands’ of best performance. Competition and commercial relationships remains a major barrier to attempting this goal, but such optimisation offers the greatest potential for a sustainable long-term improvement to profitability from build to order supply.
Figure 1: Summary of proposed integration revenue management and capacity flexibility
**Key Recommendations On Managing Demand With Capacity In A Build To Order System**

1. A Real-time ordering system for direct order booking; the schedule should be a dynamic data source for the whole supply chain, aiding forecasting and planning.

2. Recording of transaction prices, associated promotions, dealer payment (and used trade-in valuations?)

3. Subsequent analysis of real demand, which in an operational sense involves monitoring and continuous analysis of:
   - Price mix
   - Customer and Market mix
   - Product mix
   - Subsequent Profit mix
   - Opportunity cost of rejected Un-fulfillable order queries

   Cost of capacity utilisation including the 'multiple capacities' of derivatives, engines, supplier related options etc. The higher the build to order content of a system, the more accurate the order and sales data become in reflecting real demand.

4. Changes to dealer incentives and payments to remove distortions created by monthly and quarterly targets. There are two elements to this; rolling future targets to incentivised the target future order time profiles, and rolling volume related margins.

5. Introducing pricing variable by delivery date. This change naturally leads to the eventual introduction of agency fees for sales channels, if acceptable within regulatory frameworks, via the evolutionary route of variable list prices or wholesale prices.

6. Use of revenue management for real time pricing and promotions for:
   a. Primarily profit maximisation
   b. Managing risk in the order bank in terms of capacity utilisation
   c. Meeting customer needs for price flexibility
   d. Managing the long-term price position in relation to volume in the market and customer valuation of the product.

7. Use of agility
   a. Using advanced competitor foresight and prediction software to outsmart competitors revenue management systems.
   b. Building sold orders ahead of delivery date for peak delivery periods.
8 Whole system demand management
   a. Integrated forecasting and planning across all functions and supply chain partners.
   b. Fixing daily capacities at points as close as costs make reasonable to day of build.

9 In a system where all cars are built to customer order, the true customer demand becomes apparent. Exploiting this to optimise the efficiency of the whole supply system requires the development of mechanisms to monitor marginal costs and profits, and manage price in line with capacity change costs for profit maximisation.
1 Introduction: Report Structure and Methodology

1.1 Report Structure

The starting point for this report is the problem for a build to order system that has been highlighted analysis of patterns of demand. The matching of supply and demand will move from forecasting a stock requirement and the price management of selling from stock to price management of sold orders, delivery date, and future demand. Through selling time and resource in the supply chain rather than finished goods, there is an opportunity to maximise the profitability of sales in line with real demand.

The report begins at the challenges posed for the manufacturer in running a build to order manufacturer system, and the subsequent requirements for the ordering and sales system. The focus then shifts to the problems posed by the existing patterns of demand, to examine to what extent these demand patterns represent real demand or demand distortion resulting from the sales system. This summarises the effects of current price management, and subsequent retail payment and incentive systems, which will be examined in more detail in a forthcoming report on dealer payment, discounts, promotions and incentives.

Next consideration turns to what customers expect from buying a new car, and how this fits with the need for demand management. Then the use of price as a demand management tool is introduced. Three different potential pricing approaches are discussed in detail, as ways of operating real-time variable pricing. Then the consequences of this for the management and accounting of the sales and ordering system are considered.

The final section looks at how variable pricing would operate through sales channels. Two example scenarios are offered which are essentially models of application. To conclude, customer acceptance of different selling systems are evaluated in the light of customer research and their application in other sectors.

Methodology, Aims and Objectives

The aim of this report is to explain how demand is matched with supply in a stock-driven system, and to evaluate what changes are required to enable build to order. Indeed, the changes are designed to maximise the potential of build to order in returning profitability to the entire enterprise.

This report is the output of several areas of work. With a system where the pricing is so opaque, it is difficult to separate the distortions created by pricing and payment methods from those created by other factors, i.e. the UK registration change. What 3DayCar is trying to achieve is a system where the relationship between supply and demand, particularly in relation to price, is better understood by the production system. Currently, demand management is outside the remit of any one individual or department within the manufacturer or any other part of the supply chain.
Moreover the commercial sensitivity of this area is such that there can be a reluctance to discuss the figures involved. From the individual standpoint of players in the supply chain, the issues at stake appear different; the views of the manufacturer, customer and dealer are often at odds. To get a clear view of how the current system actually sells cars, and how the system could be adapted to sell entirely for build to order, the system has had to be stripped down to basic components and re-examined.

**Interviews with Key NSC Promotion, Forecasting and Sales Planning and Plant Production Planning Managers**

Interviews were undertaken with representatives of several manufacturers at the NSC level. These included those responsible for sales analysis and forecasting, sales and promotion planning, dealer support, distribution planning, stock management and allocation negotiation. This covered the process of new car sales, from initial market long range forecast, through allocations, to dealer support, promotional activity and stock monitoring. Further interviews were undertaken within manufacturing departments, in particular on their view of allocations, programming meetings and sales and production planning.

**Collection of Actual Detailed Ordering and Sales Data**

The detailed analysis that supports the argument will be more comprehensively covered in a forthcoming report focusing exclusively on demand variation - mix and volume variation in orders and registrations.

This order and sales data included consideration of the following:

- For several sponsor models we have analysed daily order bank data, for 1999 and 2000
  - Orders by Customer, Dealer, NSC,
  - Looking at volume and mix variation factors including
    - Trim level ("L", "GLS", "Sports", etc)
    - Paint colour
    - Options
    - Customer types (Fleet, private retail, employee, production order, dealer order, etc.)

- Daily Registration Data for 1999, (for the same models)
  - 2000 registration data was not available in the format we required

- Marketing Spend (for the same models)
  - Advertising, Promotions and Dealer Support/Incentives

- Forecasting and Allocation
  - Rolling Sales Forecast
  - Allocation Request and Rolling Production Programme
Survey of Dealer Payment Structures and Current Price Management

Data has been obtained through
1) Discussion with individuals with expert knowledge of current price management,
2) A detailed survey of the structure of payments made to dealers by different franchises, from industry sources on both the payer and payee sides
3) Desk research on existing data such as that provided by the Competition Commission report,

In this way a reasonably detailed picture has been assembled of how dealer revenue and price management operates as a single system.

Comparison with Other Sectors: Airline Pricing Study

Comparisons with other industries have been made to understand the requirement of the build to order system in managing demand, and to understand the ingredients of revenue management and a more scientific approach to pricing. We tracked price quotations online for eleven flights, scheduled by five carriers. Price queries were made on these same exact flights every day for 17 calendar days until the day before the flight or the flight closed. This report builds on previous work, with particular reference to previous work by Harris and Pinder on Revenue Management and manufacturing in other sectors, (Harris and Pinder, 1995,), and Jonathan Brown of ICDP (Brown, 2000). Also consulted were individuals with expert knowledge on the application of revenue management in the airline sector.

Dealer Workshops

Retail models have been created to implement price management systems, based in part on analysis of other sectors such as estate agency, tourism and travel. These we tested by presenting to two workshops, one to members of the management team of a large dealer group, the other to a group of independent and small-scale dealers. Finally, we tested the ideas on a group of sponsors in a workshop at the December 2000 3DayCar conference.

Feedback and Further Detail

If any of the data sets or assumptions made are deemed to be incorrect, we would welcome any more data that can further help our understanding. The data is by necessity an amalgamation from various sources, and covers a variety of brand systems and businesses. However, we believe that we have drawn a picture that typifies the operation of the system as a whole.

Further detail on particular aspects of this report are forthcoming. In particular, three reports by this author will expand on points made throughout:

- Demand Variation: Analysis of Order and Registration Patterns for Build to Order
- Pricing and Incentives: Analysis of the Current Price and Sales Management system
- IT for Build to Order (with Mickey Howard)
2. Why Demand Management?

The detailed findings of this area of research will be covered in depth in a forthcoming report. However, the key issues arising from the research lead directly to the solutions we are proposing, so a brief summary here is appropriate.

The key question is why do manufacturers need to think about demand management? The main issue is risk management in ensuring employment of capital throughout the supply chain. Flexibility of capacity and the expected variability of demand are the factors that will determine what kind of demand management is required.

2.1 Seasonality and Risk Management of the Forward Order Schedule

The biannual peaks in the UK market mean there are clearly problems in meeting sales peaks with build to order at short notice. Building to order means that both orders in and expected capacity for meeting peak sales need to be managed well ahead of the sales peak to allow the system to cope with the variation involved. The change from one to two peaks in 1999 has reduced the extreme seasonality that evolved over the previous three decades. The capacity flexibility required to serve this market on its own with all orders supplied within three days would be completely non-viable.
2.2 Five Principles of Managing Seasonality

1. There will be a spread of order lead times which can be segmented, rather than all orders fulfilled to a specific minimum (i.e. 3 Day) lead-time.
2. Producing for several markets with differing seasonality will assist the smoothing of demand, but alone it is not enough.
3. Some customers may be persuaded to buy off peak if it is made attractive for them and for the sales channel.
4. Encouraging the early sale of a large proportion of the orders for sales peaks will assist the capacity planning of the whole supply chain, and the ability to meet targets at these peaks.
5. Selling orders well in advance of the peak must take priority over selling for delivery off peak.

Each of these is explained below in more detail.

**Principle 1: There will be a spread of order lead times.**

Not all customers expect or want delivery in 3 days. It is important to stress that there will be segmentation of order to delivery lead times, and these can be taken into consideration when setting capacity for orders. The 3 days is just the minimum order to delivery capability that enables the system to respond to orders as though they were customer orders fulfilled from a distribution centre. The graph below summarises the ideal order to delivery time profile for UK retail customers\(^5\).

![Ideal OTD Times - Retail](Figure 3: Ideal OTD lead-times: Source: New Car Buyer Survey, S Elias and B Waller, 3DayCar)

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\(^5\) We expect the fleet customer profile to be different, and the results of the fleet survey will be available in the autumn of this year.
Over the next few pages, it is shown that the seasonality seen in the UK, when combined with the customer expectations shown above, amount to an impossibly large jump in the supply chain capacity requirement.

95% of retail customers expect cars within 4 weeks. 3.4% of annual sales are sold in February. This rises to 18.4% in March. Assuming average capacity use is at 8.3% of annual sales per month, the change amounts to a 50% drop in production in one month, followed by a 220% increase the next. With 95% not waiting more than four weeks, the system is expected to cope with an extra 10% of annual sales in a single month over the average.

The actual sales pressure on the system will actually be more complicated than this would suggest; for example, the different segments of customers will have differing time expectation profiles.

Segmentation of all lead times will be required, and expectations managed. Of course, even through analysing current order and registrations, there are limits to how much these will reflect build to order sales, for several reasons. Some of this will be down to distortions created by the current system, but there is also the uncertainty of exactly how customers will behave under a new system. However, as the schematic below illustrating how product slots can be allocated illustrates, we expect there to be significant benefits in balancing lead-time expectations through segmentation. Segmentation below is schematic only and may well differ from the actual.
Principle 2: Producing for several markets with differing seasonality will assist the smoothing of demand, but alone it is not enough.

As the graph below demonstrates, seasonality of all main European markets combined does not provide the stability of sales that a build to order system requires. Orders placed ahead of peaks will assist the ability of the systems to meet peak demands.

August is the month when plants traditionally shut down. Under build to order, a prolonged shut down period adds constraints, and staggered holidays would be a preferable solution if they were made acceptable to employees. The trend line in the graph below clearly demonstrates the seasonality of a spring peak in Europe, which follows the actual seasons in the same way in other market areas (see Japan and US in Figure 51 in Appendix II).

![European Seasonal Volumes](image)

Figure 5: European Seasonality (percent of total volume of annual registrations, based on the combined volume of sales of France, Germany, UK, Italy and Spain)

Individual brands and models will show different mix of market sales, and so the picture could vary for any individual model, as shown in the example above.

Seasonal variation over the year requires an understanding of model sales in each market, and therefore a balance of capacity requirements over all markets served by a plant. Even with plants serving a larger area, the delivery dates contained within order input variation will require smoothing to levels within capacity constraints of both aggregate volume and mix. Since this is a UK project we have concentrated on the need to meet UK demand. As we have seen, the UK is the most variable market in
terms of predictable swings of seasonality, and if this market can be served, then any market can be served.

The breakdown of market seasonality in the five main European markets is shown below. Comparing Figure 6 with Figure 7 demonstrates that since the change from one to two plate changes in the UK in 1999, the overall seasonality has become even more extreme across Europe. The August UK peak coincided with the traditional holiday period, and so balanced the overall variance to some extent.

![Main European Market Seasonality](image1)

**Figure 6**

![Main EU Markets Seasonality Prior to 1999](image2)

**Figure 7**
However, the August peak itself coinciding with the traditional holiday period goes some way to explain the requirement for distribution centres, compounds and the relatively low proportion of build to order in the UK market, which is shown by ICDP research to be 32% compared to 60% in France and 62% in Germany (Williams, 2000). The March plate created a pattern of sales across Europe closer to the spring-based seasonality seen in other market areas.

Further to this is the management of product mix. This may vary considerably, planned or otherwise.

**Principle 3: Some customers may be persuaded to buy off peak if it is made attractive for them and for the sales channel.**

Customers and Sales Channels currently hold back for the peak period for perfectly good reasons. The residual value in the UK is predicated on plate change, so replacement at this time makes sense for fleets and individual customers. Manufacturers build up stock for selling at the peak, because they do not need to discount so heavily if they hold onto stock for the peak.

However, the fact that consumers do hold off and wait to purchase as a result of fairly artificial seasonality proves that if sufficient incentives are offered to the buyer they will change the timing of purchase. This opens the way for manufacturers to persuade fleet buyers and loyal individual customers to take delivery away from the peak. If the offer were significantly attractive, for example compensating a buyer for the depreciation cost of changing cars a couple of months after a plate change, (for example, during the last two months of the year which are traditionally quiet sales periods), then this discount may prevent the customer from holding off until the next plate change in March, and buy now. An actual sale is always better than putting off a sale that could switch to competition.

**Principle 4: Encouraging the early sale of a large proportion of the orders for sales peaks will assist the capacity planning of the whole supply chain, and the ability to meet targets at these peaks.**

Peak demand cannot be met through build to order unless a significant proportion of orders are placed in advance. These orders can then be built and stored prior to the required delivery date.

Therefore it is the build up of orders prior to the peak that will determine the ability to meet delivery dates for peak periods. Briefly, in terms of volume alone, these orders must be coming in at a rate that allows the building ahead of sold orders.

There the flow of orders will need to be analysed and anticipated. Most manufacturers have traditionally only analysed sales not orders.

Both this approach and that outlined in Principle 3 require more sophisticated forecasting than is currently employed in the car industry.
Principle 5: Selling orders well in advance of the peak must take priority over selling for delivery off peak.

A very small percentage of the parc is replaced each month, and only a very small percentage of that is obligatory because of scrapping or accidents. As stated, this and current plate related seasonality demonstrates that the timing of replacement is therefore very flexible.

However, competition adds a layer of inflexibility and risk. If you don’t sell today but sell tomorrow, that is OK. If you don’t sell today but a competitor sells today, then that is not okay. This also demonstrates the importance of the maintenance of the plate change. Although in many ways the movement of sales to a peak means that the simultaneous competitive advertising, marketing and sales effort is largely cancelled out, once in place, the plate change remains attractive to customers and sellers because of the effect upon residual values. The aggregate impact is a shift of the timing of purchase, but no individual brand can afford to opt out. Therefore shifting sales off peak must be given secondary priority to selling advance orders for the peak.

An order received well ahead of required fulfilment date, although costly in terms of storage of finished goods, is better than a lost sale. There is evidence from previous work (Brown, 2000) that the peak contains more delayed sales than sales brought forwards, which makes persuading customers to order ahead a less daunting task. However, the need for segmenting and encouraging certain orders is no less important as a result; a large proportion of peak sales as delayed orders will need to be managed.

![Figure 8: Sales minus Orders](source: 3DayCar data supplied by Sponsors)
2.3 Non-Seasonality Related Distortions In Demand

Distortions in demand create statistical noise and demand amplification, which confuse the understanding of actual demand and create exaggerations in apparent capacity requirements. There are several elements intrinsic to the current system that creates distortions in the flow of orders that are not directly related to seasonality.

Speculative Orders

In the best current ordering systems, many parties can both place orders and amend existing orders. The NSC will make the long range forecast for their market area. This then helps plants in planning multi-market production. Following long range planning, allocation of production is determined for each market. Meetings are held between the NSCs and central programming teams, where forecasts, targets, production programmes and most crucially, allocations are finally agreed. Crudely put, it is then down to production to deliver the product they planned, and the NSCs to sell that product. Daily orders therefore rarely reflect market demand, as shown in figure 9.

![Figure 9: Speculative Orders (3DayCar Data).](image)

Speculative orders are therefore often generated in the first instance by production planning based on long range NSC forecast requirement, then later amended in the light of the monthly allocation and programming meetings. These quotas are then opened up to NSCs to sell directly, or change as they see fit. Therefore the NSC may sell a large order to the Post Office with all the amendments implied. Also, the NSC may place speculative orders or amendments to existing orders on the basis of market trends and forecasting. Dealers can also place such speculative orders, or amend their own allocated production or that assigned to other Dealers, depending on the franchise system and rules. Speculative orders make up the bulk of sales in the UK.

It is therefore very hard to determine what ‘real’ demand actually is. Even actual customer orders may be indistinguishable from Dealer orders, and customer orders themselves are in surprisingly not generally broken down into ‘new’ production orders and amended or stock- sourced orders. Even if a manufacturer can distinguish between a customer order in production and other customer orders, the production fulfilled orders only give you the part of customer demand that was not satisfied by all the stock already in the system. Therefore customer orders in production are the unusual or outlier specification, if the manufacturer is managing core stock effectively.
What this means is a lack of understanding of what customers want. Instead manufacturers know what was sold, and through stock clearance action, an indication of what they really do not want. The effect on forecasting is also therefore very distorting. Under a fully build to order system, there can be no speculative orders. Order amendment is not build to order unless production orders are not built without an attached actual customer order - which defeats the idea of having a production order. Instead, forecast sales and bill of materials forecast would give the supply chain the planning data required to adjust to whatever is required.

Lack of Manufacturer Knowledge of Market Demand

These speculative orders therefore amount to noise in the system when trying to understand ‘real’ demand. This lack of knowledge is compounded by the feedback loop being so long from sales to production planning. Sales are reacted to on a day-to-day basis, but no action is taken on production until long after sales would indicate change is required; the real customer interest is not known, since all cars made must be sold somehow.

The implication of this noise is a lack of knowledge of market activity. Allied to this separation of daily registrations from production planning is the lack of data on actual transaction prices, dealer payments etc. NSCs may monitor the profitability of their franchises, but there is no record made of actual sales costs and prices paid. These costs are absorbed into general Dealership revenues from manufacturer and new car sales department running costs. Only Fleet deals made by the NSC are recorded and monitored in detail.

This lack of knowledge of sales behaviour makes forecasting extremely unreliable, in particular the expected uplift generated by a promotion. There is the problem of relatively infrequent purchases, but aggregated at the market level the data is usable. On the whole, demand forecasting has little changed over the last twenty years. The Box Jenkins Model is the basis of market and model forecasting for most manufacturers. Strategic forecasts do employ techniques that adjust future demand expectations on the basis of the general economic climate, previous peaks and cycles in used cars, but these do not tend to be used by either sales forecasting or production planning once into the budgeted year of sales and production. More sophisticated techniques could be employed but manufacturers would have to gather more information on real sales rather than production and dealer orders for the change to be worthwhile.

Other sectors record all sales, associated sales costs (i.e. promotions) and transaction prices. This is possible largely because of the nature of the pricing systems. The collection of this data is built into the retail IT systems.

The Effect of Dealer Bonuses and Dealer Incentives

Dealer bonuses, manufacturer promotions, and incentives and other payments have a distorting effect on both orders and sales. Figure 10 shows the cumulative daily registrations for two models by different manufacturers for the year 2000. The seasonality can be seen in the sales of the two models. However, all jumps in
cumulative registrations are not at the beginning of the new registration month. The jump in sales occurs on the first day or first working day of March and September (see lines a and c in the graph), which is in line with increased seasonal demand. However, the next increase after these occur before the first day of the next month (at lines b and d in the graph), as the peak sales month draws to a close.

These end-of-month registrations result from the pressure created by targets and bonuses for Dealerships and NSC’s. For NSC’s, the objective is gaining target market share for the critical sales months.

Figure 11 highlights the same cumulative registrations for the two models, but plots them against a cumulative line of average registration per day. Again the peaks and troughs of registrations can be seen, but behind this pattern can be seen the stepped nature of end of month registrations. For each month Model X registrations increase at the end of month far more than at the beginning of the month. Model Y demonstrates less of this tendency, and is therefore less pushed into the market.

Most franchises end up pushing stock into the market at some time, often towards the end of the life of a particular model. However, this variation is largely caused by the system of incentives that reward on monthly and quarterly targets. An example below, shows the breakdown of bonuses awarded to an individual franchise of a volume manufacturer. This is based on data that is the subject of more analysis in a forthcoming report on Dealer payment and incentives. However, monthly peaks are partly caused by internal franchise salesperson targets.

<table>
<thead>
<tr>
<th>Bonus System</th>
<th>What Qualifies?</th>
<th>Targets</th>
<th>Value (per unit as % of base model list)</th>
<th>Frequency of Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Retail / Business (SB) &lt;25 sales</td>
<td>Targets for each Model</td>
<td>5.5%</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Fixed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Related Sales Payments</td>
<td>Retail / Business (SB) &lt;25 sales</td>
<td>Not target related</td>
<td>5.5%</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Changeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fleet Sales</td>
<td>Businesses &gt;25 sales ‘Delivery Fee’</td>
<td>Not target related, NSC involvement</td>
<td>3.1%</td>
<td>Quarterly</td>
</tr>
<tr>
<td>CSI/Retailer Performance /Standards</td>
<td>All measures</td>
<td>By measure</td>
<td>0.2%</td>
<td>Annually</td>
</tr>
</tbody>
</table>
Figure 10: Cumulative Registrations 2 Models behaviour at peak
Source: SMMT data provided by Manufacturers for 3DayCar Research

Figure 11: Cumulative Registrations for 2 Models with base daily average
Source: SMMT data provided by Manufacturers for 3DayCar Research
Each Salesperson will have an end of month target set by the dealer principal, in order that the overall targets are met. The manufacturer has the right to remove the franchise but not the individual salesperson. The manufacturer therefore is concerned with the performance of the Dealer. The individual salesperson is the direct employee of the Dealership, and so is rewarded by a system that will vary by Dealership and Dealer Group and will also vary by contractual terms that will be negotiated by the Salesperson on joining.

Generally speaking, salespeople will be given targets based on the manufacturer target for the dealership implicit in the payment structure. This manufacturer target becomes the Dealerships monthly budget, which effectively is a monthly target, which will be the responsibility of the Dealer principal. If managing a franchise that is part of a group, then the performance of the new car sales department against budget becomes a measure of the performance of the Dealer principle. Salespeople are therefore pushed to meet targets for real sales each month, thereby reducing the pressure on the dealership to sell rental cars if appropriate or ‘pre-register’ cars as demonstrators etc.

Individual salespeople will tend to be awarded a commission percentage of the basic margin on each car (often 10% of base margin). Other payments to the dealership, i.e. bonuses etc may form part of this commission if this has been negotiated. Wholesale subsidy payments or promotional payments made by the NSC on a variable basis may be passed directly as a lower limit on discounting each sale, or may be passed as a bonus to the salesperson for selling ‘X units’ of ‘model D’.

The dealership itself monitors progress against target every week, although there may be daily measurement of key variables. Where the franchise is part of a group this can be highly formalised. At the end of the second week of each month, a forecast will be made on total sales, and profitability of those sales. At the end of the third week, a revised forecast will be produced. Around the 29th of the month, a final forecast will be produced that is a fairly accurate estimate of month end performance. The accounts are finalised for month end at the end of the week of the month following. And the cycle is then repeated.

Figure 12 : Proportion of registrations made in each quarter of a standardised month.
Source: Sponsor data
Managing Demand/Selling Time

Also, the psychology of selling needs to be taken into account. Targets and reward motivate salespeople. Most salespeople will be on a basic plus commission with perhaps an annual minimum guarantee.

The emphasis on month end is therefore a natural result of many pressures both from the manufacturer and within the Dealership itself. The result is the pattern of registrations each month shown in Figure 12. The days for all the months in the sample have been equalised to reflect a twenty-day month, and then divided into four quarters of a month. 34% of registrations each month are made in the last quarter of the month. Such fluctuations in sales over a month do not as such reflect real customer demand and creates unnecessary strains on the supply system; therefore such distortions should be removed if possible.

**Promotions**

Promotions are often used in times of difficulty to dispose of unwanted stock, and often create distortions in demand. However, promotion distortions are not in themselves a bad thing, so long as the effects are predictable to some degree and the supply chain has been told to expect such uplift.

Figure 13: Marketing spend monthly share on a model minus sample average compared to model registrations monthly share minus TIV monthly share

It is very difficult to identify the effect of promotions in volume or mix. However, the effect of promotions should be to increase the share of market whilst going with the flow of real demand, observable in Figure 13.
Order system responsiveness

Order administration is a major bottleneck in the current system. Whilst many systems allow orders to be placed directly when the customer sale is made, there are plenty of circumstances when this is not possible. Furthermore, the speculative orders are often placed monthly. The difference between a system where orders are entered daily and another system where orders are almost all speculative orders and placed monthly is shown in Figure 14.

Figure 14: Order Input Frequency
Source: 3DayCar Data

The time lags from order to delivery inherent in existing systems, particularly those caused by weekly dealer ordering, create distortions in demand that typify demand amplification (otherwise known as the Forrester effect). In effect mix of product orders rise and fall as users over steer to compensate for the infrequency of their stock orders.
The overcompensation can be seen in the mix ordered from month to month in Figure 15. The basic trim level moves from 21% of orders to 50% of orders over the year, rising and falling each month as order input attempts to balance the right mix. This model has a longer OTD lead-time. Longer reaction times result in constant overcompensation.

Even when the orders are real customer orders, these can be subject to a delay prior to entry on the ordering system. This is shown in Figure 16.

Under the current system Dealers optimise order administration by holding order input until Monday; first, administration staff may not work at weekends, and many systems open up newly available pipeline orders on a Monday. Dealers point out that NSC’s often do not offer order system support at weekends, particularly Sundays. For
a build to order system, this is unacceptable for as number of reasons. There is no feedback on booking of a production slot and therefore delivery date.

Even the best European order systems do not give a confirmation of order until at least twenty-four hours after the order query. A provisional estimate is given at the time given on the basis of expected system performance under average conditions; several manufacturer order systems give a virtually instant confirmation of order but it is constantly revised. The date given is a provisional date based on estimates, not on booking queries. It is not a not a reliable delivery date and is not a credible confirmation for BTO. The dealer will pass on the actual delivery date, which may still not be accurate, to the customer after the order has been processed by the overnight batch system. According to ICDP research, on average 19% of orders are delivered after this confirmed date.

This considered delivery date is calculated on the basis of rules and expected conditions, (i.e. maximum production of diesel engines per day). There is no actual check on components and logistics feasibility. For guaranteed lead-times, a key dealer and customer requirement, and for better demand management, there is a need for integration of feedback mechanisms into the order system on the actual ability to fulfil orders at a certain date.

2.4 Increased speed of exposure to risk in the market?

In an environment where product is only built-to-order, the vastly reduced feedback time loop from sales to production to a real-time system should assist in managing a strategy of market risk. Put simply, where you are only building sold orders, a fall-off in sales will force either slowdown in production, or price adjustments, since building for stock is not an option.

These actions are taken at present but over much longer time scales than would be required in a build to order environment. The opportunity to react quickly to the market is tempered by what will be cultural change for manufacturers in having to fill order slots with real sold orders. Currently, some manufacturers have embarked on a programme for build to order where some build to stock will occur given lack of orders. However, there is a strong likelihood that without management of finished stocks and pricing for demand, a build to order system will not be stable in the long term. The higher the build to order content, the more apparent the issues will become.

If we are to stick to the brief for 3DayCar, building only to order, then only sold orders can be built ahead as the rate of order input declines. There certainly needs to be the flexibility in the production chain to increase or decrease capacity in reaction to market demand. However, there is the need for meeting changes in demand in a

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6 If a hybrid BTO and Locate to order stock-based system is operated, a difficult balance will have to be struck between supply and sales. The tendency of the system may always be to sell from and replenish to the stock. There exists a constant pressure on the supply system to be as lean as possible. Which means as much sold from stock as possible; this pressure will be directed to the sales system to sell stock, which will be base stock with a high stock turn. However, if sales and marketing are effective, then the mix is richer and goes through the BTO channel. In turn this then causes excess stock and slow turn in the distribution centre. There is a conflict between the two approaches.
comprehensive day-to-day way. Price adjustments are the clearest way of maximising revenue when sales are good, and of minimising risk when sales are not so good. With the enhanced speed from market to order bank, the price adjustment will be an essential tool for managing risk of under-utilised plant and resources. If orders are down against forecast then marketing or sales action may be needed, particularly if orders are down against the forecast rate of order accumulation required to meet peak demand. The pressure of build up of stock in the traditional system, and fall off of sales at the dealer, changes in a build to order scenario to both an immediate and medium term peak related pressure for utilising plant and resources.

The balance between price management is a fine one. A view commonly held is that plants must be kept going at full capacity to be viable; as Eric Wallbank, of Cap Gemini Ernst and Young, argues, "A plant is a huge capital investment and manufacturers believe they have to make maximum volumes to get their return on capital employed. This is not necessary true because below-the-line marketing (discounts and incentives, trade sales etc.) costs a lot of money. In the USA below-the-line marketing costs average US$1500 per car. For some cars this is more than the proportion of capital cost that the car has incurred. A better model might be to produce less but have lower below-the-line marketing costs to shift the excess", (Brown, Build to Order, Just Auto 02/01/01).

But why this obsession with capacity costs and minimising cost rather than maximising profit? Each incremental sale (volume) or higher revenue per individual sale (pricing) increases the profitability against the supply chain capital cost. The key question is whether the incremental profit of a sale is good for long-term profitability; the price for each sale cannot be optimised above or below a level that damages long term price.

Indicative costs of running at different capacities were studied in depth by IMVP, and indexed averages for plants in the US, the EU and Japan are shown in Figure 18. These figures relate to longer variations in utilisation, not day-to-day utilisation, and are averages from a number of plants (the marginal cost implications of these figures are represented in the appendix – figures 53 and 54).
The variation of these marginal costs at the plant are only a fraction of the total supply chain cost; and they are often smaller than the range of marginal discounts given by the current stock-push system. Therefore although optimised performance of the whole system may well be lower capacity utilisation during off peak periods and higher price, volumes can be maximised, so long as the price set to invoke the required demand does not damage the long-term, price position; this long-term price position is important in the long run so prices can be raised during periods of high demand.

There are several aspects to be considered;
(a) Is the exposure to empty production slots any worse than to stock that is falling in profitability the longer it stays in the market. This in many ways is the key issue that the 3DayCar programme needs to cost. Empty production slots are a perishable commodity, whilst finished stocks are less so. If empty production slots need to be minimised to a basic running capacity then orders in will have to reach a certain level.
(b) Not all orders will be "3-day orders" therefore order bank attrition caused by falling orders will be a gradual process over several weeks. The mix of lead-times and the rate of forward orders will need to be monitored against forecast and minimum. Remedial action will therefore be possible through gradual price adjustments and capacity changes.
(c) With flexible capacity, exposure to empty production slots will mean that the cost of incremental sales will need to be evaluated. The marginal cost and profitability of each sale will need to be known, or at least estimated, prior to build in order to balance price against capacity. In contrast, the cost of finished car stock in the current system is only available in the future, only known after production.
(d) Selling time in the order bank, rationing slots by price, can be managed effectively, but only if the price sensitivity of the product in the market is known.
(e) Therefore, there is a need for greater knowledge of the market, in order to determine or guide the selling price.
(f) Whilst the effect of falling sold orders will not be immediate, (since future orders may tail off faster than short lead-time orders), the feedback loop into production is much faster than from the current 1.5 months worth of stock in the market. The fall-off in sales in terms of the stream of orders will clearly have to be monitored, and targets and forecasts measured against actual sold orders. At present, largely due to the high levels of speculative ordering and selling from stock, most manufacturers do not analyse their order input. This is discussed in more depth in forthcoming report on Demand Variation.
(g) Closing the feedback loop in the order system will allow the supply chain to make the best use of the increased speed of impact of the market on manufacturing. The decisions for manufacturing should be made quickly based on real-time data; it

<table>
<thead>
<tr>
<th>Utilization</th>
<th>EU</th>
<th>US</th>
<th>JN</th>
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</thead>
<tbody>
<tr>
<td>50%</td>
<td>74.5</td>
<td>67.3</td>
<td>75.8</td>
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<tr>
<td>60%</td>
<td>78.2</td>
<td>73.6</td>
<td>81.4</td>
</tr>
<tr>
<td>80%</td>
<td>90.3</td>
<td>84.1</td>
<td>91.9</td>
</tr>
<tr>
<td>90%</td>
<td>94.7</td>
<td>93.4</td>
<td>96.2</td>
</tr>
</tbody>
</table>

Figure 18: Cost of Capacity, source: IMVP.
Managing Demand/Selling Time

has been observed regarding plant processes “many companies allow decisions to pile up between stages and allow feedback loops that should be closed routinely to be left open” (Stalk et al, 1990). The same is true of the interface between the market and production.

The key question is whether the flexibility of a plant can be sufficient, along with demand management, to avoid lost sales. Related to this is the question of whether this will be more or less expensive than selling ageing finished cars from stock.

Summary

The variation in demand can be categorised as follows:

Intrinsic Variation: Real Demand Seasonality
- Seasonality across the year (which in the UK market is caused by registration letter changes and peak marketing activities at such times, allied to significant changes in residual values across the letter change).

Extrinsic Variation: Planned Effects
- Discrete marketing promotions in conjunction with dealer incentives distort both volume and mix of sales. This is not a problem in itself, so long as it is managed effectively. Currently, promotions are generally geared to disposal of unwanted stock.

Extrinsic Variation: Unplanned Effects
- Dealer bonuses which together with promotions and dealer incentives encourage sales to be weighted heavily towards the end of the month at the end of the period in question. This target driven behaviour creates ‘hockey stick’ demand patterns (see this effect in the daily registrations shown in Fig 52 in Appendix I).

- Any car that is produced for stock will eventually be sold and therefore the manufacturer does not know the true demand. In addition while the manufacturer sets the recommended retail price and influences demand through promotions, it is the dealer who negotiates the final price with the customer. This confuses assessment of the price/demand relationship for the manufacturer and means that the customer feels insecure in whether he has obtained a good deal. Furthermore, due to poor quality sales data the manufacturer has a difficult problem in forecasting accurately. Therefore there is a lack of manufacturer knowledge of market demand and price elasticity.

- Order administration is optimised for selling from stock under the current system, which encourages orders to peak across a month or week. Also, the combined effect of reserving the best production orders newly available on a Monday, and the lack of relevant manufacturer systems availability or dealer staff at weekends causes artificial peaks in order input on a Monday.

Five Key Requirements of a Build to Order Demand Management System
In order to manage demand in a build to order system, the following aspects have to be considered for the supply system:

- Customer orders for the peak need to be accumulated in advance over a significant period before peak demand months
- Pricing and promotions should be used to pull forward order input to enable building ahead of peak sales periods where necessary
- Promotions which if they heavily distort ongoing demand, should do so in a highly predictable way
- Sales channels, including Dealers, need to be incentivised to sell without causing distortions (to avoid end period peaks in sales)
- Order queries need to be processed in real-time allowing continual permission from the plant master schedule, and pre-confirmation analysis for the optimisation of build-date. Closing the feedback loops in the system is critical to achieving responsiveness.
3. Revenue Management

3.1 Revenue Management: What is it?
Revenue management, sometimes known as Yield management, is a business strategy first used by the airline industry, namely American Airlines and United Airlines, designed to help them optimise their revenue.

Hotels, car rental firms, cargo shipping handlers and even restaurants have since adopted it. It may well have potential in increasing the capacity utilisation of load traders on trade exchanges for logistics. Broadly defined, Yield/Revenue Management is to sell the right inventory, to the right customer, at the right time, and at the right price.

Increasing interest generally for customer responsiveness as a business strategy is encouraging more service-orientated manufacturing to explore the application of revenue management techniques. Advanced revenue management techniques have tended to be applied to service providers rather than manufacturing, but a build to order system resembles a service far more closely than a traditional build to stock manufacturing system. The application of revenue management to assemble to order manufacturing has been discussed before (Harris and Pinder, 1995). ICDP has looked at the potential of revenue management before, (Brown, J, 2000, 2001), in terms of application to the car industry. The aim of revenue management is to maximize revenue per available sale while minimising unused capacity.

One of the key challenges of Yield/Revenue Management is how to manage the uncertainty of customer orders, product mix, and delivery date requirements. Managing uncertainty requires forecasting, particularly when capacity is flexible. Hence, there is a need for sophisticated management tools, such as long-term and short-term forecasting, linear programming, and the use of probabilistic models.

The typical characteristics of a sales system that can be addressed by revenue management are as follows:

- Perishable product
- Relatively fixed capacity
- High fixed costs, low variable costs
- Advance booking
- Seasonality and other demand variation over time
- Appropriate cost and pricing structure
- Market Segmentation

Perishable Product
As stated above, a frequent criticism of the idea of applying Revenue Management to selling cars is that such concepts are applied most frequently in the services industry where you are selling a service and not a physical product. A service is a perishable commodity, if you do not sell it within a given time period, the opportunity to make
revenue from it is completely lost. Cars can be built without sales and although more expensive if they are stored for long periods, the resource does not lie idle.

However, as stated before, the non-use of production resources as a service is a perishable commodity, and secondly if a car is not sold today, but is sold by a competitor that particular sale has been lost forever.

**Relatively Fixed Capacity**

Relatively fixed capacity needs to made use of in a way that maximizes revenue. In the hotel industry the number of rooms (capacity of the hotel) remains the same in the long run. Another example would be air seats on scheduled flights, although some leading-edge airlines (e.g. American Airlines) are trying to increase the flexibility of their capacity. More of this later. As stated before, a build to Order manufacturing system should have some capacity flexibility although cost constraints will place limits.

**High Fixed Cost, Low Variable Cost**

The initial investment is very large, but the variable cost of selling an additional unit of inventory is very small. In the hotel sector the construction costs are very high, but the cost of selling another room is very small (usually it is the cost of cleaning the room after it is occupied). In the car industry it has long been recognised that there are investment costs per supplier and manufacturer plant and per model that need to be made to ‘sweat’, although like the cleaning cost in hotel management, the cost of labour and materials is potentially variable.

**Advanced Booking**

Bookings can be made in advance, so companies can "pick and choose" the segment of paying customers that they want. This brings about a dilemma; should one accept lower paying customers who usually make their reservations far in advance of their service requirement or delivery date (flight or production date), or wait for higher paying customers who typically make their reservations last minute? Is the sale now always going to be better than potentially more profitable sales later?

There are ways to reserve certain ‘buckets’ of slots, whether seats, rooms or production slots, so that a proportion of higher paying customers can be targeted. However, the dilemma of the strategy for filling slots way ahead of the actual resource use date remains unresolved. Would a carmaker want to fill their production slots for September in July, or would that be a failure of the system? If there are customers who will be lost and perhaps be higher revenue customers, because no slots are available for 3 to 14 day OTD orders? The answer for a car manufacturer is to maximise the resource use by ensuring that ‘advance build’ production slots can be allocated to advance orders early enough to free up a proportion of slot availability for short lead time. There may also be demand that can be shifted, as ‘stand-by’ sales.

**Seasonality and other demand variation over time**

Revenue management is the solution to minimising sales lost in systems where there are predictable fluctuations or peaks and troughs in demand. As covered in section 2, seasonality is a major problem for build to order. Lost sales due to the inability of the supply system is a key issue, and some degree of capacity flexibility alone will not be able to provide a solution. The trick is to "shave off" or shift excess demand in the peak periods to fill out the troughs. One of the ways through which this can be done is by using variable pricing.
As discussed earlier, selling ahead orders is preferable to selling off peak, since it requires less revenue loss. Revenue Maximisation will be achieved mostly by building sold orders ahead of the peak, whilst selling for delivery of product off peak is more about capacity cost minimisation. It is likely that the cost of discounts for selling off-peak will be greater than that for selling advance orders for peak period delivery.

**Appropriate Cost and Pricing Structure and Market Segmentation**

Different customers are willing to pay different prices. There are customers that you can attract with lower prices, but offering a reduced level of service – i.e. wait longer. For example, a hotel should have multiple pricing structures to attract different segments of customers. However, how can you prevent higher paying customers from moving into the lower paying segment, thus eroding your revenue? Segment ‘drift’ can be prevented by limiting accessibility to price grouping. The car industry has a ready-made price segmentation that cannot be easily breached. Retail customers at present cannot access the prices paid by fleet buyers, nor can the individual get the deal offered to a PCP company.

**Everyday examples of Yield/Revenue Management**

- Airlines and train companies: two people on the same flight, sitting in the same class, may have paid different prices for their tickets depending on when they purchased it. Another example would be "super saver" type deals, but with restrictions on dates or time of day for travel.

- Hotels: high season or peak period room rates differ from low season room rates. Leisure customers who make their reservations far in advance of the intended date of arrival usually pay lower rates for a room, as opposed to business travellers who typically make their reservations within four to seven days out from their date of arrival.

- Telephone: different rates for calls made during different times of the day. E.g.: weekend call rates.

- Home Video Rental: weekday rentals are often "rent one get one free".

- Restaurants: lunchtime menus or specials.

**3.2 Case Study: Talus and Manugistics**

Talus Solutions, recently acquired by Manugistics, designed leading edge price management solutions for air passenger and cargo carriers. They have been designing travel and hotel revenue management systems for more than a decade, including systems for 17 of the 25 largest global airlines, 7 of the largest hotel chains, and 4 of the top 5 rental car companies.

One of the main barriers to adoption of revenue management appears to be belief that it will actually work; “Its value was misunderstood, the data requirements appeared overwhelming, and the solutions for managing it effectively did not exist.” (Manugistics, 2001a). For the airline industry the first two barriers were overcome by the nature of other business changes;
Variable pricing and decentralised booking was made possible after the deregulation of fare price maintenance in 1978 in the US. Centralised Booking system - systems had to be designed to be real-time to allow decentralised direct booking. Travel agents using the system needed up to date information and the ability to book passengers flights themselves. As all bookings had to be checked against existing bookings, the striking lack of discrimination between those who book early and the much larger numbers that book later in the booking period made the value differential very clear.

The solutions came about simply because they had all the data to see what could be done. All sales data could be recorded: who booked when and at what price. It is important to stress that only with the availability of real transaction and demand data does revenue management become a possibility; "We have to analyse massive amounts of data to determine the optimum mix of passenger traffic for each flight over 331 days using a fleet of 580 various aircraft," says Bob Bongiorno, (director of research and development for United Airline's Information Systems Division); "The combinations we must analyse can be astronomical."

United Airlines book 684,000 flights and carry up to 82 million passengers annually. Its booking system uses an IBM Deep Blue supercomputer, which manages thousands of variables per ticket request and adjusts millions of fares each year. Talus Solutions and United pioneered a major recent industry first when they launched United's origin-and-destination revenue management system in 1999. The system determines which travellers to book along United's hub-and-spoke US internal flight network to earn the most revenue. United Airlines's RMS takes into account a complete journey, forecasting demand for a seat across the transportation network, not just a single leg or flight. "Our biggest concerns were the tremendous volume of data and the number of calculations that had to be done in a very short period of time," says Ajay Singh, manager of research and development for United's Information Services Division. The same challenges exist for booking car-manufacturing slots.

When United Airlines launched its first revenue management system in 1984, U.S. airlines sold on average 60.4 percent of their seats. In 1999, passengers filled 71.2 percent of them, the highest occupancy rate for U.S. carriers since the 1940s. Between 1984 and 1998, the airlines doubled seating capacity and cut the cost of air travel by one-third. United Airlines estimate that they have earned an additional $75 million over the period. In addition to this is the much larger increase in revenue attributable from the more sophisticated approaches to pricing. Estimates range from 2% additional profit for British Airways to 6% for American Airlines. American Airlines revenue management system was credited with putting People Express, their main domestic competition, out of business in 1985.

Talus also developed revenue management applications for hotels, cargo booking, parcel delivery services, and interestingly, car rental. Most major car rental companies

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7 U.S. Congress Airline Deregulation Act 1978
8 The revenue management system for hotel booking has to accommodate the unknown variable of unpredictable length of stay by guests, in addition to arrival demand. There is a probability of a certain spread of lengths of stay, with most staying a short period, with a very few staying for a few weeks or
operate a form of revenue management, although some are more explicit than others – (for obvious examples visit Dollar.co.uk or Easyrentacar.com). Talus estimate that the application of revenue management in the car rental sector on average increases revenues from 4 to 8%.

In early 1993, General Motors bought out National Car Rental, which was sustaining heavy losses. Designed to interface with National's exiting reservation system a revenue management system was installed to managed capacity, price, and reservations. Subsequently NCR reported an annual growth rate of 19 percent two years after drifting toward bankruptcy.

Talus understood from their implementation of revenue management in the airline industry the potential for increasing system performance through integrating revenue management with existing back end systems and processes; often a complete replacement of existing systems is unnecessary since “forecasting and optimisation functionality can integrate with existing ERP and legacy systems” (Manugistics, 2001b).

Through their merger, the combination of Manugistics’ experience in designing supply chain management software and Talus Solutions’ revenue management expertise has opened the way to a new era in optimising whole supply chain performance. The Manugistics systems were designed to “optimise inventory, production, and transportation planning and to link trading partners” while the Talus revenue management systems were installed successfully in many sectors. Their new products, “Enterprise Profit Optimization” combine these capabilities.” (Manugistics, 2001b)

**Automotive Target and Promotion Pricing**

Talus had experimented with target pricing for the automotive and other manufacturing segments (Talus, 2000b). The aim of target pricing was to mirror revenue management by giving the salesperson a set of guideline prices for any product mix, which would be updated every sales period. Salespeople could then more accurately and predictably get the ‘big picture’ not open to them because of the relatively small volumes sold by any individual. By setting target prices (as opposed to list prices) the individual salesperson can estimate how customers will react to certain discounts before they are offered. In other words, the manufacturer could tactically direct discounts for the salesperson to use. Similarly, Talus developed a ‘price promotion’ solution package to direct promotions so that “automotive and manufacturing companies can more effectively and efficiently move depressed or overstocked inventory by offering the right promotions, to the right customer, to the right sector whenever necessary” (Talus, 2000b). This approach formalises the promotional and discount subsidies given to sales channels by manufacturers to move over-aged car stock.

Various other companies, including Fujitsu, offer revenue management and optimisation solutions, and such software is far more affordable with the advent of e-commerce technologies.

more. Car Servicing and repair shares many of the same characteristics, and a revenue management system derived from hotel room booking systems could be applied.
3.3 How is Revenue Management Achieved?

There is a range of approaches, depending on the application; essentially the process is forecasting and optimisation, where the sophistication of the pricing calculator is a strategic decision. When Revenue Management Systems were first developed, Operations Research developers and programmers developed them in-house. Now they are as likely to be off-the-shelf products designed by a systems house such as Manugistics or Fujitsu. However, more demanding users will always require a customised system. In the airline sector, revenue management systems are so embedded they are considered a competitive necessity. The sunk costs are high in terms of capital employed and skilled labour, and margins are slim; the anecdotal claim that “they would make more money if they sold the aircraft and put the money in the bank” will sound very familiar to those in the automotive sector.

The basic objective is to achieve the maximum revenue per flight. Essentially this is done through forecasting the demand pattern and then optimising revenues as the demand increases closer to the flight date and depending on what the customer is prepared to pay. However, there are different ways of achieving this objective. All models used by the airline sector fall on the spectrum from single class booking limit to bid price where all seats are effectively an individual fare class; the spectrum of approaches is summarised in Fig 19.

Figure 19: Approaches to Revenue Management

<table>
<thead>
<tr>
<th>Method</th>
<th>Booking Limit</th>
<th>Booking Bucket</th>
<th>Bid Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimisation</td>
<td>PC based, off the shelf</td>
<td>Adapted designed product, Bespoke system</td>
<td>Bespoke system</td>
</tr>
<tr>
<td>software</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segmentation</td>
<td>Class of one – one class for all seats</td>
<td>Several classes of seat, based on customer offer segmentation</td>
<td>No of seats = no of classes</td>
</tr>
<tr>
<td>Effect on Price</td>
<td>Price moves every number of seats sold</td>
<td>Price moved on the basis of seats sold in the bucket</td>
<td>Price optimised by demand for whole flight, and by segmentation to date</td>
</tr>
<tr>
<td>Minimum Unit of Price Movement</td>
<td>Large relative to starting price of ticket; minimum change £5</td>
<td>Continuous; small changes relative to starting price of ticket; minimum 10p</td>
<td>Continuous; small changes relative to starting price of ticket; minimum 10p</td>
</tr>
<tr>
<td>Examples</td>
<td>Easyjet</td>
<td>BA</td>
<td>AA</td>
</tr>
<tr>
<td>Primary Objective</td>
<td>Full Flight at maximised revenue; no price ‘floor’</td>
<td>Full Flight at richest class mix; minimum class mix</td>
<td>Richest Price Mix, flight filled to minimum price</td>
</tr>
</tbody>
</table>
Managing Demand/Selling Time

Booking Limit Model
The booking limit model rations supply through pricing a fixed number of tickets at one rate, then when these have sold, moving onto the next ticket price group. The price may move up or down further to this as a result of the sales against target comparison. There is only one price available at any one time.

Booking Bucket System; segmented booking limits
The bucket system segments the seats into classes; the price for the seats are varied in orders to fill the classes. As each bucket fills against forecast, the price rises. Reforecasting based on sales to date for a flight may result in new mix of classes. If reforecasting is too frequent, then the system becomes unstable, and classes open and close with the effect of losing sales.

Managing bookings by pricing according to how close bookings are to limits has the strength of making sure capacity is filled, and as such this is can be set as the priority for the approach. Given low margins and high sunk costs this approach may be the most appropriate for capacity critical operations. However, all seats can be treated as individual classes; this is the bid-price model.

The Bid-Price Model
The aim of the Bid-Price model is to maximize the revenue of an entire origin-destination (O&D) network based on the aircrafts’ capacities and the forecasted unconstrained demand per O&D and fare class. Therefore the price is set based on both sales within a fare class and over all seats.

\[
R(D,C) = \max \sum_{i=1}^{n} \sum_{j=1}^{m} f_{OD_jF_j} \times x_{OD_iF_j}
\]

(revenue) \rightarrow \text{(forecasted) demand} \rightarrow \text{(remaining) capacity} \rightarrow \text{fare (O&D / fare class)} \rightarrow \text{number of PAX (O&D / fare class)}

\sum \text{over all fare classes} \rightarrow \sum \text{over all O&Ds}

Figure 20: Bid-Price (After Burkard and Minder, 2001)
The Bid-Price Model optimises sales by making sure that each sale is the best possible out of all available fare classes, and therefore can adjust the mix of booking groups according to each query. In this way the price mix can move upwards for a flight according to customer demand overall, whilst maintaining price differentiation, rather than just on certain constrained categories. Compared to the Booking Limits model, this system tends not to be used to fill all empty booking slots. Instead the focus is on getting the best price based on known elasticity against capacity constraints; discounting will be limited to protect future prices. As with all revenue management systems, the price elasticity is based on previous demand yield from levels of pricing.

Forecasting is integral to any Yield/Revenue Management strategy. The application of forecasting to either of the alternative systems outlined above depends on the actual capacity being managed and the number of identifiable customer segments. However, the forecast will include a price sensitivity and predicted demand for the flight route and timing.

A bid-price system aims to constantly raise the threshold of all seats on a flight. If demand is above predicted, the entire pricing schedule is moved up. The pricing schedule will down with every cancellation, and up with every booking. The rate of cancellations and bookings expected over time may also be accounted for. With every booking, a tangent is taken on the demand curve, which forms the basis of the straight line ‘price curve’.

**Bid Price vs. Booking Limit Models**

Booking Limit models are more likely to increase overall revenue through ensuring that all seats are sold with heavy discounting. However, a Bid-Price Model ensures that price across all segments is maximised in line with overall demand, and although may not fill all seats will not discount below a certain point which would damage customer perception of future price value. The base price in a simple booking limit model may be much lower.

In considering revenue management systems for selling cars, it became necessary to think how it would be applied. The hypothesis to be tested would be that in terms of overall revenues over time, the theory states that the structure of revenue flow should mirror the pattern shown in Fig 21. The upper line shows the effect on price under high demand, compared to the lower line that demonstrates the lower price obtained from lower demand. However, Bid Price models should generally move the price up towards the end of a booking period to protect future price values, whilst a booking limit model will pull prices down if necessary.

![Figure 21: Example of Modeled Expected Revenue Profiles over Time. Source: Figg (2001)](image-url)
Airlines Pricing Study

Methodology

In order to test the hypothesis stated above, the websites of five leading airline operators were accessed on a daily basis (two transatlantic operators and three European budget operators). Every day a price quotation was generated for the same future flights, for a period prior to the flight. These individually quoted prices were recorded and compared. One drawback of this approach is that the real demand profile and the actual spread of pricing can only be determined through obtaining data on all sales, not just one price query. Therefore, as a customer, there are limits to what you can find out, since you are unable to view the full scope of prices, classes or seats available. The airlines we approached were not willing to discuss their revenue management systems or provide any data, due to the competitive advantage the different elements in their differing systems represent. However, some insights can be made into different systems from the study we undertook.

Fig 22: Monitored Easyjet Prices (See Fig 23 for Series details)

The pattern of demand does mirror that expected. The movement of the price up and down is demonstrative of a booking-limits model. The Friday evening and Sunday evening flights (series 2 and 6) have quoted the highest prices close to departure date, probably as the result of people taking a weekend break. The Saturday night and Sunday morning (series 4 and 5) show the lowest level of demand. The popular flights have therefore sold more seats and so the price quoted has risen, whilst the Sunday morning flight will have many empty seats.

Figure 23: Easyjet Series details - London Luton to Madrid Return

<table>
<thead>
<tr>
<th>Series</th>
<th>Date</th>
<th>Time</th>
<th>Flight No</th>
<th>Return Date</th>
<th>Time</th>
<th>Flight No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series 1</td>
<td>Friday 18th</td>
<td>06:40</td>
<td>501</td>
<td>Friday 25th</td>
<td>10:45</td>
<td>502</td>
</tr>
<tr>
<td>Series 2</td>
<td>Friday 18th</td>
<td>18:20</td>
<td>503</td>
<td>Friday 25th</td>
<td>22:30</td>
<td>504</td>
</tr>
<tr>
<td>Series 3</td>
<td>Saturday 19th</td>
<td>06:40</td>
<td>505</td>
<td>Saturday 26th</td>
<td>10:45</td>
<td>506</td>
</tr>
<tr>
<td>Series 4</td>
<td>Saturday 19th</td>
<td>18:20</td>
<td>507</td>
<td>Saturday 26th</td>
<td>22:30</td>
<td>508</td>
</tr>
<tr>
<td>Series 5</td>
<td>Sunday 20th</td>
<td>06:40</td>
<td>511</td>
<td>Sunday 27th</td>
<td>10:45</td>
<td>512</td>
</tr>
<tr>
<td>Series 6</td>
<td>Sunday 20th</td>
<td>18:20</td>
<td>513</td>
<td>Sunday 27th</td>
<td>22:30</td>
<td>514</td>
</tr>
</tbody>
</table>
Since Easyjet flights are non-refundable and cannot be cancelled, the price movements down are the result of all the seats being discounted to increase sales. The attainment of seats does not therefore simply move the price up after a number have been sold; the price will be reduced if sales are below the target or forecast level of sales achieved to date.

RyanAir demonstrated a slightly different pattern; the price movements, whilst fluctuating less than those of Easyjet, moved up and down towards the end of the period. The predicted trend from falling to rising price is also evident.

Fig 24: Ryan Air. Daily prices quoted for London Stanstead to Pisa, departing Saturday 19\textsuperscript{th} at 17.30pm (Flight FR586), returning Sunday 27\textsuperscript{th} at 10:45 (FR583).

The GO Airlines flight tracked (London Stanstead to Bologna, departing Saturday 19\textsuperscript{th} at 14:30 [GO 551], returning Sunday 27\textsuperscript{th} at 16:15 [GO 552]), showed very little price movement, dropping only once from day one to two. It could be inferred that the flight booked up slowly and did not fill above a certain price level; however, little else can be understood from the flight booking profile in terms of the GO revenue management system.

Figure 25: GO

To summarise, RyanAir and Easyjet flights demonstrated the characteristics of booking-limit based revenue management systems, whilst the GO flight showed no evidence of revenue management; they undoubtedly use it but the flight chosen did show the pattern displayed. As stated earlier, the research method has weaknesses in trying to pick up the characteristics of a system from examining one flight.
The transatlantic flights showed a very different pattern. The American Airlines flight (London Heathrow to JFK New York, departing Saturday 19\(^{th}\) at 10:00, Flight AA101, returning Sunday 27\(^{th}\) at 06:35 AA100), shows a relatively stable price until five days out, whereupon the price begins to climb significantly. These final bookings are paying between 120% and 170% of the recent price. The trend is strictly positive only, and online bookings are being discounted. This demonstrates the bid-price model, which maximises price. There may well be empty seats on this flight at departure, (although it is worth stressing that the prices through other non-online channels may well be managed differently).

![Figure 26: American Airlines](image)

The British Airways flight (London Heathrow to New York JFK, departing Saturday 19\(^{th}\) at 08:45, Flight BA117, returning Sunday 27\(^{th}\) at 09:05 BA178) showed a similar pattern to the American Airlines flight, although the price increases were both fewer and smaller. Three days prior to departure, one leg of the journey (outbound) was sold out and therefore closed, but reopened the next day. This was an element not accounted for in the design of the study, but indicates:

(a) the effect of forecasting error. As discussed earlier, if reforecasting prior to a flight is too frequent then the price classes become unstable, and classes open and close. It seems that a class is selling in a way that is inconsistent with the forecast, therefore a segment is full, but after reforecasting is reopened. Effectively the flight has been ‘re-segmented’. The ‘selling out’ of a class when others are under booked is essentially a failure of the system.

(b) the flight or segment was sold out, but cancellations, which are allowable for certain classes, opened seats up for sale after re-segmenting the seats.

![Fig 27: British Airways](image)
Daily Change from Base
It is not only instructive to look at the price trend, but also to examine how the price moves. The daily change from the base price will be calculated differently according to the revenue management system being employed.

Looking at the four Easyjet flights shown in fig 28 to fig 31, it can be observed that the movement from base price is in discrete fractions. All price changes are in units of £5.00. Furthermore, the price changes fluctuate, probably against slowing in actual booking compared to forecast/target over time.

Fig 28: Easyjet Flight 1 (daily change)

Fig 29: Easyjet Flight 2 (daily change)
Fig 30: Easyjet Flight 3 (daily change)

Fig 31: Easyjet Flight 4 (daily change)

Fig 32 charts the cumulative daily changes in price from eight days prior to departure for the American Airlines flight. Although the true starting base price is not actually known, (flights open 365 days prior to departure), taking the first monitored price shows the step upwards only curve of the prices quoted.

Figure 32: American Airways price difference changes from the price eight days prior to the departure date.
Effectively, the price increases are the result of calculations along a continuous scale, not the discrete jumps in price seen in the Easyjet pattern; although the units of ten pence are actually just smaller discrete jumps, but represent a much smaller and more subtle price change compared to the starting price.

Similarly, (as shown in Figure 33) the British Airways price jumps by £0.10 from day two to day three of the observed period. By moving by such an incrementally small amount, it is likely that the price is calculated using a form of bid-price model, based on price optimisation within a demand-price sensitivity and time profile.

![Fig 33: British Airways](image)

The continuous and subtle price changes inherent in the transatlantic price generators indicate two characteristics of the revenue management systems being employed. The changes should be more gradual because the flights open for booking a year before the flight date, whilst the European budget flights open at most six months before departure. Secondly, and more significantly, the subtlety of the price changes indicates a more sophisticated price generator (requiring more powerful hardware and software) than that operated by the budget operators, with the emphasis on maximising the revenue per sale.

**Strategic Objectives And Priorities Of Revenue Management Systems**

Overall, it can be stated that the transatlantic operators tend towards revenue per sale maximisation using the bid-price model whilst the budget airlines maximise capacity utilisation using booking-limit based models. The different priorities reflect the different commercial strategies employed by providers of a highly priced service or product and a volume service or product. A highly priced service can maintain a certain degree of under-utilised capacity; it may be a necessary requirement to keep prices higher. A product competing keenly on price cannot command a relatively high price per unit and must sell in high volumes to justify the costs of providing the service. The parallels are very familiar to the car industry. Neither model would be suitable for build to order car selling without modification; car manufacturing needs to offset the objectives of these two strategies, achieving a balance between revenue maximisation per sale and maximised capacity utilisation. Regardless of application, understanding how to prioritise these competing strategic objectives requires consideration of the prices individual customers are willing to pay and the perceived acceptable limits of elasticity of all customers. If this is known, then these factors can be offset against the costs of capacity utilisation.
3.4 Integration of demand management and capacity planning

Airlines currently manage capacity through use of feedback based on average flight capacity utilisation trends. Figure 35 shows the typical Scheduling and Revenue Management Process for an airline. Network scheduling and planning provide the fixed capacities, which the revenue management system must work from. The long-term flight demand forecasts are disconnected from the revenue management system, but instead feed into the capacity planning. The flight forecasting and scheduling aims to predict the demand for a single leg of a journey. Once capacities and schedules have been fixed, the revenue management process then generates prices based on price sensitivity analysis. The RMS then has to make continual forecasts of the origin-destination demand profile over the booking period from flight opening to departure date. Again, note that both capacity setting and selling systems are built on reliable data.

Figure 35: Airline Scheduling and Revenue Management Process: Source: Jacobs et al, 2001

Such a model would be appropriate for a car manufacturing revenue management system, where capacities were absolutely fixed in advance. Indeed, this is essentially what happens now, albeit that the discounts on perishable product occur after the service interval (flight for the airline industry, production for the car) has occurred. As stated earlier, revenue management systems have been adopted by Talus into target

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9 As stated earlier, United Airlines operate a system that works on the principle of multi-leg journeys but this is only appropriate in a network with a high incidence of multi-leg journeys typified by the US domestic flight business.
Managing Demand/Selling Time

Pricing for better management of automotive stock in the marketplace. This approach represents a first step, but in a build to order system, the capacity can be flexible against demand, and the model above, like most manufacturing systems, is not responsive enough to be able to achieve this objective. The current system for car manufacturing shows a similar disconnection between capacity planning and sales, shown in Figure 36. The process is a long and detailed one, and the line between forecast and order is blurred very early on.

Figure 36: Current Car production planning and sales process (after Jacobs)

The sales and stock management process effectively is the revenue management system of the current new car sales process, setting macro prices, which are in turn optimised by individual salespeople.

Revenue Management can be used to maintain the level of revenues whilst lowering capacity utilisation.

Returning to the airline industry, American Airlines has estimated that their (bid-price based) revenue management system increases revenues significantly at lower loads, (or sales) compared to selling without revenue management. This allows them to deal with under-utilised capacity, i.e. remain profitable whilst accepting empty seats on flights. The difference in yield at different loads (aircraft fill) is shown in Fig 37. The key benefit of this approach to revenue management is that capacity utilisation can be lower than present whilst earning the same revenues. An understanding of this relationship is fundamental to weighing price management against capacity changes. As stated earlier, with this emphasis it is possible to maintain higher prices and also maintain higher prices whilst operating at lower capacities. Competitive pressures are unlikely to make this a long-term viable scenario for all sales in a manufacturing environment but might enable a build to order system to overcome short-term supply problems in the mix, and give a BTO system an advantage over non BTO competition.
Managing Demand/Selling Time

Figure 37: Revenue Management allows increased yields at lower loads (Source: Jacobs et al, 2001)

American Airlines are proposing integrating their revenue management system with the capacity setting process. To do this they have embarked on a project of re-engineering the entire booking process, shown in Fig 38. In the proposed system, the sales forecasts feed directly into the flight scheduling process for each flight, not just
periodically to adjust long term capacity as now. The steady-state industry forecast is incorporated into the network scheduling and the daily capacity demand (in terms of origin and destination demand expectation) is fed into the daily scheduling system. By doing this the revenue management system can optimise revenues for a number of possible capacities. For each sale to be viable, the revenue management system must work from an estimate of continued demand, and anticipate certain levels of extra demand for the range of possible capacities. One important complication is that airlines operate overbooking. Some airlines operate a policy of non-cancellation, whilst others will accept a degree of cancellation depending on fare class. Even those who do not generally accept cancellations will expect a certain level of extra demand for the range of possible capacities. The flights where absolutely no cancellations are possible but no-shows still occur tend to be those where the revenue management system is working on booking limits, and so are oversold to make sure capacity is filled. Therefore, the revenue management system overbooks capacity based on an expected rate of cancellation, (and mix of cancellations, i.e. booking group size etc).

The cancellation of orders for a build to order manufacturing system will create distortions in demand. Cancellations should be random enough not to cause drastic mis-forecasting of the mix, which would be problematic for suppliers, but may cause problems for other capacity booking elements such as outbound logistics. The issue of cancellations will be for manufacturers to decide as a matter of company policy. However, it is inconceivable that all customers will be unable to cancel orders including fleet buyers. Some level of cancellation will probably have to be tolerated; the cut-off date for cancellations prior to build will probably vary by customer segment.

The near-term allocation of aircraft that is central to the proposed American Airlines integrated process allows the system to judge much closer to flight date the capacity required. The improved performance of such a system is forecast in fig 39.

Fig 39: American Airlines improved performance (Source: Jacobs et al, 2001)
The improved performance depicted is at present theoretical, since American Airlines are currently designing and implementing their new system.

4. Applying Revenue Management to New Car Sales

"Pricing should be treated as a “science”. In the last two decades, the finance function in companies has become highly quantitative and theory-driven. Pricing is experiencing a similar development. Masses of data exist and the internet will lead to the availability of even more data. With the notable exception of the airline industry, these data are hardly used effectively to manage and control price decisions." (Simon Kucher, FT 31/10/00)

In terms of applying revenue management, the current pricing system fails to deliver price optimisation for four key reasons:

1. No account is taken of cost, for example that of storage and interest. Cost of storage imposes discounts that effectively double the cost of holding stock.
2. No account is taken for willingness to wait. The car obtained quickly from stock is the cheapest.
3. Since currently meeting peak demand is achieved through building stock, the current focus of demand management on what is already available to buy from stock.
4. Subsequently, variable price retailing is currently used to manage demand, but only in a reactive stock driven way.

Pricing application

In the new car sector, revenue management can make use of three distinct pricing tools:

Pricing against Lead-Time

- Using lead time segmentation of customers as a price lever allows maximization of revenue from customers prepared to wait the least time, whilst allowing relative discounts for those who order ahead to the benefit of capacity planning.

Pricing against Demand

- Maximization of revenue per slot in the order bank, through price changes, can reflect order peaks and troughs and maximize revenue at peak whilst persuading to buy off peak. This approach needs to be taken with care, in order not to damage sales at peak. Accordingly, as per the principles of demand management laid down earlier, pricing against lead-time should be the priority since orders at peak should be ordered ahead rather than moved, since a moved sale may be a lost sale.

- There will be a complex variety of target prices directed at a variety of target niches (airlines often offer over 60 classes of seat on a single flight). The complex segmentation of sales channels, markets and customer groups possible in the new car sector, plus the product complexity, suggests a very variegated price offer, with many more classes of sale than found on a single
Managing Demand/Selling Time

flight. The complexity will be high but should be fairly straightforward in terms of product and market segmentation; the complex calculation will be the price sensitivity of different segments.

- The system must be dynamic and able to change the offer based on existing orders; as discussed, optimization should mean that minimum capacity utilization could be achieved at lower volumes if required, i.e. the break even point is lowered.

Pricing to the Individual Customer

- Real-time systems, combining actual sales and transaction data, customer data, CRM, and individualized promotions, could give an offer tailored to individual high value customers, which also may promote certain slots over others in a way that assists capacity utilization.

How could these approaches be applied in practice, and what would be the effects, both intended and unintended. It is likely that there will be unforeseen side effects, but to look for them at least raises the issues. In order to try to understand reactions and experience of the industry, discussion groups were held with large Dealer group employees, Independent Dealers, and a group of cross-industry experience. These invaluable sessions contributed to the following analysis.

4.1 Pricing against order to delivery lead-time

In terms of build to order, one of the key impacts of time compression is the added cost of flexibility. Put simply, the shorter the notice, the higher the cost. The principle is the same as for airline or train seats, where customers book early for a discount. The key advantage is capacity planning and allowing build of sold orders ahead of peak. However, will the principle be accepted when introduced?

Figure 40: Customer facing order system
The customer does accept pricing by lead-time in other sectors. As cited, examples include air travel, holidays and car rental (e.g. Easy-Rent-a-car). Products looked at for managing lead-time reduction in other industries found lead-time pricing in photographic development and spectacle manufacture (Williams and Waller 1999). Price conscious customers make a system far less stable and require more complex price differentiation. However, product differentiation and channel differentiation manage this price sensitivity at present. One factor that will determine the price sensitivity is buyer power, (Pine, 1993). The more powerful buying groups, such as large fleet buyers, will be highly price sensitive and may or may not be resistant to the introduction of demand and time-based pricing. However, there are two elements here that need to be considered. First, large fleet buyers have more planned purchasing cycles, (with the possible exception of large rental fleet buyers\(^{10}\)), and are already time and demand sensitive in terms of NSC price negotiations. Second, volume discounts do present an overall problem for managing demand. This is a contentious area and one that requires separate discussion, (See Appendix I: Considering Volume Discounts), but essentially, the more buying power wielded by a sales channel, the less the supplier can control the price in the marketplace.

However, pricing by lead-time, even in the most crude sense, (i.e. 5% discount if order before a certain date), can be used to directly cost-in the waiting time. The customer can cost-in the importance of time in their decision-making. Currently, the customer pays more the longer they wait (i.e. can obtain quickly from stock, but have to wait for extended periods for orders built at the plant), since the largest individual sales discounts are obtained from stock.

In some senses it is done very simplistically at present through finance offers, (i.e. buy now, pay nothing until six months time). However, since the customer is used to paying less for buying from stock (i.e. supplied more quickly), will the customer be convinced that time is money in 100% build to order system? The answer is that the BTO system will be more competitive overall.

**Residual Values, Market Share and Future Sales Value**

Another major consideration is that price adjustments offered will have to take account of residuals over the lead-time; these cost of change differentials over the waiting period for the customer will have to be compensated or the offer will not be attractive. This is particularly important when considering the fall off in residual value at peak period and calendar year change.

For the dealer, lead-time based pricing allows justification of price differentials, which arguably are far more arbitrary if left to the discretion of each salesperson. Dealers can also sell ahead, making sales for a future period, for the customer and VM benefit, but also securing future income at the same time.

However, there needs to be consideration of how pricing by lead-time, would impact upon monthly share targets. This is really a debate on how monthly share targets are measured, and the relative importance placed on volume over profitability of sales in the current month compared to sales generated for future periods. Some account will have to be taken of future orders made by salespeople; this point is returned to later.

The balance of volume against profitability of sales is really a question of the fundamental economics of the auto industry. The fight for market share of new car sales is really a fight for share of the ongoing 'parc', and the after-sales and servicing

\(^{10}\) This is an area where we are currently conducting more research.
business that this provides. After-Sales has this importance, although the sums of 
money involved are small in the context of global manufacturer revenue, largely 
because the core-business has become problematic as a profit generator: build to order 
returns the profitability to the core business.

A key point is that the use of price and promotions should be highly directed. 
Otherwise, use of discounting to achieve certain market share objectives has the long 
– term effect of devaluing the product and its desirability. **Residuals are harmed and 
eventually a prestige product will become a volume product.** The NSC does not at 
present have the right information to accurately predict uplift from directed 
promotions. This is discussed in more detail in the next section on price elasticity and 
customer expectation.

For salespeople, would pricing by lead-time increase stability in sales targeting? In 
workshops we have conducted Dealers made it clear that the cost of lead-time pricing 
should be borne by the manufacturers, since it works very much to their advantage 
rather than the dealer who may have to wait for payment.

For the manufacturer, pricing against lead-time mechanism emphasizes that time slot 
is a perishable commodity, in terms of supply chain sunk costs and capacity 
overheads. The customer is made aware of the implications through the pricing 
mechanism, which vastly aids planning in the whole supply chain.

All of these reasons are compelling, but a key weakness is the possibility of distress 
selling. Currently, distress selling occurs in the form of dealer incentives on ageing 
stock. In a build to order scenario, empty order slots are the converse of ageing stock 
vehicles. But the key is how to avoid last minute discounting of slots? Discounting of 
slots, although seemingly prudent, would create a culture of expectation for customers 
to go for last minute compromise choices to take advantage of the price discounts 
available. For the customer, a situation would be created similar to the current one 
where customers expect discounts on stock. There are several ways to avoid distress 
selling in the order bank, listed in the box below.

<table>
<thead>
<tr>
<th>Avoiding Distress Selling in the Order Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Encouraging sold orders to be placed well ahead of the peak: build what can be built ahead according to expected uplift.</td>
</tr>
<tr>
<td>2. Encouraging sales to be made off-peak, by use of CRM promotions, residuals compensation etc.</td>
</tr>
<tr>
<td>3. Delivering large fleet orders over a staggered agreed period</td>
</tr>
<tr>
<td>4. Using showroom and demonstrators as buffers</td>
</tr>
<tr>
<td>5. Reducing capacity or accepting overcapacity for a period and leaving slots empty</td>
</tr>
<tr>
<td>6. Carefully directed promotions - i.e. filling up requirement for 1.6L capacity only with price adjustment 'promotion' upgrade from 1.2L</td>
</tr>
<tr>
<td>7. Heavy last minute discounting of slots is to be avoided. It represents a failure of sales and marketing, and last minute discounting will create a new undesirable customer paradigm with customers holding off for last minute deals. In the long term the demand management objectives would be undermined altogether.</td>
</tr>
<tr>
<td>8. <strong>Build to stock:</strong> the 3DayCar brief for full build to order disallows this, but is a clearly an option in a ‘hybrid’ system. Never say ‘never’!</td>
</tr>
</tbody>
</table>
4.2 Pricing against Demand

Whilst changing pricing in response to changes in demand is clearly related to lead-time, revenue management is not just segmenting by lead-time, as I hope has been stressed in the previous section. As in the selling of holidays, prices can be changed at any point determined by the overall current level of sales. Attempts have been made to put revenue management in place for setting target prices for Dealers (Talus, 2000). For BTO, this will reflect the current fill level of the order bank stretching into the future, and will have to be measured against forecast or target orders and target prices.

For the manufacturer, price changes across the entire product range will manage demand against production capacity. To make this system work, the manufacturer will monitor orders and price, and through employing decision making analysts specialising in particular product and markets, will constantly adjust base (not lead-time related) pricing offers based on sales. A parallel would be the employment of specialist buyers and merchandisers by large retail groups.

Again, basically pricing by demand already happens. When a product is new and or in short supply, the incentives to dealers will be low, with little discounting. When the product is old or in oversupply (stocks building in the market place), manufacturers will run more promotions, and will also be offering large discounts to customers (via increased pressure on volume through higher targets tied to incentives, forcing payments being made to dealers to be converted into discounts).

Consequently, customers expect price to vary by demand. The timescales are longer, but the principle is the same. Customers accept that an RRP/ list price is just a maximum or benchmark price, (or at least some do!!), and very few pay the list price, certainly on volume product.

A perceived weakness is that customers will not accept different prices for the same product, and there will be subsequent impact on customer satisfaction. The argument is put forward that if one customer talks to another and finds the price has dropped since their purchase, that the end result will be a fall in customer satisfaction. However, customers already pay differing prices for the same product; few customers pay the same price, and the level of discounts open for negotiation also change over time. The flexibility allows for arbitrage. Customers do accept the principle in other retail areas where it is more transparent: as stated, the problem is not the use of promotions and discounting to vary price, but rather the application, the degree to which the promotions are effectively targeted. In addition, the behavior of residual prices should be monitored when directing the promotions, to avoid oversupplying a market with certain derivatives thereby altering the price sensitivity of the new product.

Dealers can adapt to new systems, and they are certainly used to variable transaction prices, incentives and targets. Pricing by demand already occurs at the dealer. However, it is difficult for the dealer to assess real demand, because volumes of sales at this level are low, and there is subsequently a lot of ‘noise’ in the demand at the dealership level. Therefore, much like the Forrester effect seen in the ordering system, dealers will tend to overcompensate to account for perceived trends; the whole picture is not available in terms of the complex demand trends that develop in a market, whereas the aggregated demand at the market level will show these trends.
The dealer can directly benefit from the enriching of the mix or price if they receive a share of the increased profitability. So if demand causes a rise in price, currently the dealer will retain a higher level of subsidy and bonus; this changes to a higher profit per unit.

As a result of the possible benefit described above, reward and payment structures will have to be realigned; otherwise there would be an increase in dealer income variability. The lack of stability in income level would need to be compensated somehow, i.e. removing the support for discounts may mean necessitating higher base margin. However, after the proposed adjustments detailed later in this report are implemented, the revenue to the dealer should become more stable; it largely depends on the structure of incentives. Currently, at micro level, pricing by demand is done by the dealer on the margin, and strong product does not need discounting; in this instance the dealer receives both more of all bonuses and margins, but receives less gross incentives to discount.

As far as the manufacturer is concerned, pricing by demand already happens. The manufacturer changes price in response to demand, both over the short term to meet market share targets, and over the whole life cycle of the product. Also, price management of a model will be done in context of the whole range. This is occasionally done discretely, perhaps annually, but is also done continuously through the incentives within the dealer payment system. And the wholesale price is naturally different for every large direct fleet sale. However, ongoing price management (through incentives etc) is done retrospectively on stock. With build to order, pricing by demand has the main strength of maximising the profitability of each sale, product and customer segment.

Price adjustments, indeed actual paid prices, are kept hidden in the current system, through use of dealer incentives generated at the macro level; from the customer AND the manufacturer! The possible disadvantage of variable pricing is increased likelihood of transparent price wars, driving down prices and therefore margins (Herman, 2000); however, with highly differentiated pricing, this should be avoidable. The avoidance of price wars in a revenue management scenario depends largely on the sophistication of the revenue management system, which is discussed in more depth in the section on pricing and costing systems.

4.3 Pricing to the individual customer

By pricing to the individual customer, using CRM data, discounts can be directed at particular customers based on their individual circumstances and history. By offsetting cost of acquisition, loyalty discounts can be offered, for moving replacement date, or encouraging orders to be placed well ahead. Good quality customer, price and sales data will be needed for this to be effective.

Currently, each customer pays a different price. This is due to individually negotiated deals, trade-in, and route of purchase (i.e. fleet or retail). The same should be true under a build to order system. A car is such an individualised purchase that the trade-
offs and priorities of each customer will be different; as will their previous interaction with the manufacturer.

If customer loyalty and acquisition costs are balanced, CRM can be used to sell to each customer, with an individual price. In the first instance, this would mean that customers could themselves volume buy. So if a return customer (i.e. small fleet <25 cars), buys 25 over a year the revenue management system should recognise this and price for it (also in anticipation). How you speculate whether they actually will buy 25 is another matter, and no doubt the discount offered will have to be on each sale, rising continuously in direct proportion to the number of orders from that customer over the year. Secondly, a normal private retail customer can be encouraged to buy away from the peak by offering compensation for loss of residual value caused, sweetened by a additional bonus for lack of customer acquisition cost. The key point is, you have a rough date for potential replacement based on a previous sale and all other details that can be used for highly directed marketing. If loyal customers can be persuaded off peak, or order far ahead, then the subsequent cost savings to the system can be returned to targeted loyal customers with real value-added offers.

At least this system would rationalise the offer to some degree, providing some logic that customers can understand for pricing differences. Negotiating may be lost to a certain extent, although the trade-in ensures that negotiation can occur on the used-car evaluation.

For the dealer, there arises the possibility of consolidating offers made to the customer (for example on servicing) in a systematic way, with support from the manufacturer. The combination of CRM and pricing should aid the Dealer in customer retention, including related business such as for servicing. The customer data gathered by the Dealer in servicing assists the manufacturer, who does not have such regular contact. However, the Dealer and whole system may suffer from the loss of control over use of discretion for setting customer price. For example, if the dealer thinks that a good offer to an individual customer will bring a significant return business, he may gamble and under-quote a sale on the basis of expected future revenues. It is hard for an automated system to replicate this. In many ways this is the crux of the argument, since the judgement of the individual dealer may well be less effective than the assessment of aggregated demand.

There will also be the problems that arise with CRM in general, regarding sharing of customer data, in particular the data being used by local intra-brand competition, and the cross brand data of dealers being isolated from brand specific data for manufacturers. However, these issues have been shown not to be insurmountable in other sectors, and need to be addressed in terms of aiming for aggregated data management in the framework of a contractual retailer-manufacturer agreement on the use of the data. This data is desirable for CRM; BTO just makes better use of such data.

For the manufacturer, such a system would enable savings on money spent on customer acquisition, and provide scheduling benefits in terms of encouraging loyal customers to order ahead with incentives. It also provides the opportunity for manufacturers to offer return customers enhanced and additional ancillary services. However, whilst Manufacturers will have to take account of residuals, and will have
to compensate the difference between off peak purchase and residual difference, PCPs have provided salutary warnings on guaranteed residuals. However, the timescales involved will be far lower than those in PCP schemes, so risk should be lower.
5 Sales Forecasting and Effective Use of Price Elasticity

5.1 Forecasting Methodology and Availability of Price Information

Forecasting is integral to every Yield/Revenue Management strategy. Forecasts drive system decisions, and it is necessary that forecast errors are minimised in order to make better decisions. Forecasts cannot be right; successful forecasting is however, less wrong more of the time.

In the UK auto sector, manufacturers forecast using a mixture of expert knowledge and extensions of the Box-Jenkins forecasting approach. Box Jenkins is essentially a time series projection. Seasonality can be better accommodated into forecasts with a form of exponential smoothing of moving averages as typified by the Winters (sometimes known as Halt-Winters) method (Arsham, 2001). Multivariate autoregressive moving-average (ARMA) models use available information on past sales and macroeconomic variables (Kleinbaum, 1988). Where variables that alter the outcome on sales and share of market such as price are the result of the same system this information and experience is particularly important. Time series will be important for anticipating daily sales, since they are not linear. Some of the distortion caused by monthly targets, (that create ‘hockey-stick’ demand), may be removed by some of the proposed changes to dealer targeting and payment, but the accumulation of orders will not occur at a steady rate.

Sales and Logistics forecasts are currently monthly, and the level of detail required by a build to stock system is arguably less than that for a Build to Order system. Automotive Sales forecasting is based on a two-stage process. First is an assessment of overall market and segment volumes, which is actually the focus of a competition between the brands. An element of friendly rivalry was instituted by the SMMT in the UK, where the winner holds a trophy for most accurately predicting overall market volume. NSC forecasters use this overall predicted market volume to evaluate gain or loss of their market share. This model assumes that individual brands cannot increase their sales incrementally to that of the market, and equally that the sales will switch between segments. Furthermore, at the whole market level it takes no account of different sensitivities to macroeconomic effects; for example, Jaguar sales may have a different response to changing market conditions compared to Ford. The strength of this method however is that it separates the macroeconomic conditions from brand competition.

The relationship between customer price elasticity, in particular promotional price elasticity, and the subsequent actions of retailers, is used routinely in other retail sectors (i.e. FMCG). Elasticity of sales will have a base level from which marketing policy is determined. Also, elasticity in the future will be influenced by marketing behaviour now, which is often not adequately considered in price strategy (Zenor et al, 1998).

Traditional auto forecasting takes minimal account of price, promotional and discounting activity. Much of this price management and marketing action occurs after sales forecasts, and after a particular share of market has not been reached. The outcome is therefore not comprehensively included in future forecasts; rather the
volume target for the year is reallocated to future periods, which in turn further generates future promotional or discounting activity. The lack of accurate price data and understanding of the dynamics of the sales system leads to an inability to integrate price management into forecasts. This lack of price sensitivity data leads to a decoupling of sales from sales forecasting which actually must try to predict the activity of the sales systems as much as it must that of consumers and the marketplace as a whole. In other retail sectors price changes are strategically managed as part of the sales forecasting process; price data is routinely collated automatically through EPOS (Electronic Point of Sale) data. Lack of actual price data is treated in auto sector forecasting as a real world constraint (Zenor et al, 1998). It is only so if the transaction price and sales support data is not made available. The transaction price, related support, trade-in and discount information on each sale should be collected and passed to sales forecasting. Only in this way can demand be more effectively managed and price sensitivity understood.

Unpredictable ‘noise’ must be expected in sales forecasting, particularly with a capital good with longer replacement cycles as discussed earlier. No forecast is a substitute for expert knowledge and experience. However, noise could be reduced, certainly in understanding own sales, (if not total market activity\(^{11}\)), if the effects of transaction price were better understood.

### 5.2 Recording Real Demand Data: Real Sold Order and Transaction Prices

1) Daily mix by model of order and registration data. The mix includes the product mix, market mix, sales channel mix, and customer mix. The more BTO sales, the more true the demand data.

2) This product and customer data should be attached to every transaction price. For each sale the sales channel should record online:
   - Actual transaction price (discount off list)
   - Contribution to dealer margin, bonus and any other payment: all incentives, bonuses, targets, and other support that are affected by the individual sale
   - Contribution from any particular promotion
   - Contribution from any supplementary payment made by NSC to Dealer to support a non-promotional price-cut
   - Trade-in price

3) ALL data passed to manufacturer/NSC. Sales data should be transferred immediately from the sales channel to sales forecasting, both automatic forecasting in terms of revenue management, and manual, in terms of sales and marketing and other planning.

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\(^{11}\) Although market activity would be better understood if the data was collected, since a manufacturer would understand better the factors influencing residual values, and could assume certain patterns hold true for all manufacturers.
5.3 Customer Expectation and Price

“Sticker Shock: Consumers expect to find the brand available at a discount, and are unpleasantly surprised to find the higher price”.

What customers expect to pay for a good or service, or the ‘Consumer reference price’ is difficult to measure directly; exposure to promotions and pricing changes affects customers’ perception of a brand as a discount or ‘non-discount’ brand. How do these perceptions operate in the auto sector? Will a high level of exposure to price changes will have a downward pressure as per above?

If the customers come to expect price cuts then the long-term effect is that price promotions cease to be effective in increasing sales and become unprofitable (Lattin et al, 1988). However, this focuses attention on why price promotions are used. Frequent discounting can undermine consumer price expectations. The timing of purchases may actually be influenced over time by strategic timing of promotions. Lattin et al study concluded that consumers who have a ‘reference value’ for a product are more likely to buy during ‘deal periods’, and avoid buying during ‘non-deal periods’. In this way the influence of seasonality can be addressed over time.

“In the long run, overly intensive discounting may end up (1) redistributing demand, (2) lowering baseline sales and (3) increasing the proportion of sales made at discounted margins.” (Lattin et al, 1988). Again, the success of a promotion will decide the outcome. If demand redistribution is the main outcome then the discounts have indeed been successful.

![Figure 41: Effect of price changes on demand](image)

If the other elements are more significant in the outcome then the price management has failed. Consumer response and perception of price change is the most important factor; understanding of price game, in particular in educating and shaping the response to future scenarios. The diagram above (Figure 41), adapted from Lattin et al, demonstrates the positive and negative impacts of price changes. The less directed a promotion is, the more likely the effect will be a negative one.
Reference ‘category values’ are not simply an index of expected price, as per Lattin’s model, but actually should encompass variable price scenarios with a reference value range. In other words, customers should have a range of price expectations depending upon segment, and also based upon the price utility of lead-times.

### 5.4 Effective Use of Price Elasticity

Price Elasticity allows goods to be priced for different customers at different rates. To manage actual demand in the market, the manufacturer needs to have a better understanding of the price-demand relationship; the price setter must know the price accepted by different customers under various conditions.

Naturally customer segmentation will in part determine the price offer. It sets the broad parameters by which prices are set. Price sensitivity will have to be understood on a continuous basis, in order that changing market conditions are reflected in the price offering. The shorter the feedback loop from successful transaction to forecasting and price setting, the more quickly market conditions can be reacted to.

![Figure 42: Price Elasticity Prediction: this will vary by market and sales channel](image)

Understanding the price elasticity for a product is an extremely complicated task, particularly given the wide range of product mix for the car. Fixed price retailing is completely at odds with the wide set of variables found in selling the new car. Customer segmentation, time profile, and underlying seasonality all have to be considered. Price sensitivity will vary by:

(a) Product - high variety

(b) Customer type - highly segmented market

(c) Geography - varies by national markets, and even within markets

(d) Time profile expectations - demand for product in the market, and anticipated acceptable waiting time from order to delivery
It is important to stress that the two price targets shown in the price sensitivity matrix are interdependent. Any price offer in a range is both strategically and fiscally related to all others: the pricing matrix needs to be understood at the macro level, with target revenues from each pricing segment. Therefore, monitoring needs to be as constant humanly (or mechanically) possible to ensure that the matrix, (relying on real order data and other market data), genuinely reflects the current demand and supply situation.

5.5 Price Competition

Variable pricing can lead to downward pressures on price, and as has been noted by several commentators (Simon, Hermann, 31/10/00), price flexing has to be approached with some caution; however, it should be pointed out that current stock management strategies have such a strong downward pressure on actual transaction prices.

Also price wars can erupt from excessive price visibility. The current pricing system does actually obscure price competition for retail sales, although not at the level of the fleet buyer. However, a flexible price system does not have to be open and transparent. The customer wants a clear and simple process; the list price will remain an indicator of value, a price benchmark rather than fixed value. With revenue management, as now, the pricing should be different for each single query.

Under revenue management, as now, the prices quoted are valid only when quoted, and they are only made visible to the potential buyer. The salesperson will have a fair idea of the value of different products under different conditions to different customers and so on. This means that whilst the customer may get a spread of quotes, the competition, even attempting to query the order system, would find it very difficult, if not impossible, to work out the entire pricing matrix. The only rational way competition prices could be monitored is through making queries based on a restricted number of conditions, at the extremes and medians of each range of variables, on certain products. These benchmark quotes based on a certain waiting time markers, set of colours or options packages, etc, could be monitored on a daily basis. However, segmentation should be so ordered as to make this extrapolation impossible, particularly as it will be varied in reaction to real demand.

The fact that the quotes are not directly comparable is a significant barrier to outright price wars. No doubt intermediaries will evolve to allow some degree of price comparison, but the more sophisticated the pricing system then the less likely the competition will be able to decipher a price matrix.

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12 Although in the UK, the recent lowering of discountable margins previously allocated for price adjustments and their replacement by lower list prices, has had the effect on exposing more comparison between brands. This reduction in list prices rather than actual prices as the competition commission had intended has resulted in little change in actual paid new car prices, which have not changed significantly; the average list price cut in Autumn 2000 of around 10% being much the same as the average 1999 retail price discount. The subsequent price deflation of residuals over the same period has actually resulted in a higher cost of change for the customer during the transition phase.

The fall in residuals is telling in several ways. Dealers expect a fall in residuals. Therefore they undervalue. The fall in residual values makes the new product appear uncompetitive, and list prices or transaction prices are also under pressure to come down. Which again prompts a further fall in residual values, and so on. Thus a vicious circle of price deterioration is created.
At present the price matrix, if understood at all by any single individual, is based upon the list price, negotiable price ranges for large fleets, and the range of incentives for dealers and the conditions for different sales conditions and customer segments.

The dealer payment structure actually holds the key to a brand's pricing policy. It designates the degree of flexibility with which the dealer can control prices, and also determines the time-scales over which the dealer needs to consider holdback payments and targets achieved.

Currently, discounting is more closely related to the stock situation and dealer targets than it is to customers’ view of the value of the product. Improved targeting of price changes rather than indiscriminate devolved discounting should (a) maintain price elasticity, and (b) maintain brand value. The result should be a move away from the current paradigm where customers expect discounts regardless of the context because the recommended retail price is considered overpriced.

### 5.6 Customers and Demand Segmentation

Customer segmentation allows consideration of the value of different lead times to different customers. Fleet orders for example, are more predictable in terms of contractual replacement cycles. Large fleet orders are deemed to be more flexible in delivery requirements. However, Rental Fleets may not wait, since they sell cars from their own fleet as though it were stock. Currently therefore, if you want to satisfy the rental company from stock you need a good range of stock - which pushes up the stock objective. In build to order these may well have to be last-minute sales, which is unfortunate since they may order a large batch to replenish their 'stock'. Equally, certain private customers, such as those in PCP schemes, have predictable dates for possible repurchase. However, there may be issues regarding replacement dates for existing customers that appear relatively easy to predict. PCP providers make additional profits on overrunning PCPs, since depreciation is complete on the original sales package.

Up to 25% of sales are estimated to be a small business purchase (under 25 cars in the fleet), (Fleet Dealer, Sewells, Jan 2001), and so there exists the potential to schedule purchase dates in a much more structured way if the right relationship is forged with the customer (CRM). This is done in the financial sector and there is no reason to suggest it cannot be more formally introduced into the auto sector. Segmentation by lead-time may resemble the spread seen in Fig 4; this diagram is representational only and does not reflect actual data – real patterns could well differ significantly.

However, making the best use of customer segmentation will require additional data gathering tools, since the leveraging of attitudes to lead times can be obtained through small price differentials. Which leads us again to the subject of price management, which is obscured and complicated by the way that it is managed and subsequently suffers from being an underused and misunderstood mechanism within the auto sector.
5.7 Customers, Segmentation and the Sales System

CRM, Personalised Service and Sales Offer

There are several key requirements of the customer regarding the sales system. First, the customer wants a personalised service, not a 'mass advertised' offering. Certainly those customers who are not keen negotiators will go for structured 'offers', but even these must be sold to the individual customer in a personalised way. Traditionally, manufacturers have had real problems in knowing who their customers are. The luxury brands have with varying degrees of success built a reasonable level of contact through buyer clubs, magazines etc.

CRM (Customer Relationship Management) has long been touted as the marketing solution for manufacturers, as a way of getting closer to their customer base. This follows the pattern of other businesses trying to get more data on their customers, i.e. the UK supermarkets with cross-referencing of point of sale data, 'loyalty cards', and financial products. It must be pointed out that the problem the manufacturer has in understanding its customers is entirely due to its role as a supplier to retailers. The retailers have had this close contact all along. Those dealers who have maintained local customer knowledge will always be in a strong position to maximise value from their brand. Those who have a database but do not have 'family-local' knowledge due to their retail group corporate structure will have to rely upon a mix of CRM with the manufacturer and more sophisticated means of retaining customer knowledge in the dealer business. It is important to stress that whilst dealers are not the only channel for customers, the role of the dealer as a personalised service and point of contact is very important for both the customer and the manufacturer as brand in the market. The non-sharing of this data creates barriers to more directed marketing and sales offers to individual customers.

Therefore it is clear that with the customer increasingly demanding a more personalised service rather than being bombarded by junk mail, the dealer still has a very important role to play as customer contact. However, whether build to order is sold through dealers or other channels is less critical to the feasibility of build to order than how it is sold.

Customers understand the price negotiation 'game'

As discussed at length in the project focus groups report (Waller, 2000), there is need for an open, clear process for agreeing a deal. Regarding price negotiation, customers can be broadly categorised as negotiators or non-negotiators. Negotiators will have varying degree of understanding of the negotiation levers, and will succeed with varying degrees of success to obtain discounts off the list price. The more successful negotiations for the customer will be predicated on the surmise that

(a) the dealer really needs to sell (timing of sale and bonuses and incentives situation),

(b) the customer understands the level of discount that can realistically be achieved on the new vehicle and residual value on any trade-in vehicle

(c) It is this final element that creates the greatest confusion and suspicion by customers over the full transaction price.
Whilst negotiators will broadly accept the opaqueness of the current pricing system, there is significant demand for a more clear series of price markers based on a rationale that makes sense to the customer. Non-negotiators have the least tolerance of the current system, thinking, perhaps justifiably, that it does not serve them well.

The current price negotiation game is in part a result of buying from stock. Negotiating customers will use this to their advantage to force compromises and resulting price discounts/spec upgrades. Some analysts, particularly in the finance sector curiously enough, have rather simplistically assumed that a build-to-order system will dispense with discounting. It needs to be stressed that pricing to demand will always occur in an enterprise chain with high fixed costs.

**Ability to make trade-offs over the price paid**

Customers currently balance product choice against cost through a complex set of assumptions about buying from stock, ‘compromise negotiation’ and ordering lead-times. Not all customers have the same requirements in terms of lead-time and price. This prioritisation can be aligned with manufacturing requirements to achieve a good result for all partners in the supply chain.

**Can the customer price negotiation be formalised to meet manufacturing requirements?**

Price negotiation is expected and actually wanted by most customers. Through pricing against demand and lead-time, this could be formalised to benefit the supply system. For the customer the cheapest cars are those that are sourced from stock. Also, heavy price subsidies are passed to Dealers at periods of peaks sales, to ensure share of market is maintained. Subsequently customers who buy at the peak demand period, from the stock built up to reach the seasonal sales peak get the lowest new prices. If timed well by customers, they also trade-in their used vehicles at a good price because of the effect of registrations on residual values. The net result is a demand concentration and lower revenues per sale.

If the price negotiation process can be formalised in a systematic way, then price can be used to manage demand, to encourage ordering as early as possible prior to the peak, and from unsold stock to unsold slots in production.

To summarise, revenue management through a personalised sales channel delivers to customers:

- A personalised service according to their customer segment. This applies not only to fleet versus private purchasers, but to negotiators versus non-negotiators
- A logical pricing system from which they can determine whether they have got a good deal.
- The ability to make trade-offs over the price paid
6. Dealer Incentives and Payments: Rolling Future Targets

Currently, the retail system is used as a buffer against demand fluctuations. Dealers are used to absorb excess stock in the market place through various mechanisms. Besides straightforward adjustments to price made via the tortuously complex dealer incentives and payments systems, dealers and manufacturers have various avenues to distress sell product. The current use of stock and the retail network as a buffer against risk in the market is necessitated by the current order to delivery lead times. The effect of a change in the rate of sales on production is correspondingly slow. In a build to order system however, it is the role of the selling system to generate the incentives to both customer and salespersons to create the demand that gives the manufacturer the desired share of parc. With Build To Order this can be achieved without the ‘pressure of stock’, and without the subsequent deterioration in residual values created by flooding the market with mismatched supply.

Dealer payment and incentives create distortions in demand, as shown earlier\(^\text{13}\). Artificial variation in sales and orders across the month and other sales periods generated by the dealer payment and targeting system, interfere with underlying customer demand. Some of these factors may be mitigated by the changes to the retail model suggested later in this report, but essentially there are key elements of payment of sales channels involving targets that need to be addressed.

**From Quarterly and Monthly Targets to Rolling Future Targets**

If part of the payment for placing orders is held back for 3 months, as it is at present in the bonus structure, all relevant payments for the three months are paid after the third month end. This creates the quarters for dealer performance and payment for which they budget.

Targets cannot be done away with: salespeople need targets. To remove the quarterly effect, a continuous future 90-day rolling target could be introduced. Each sale could still have an element held back, set against the targeted sales for that period. The measured period could be the rolling forward booked sales attainment as a proportion of rolling future period target. Results would be based on the rolling average achievement of a variable rolling target, reflecting the seasonality of sales.

To avoid the end of period push to achieve milestones there would be an incremental per unit bonus, with no steps in volume achieved. This avoids all or bust effect of stepped targets, and subsequent sales distortion. Customers will not be ‘pulled forward’ in order to meet certain sales targets, (whilst they can be encouraged to order ahead, so the sale is not lost).

\(^{13}\) Dealer payment and incentives and the effects upon demand will be examined in further detail in a forthcoming short report, including more on the proposed remedies.
Given that for incentivising salesperson and Dealer staff, targets have to be hard to achieve, attainment should not be on the basis of all or nothing. Dealers should not receive bonuses therefore if the target numbers as segmented above are not reached.

Therefore to make this system reflective of actual demand as a continuous rather than discrete phenomenon, the attainment percentage should relate directly to the percentage of bonus paid. If the Dealer attained 90% of target, then they receive 90% of the bonus financial value.

Further to the bonus for attaining targets, the basic margin or fee per sale should also be rewarded incrementally over a rolling period. Every sale (which remember, are all forward sold orders), should, over a period, (for example the last 30 days), attain the same increase in margin. Such a system could operate as shown in the graph below.

Such a system ensures daily income, and the ability to rectify bad sales performance relatively quickly without penalising non-attainment of plateaus of volume.

Regardless of the commercial terms between the retailer and the manufacturer, detailed in the next section, payment terms will be a critical issue. If a car is ordered ahead, the dealer should get some reward at the point of order (so long as the

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14 Transaction price or wholesale price, depending on the retail model, discussed in the final section of this report.
customer order is binding or held by a sizeable deposit). Therefore the manufacturer will have to make some concession to paying the dealer in advance of receipt of goods for making the order, in order to persuade the dealer that it is in their interests.
7. Pricing and Costing Systems

Across revenue management systems, there are degrees of sophistication in terms of responsiveness of pricing. The stages required in implementing a more advanced system are as follows:

- Basic price changes: The most basic variable real-time price system would be one that publishes changes in price offered; this would work well for a traditional dealer model. This still requires tracking of prices and creation of an audit trail and archive (CSK, 2000).
- Testing elasticity: The next level of functionality is able to respond to a price query with an offer of alternatives.
- Internal Optimisation: at the next level, a price generator is required that interrogates back-end systems. This would be done by checking variables in the query by retrieving live data from other sources, i.e. empty slots in the order bank and then quoting on that basis. If the system is truly dynamic, then it must search for price optimisation data to generate each price quoted.
- Allowance for Competitor action: competitor tracking based pricing algorithms allow pricing systems to take account of the marketplace, and so act in response to prices offered by competing systems, but can lead to cyclical price wars.
- Gaming systems: ‘Deep look-ahead’ or foresight based strategic models are the most advanced pricing systems currently being developed.

Each of these shall be examined in more detail in the following section.

7.1 Offering alternatives

A price and quotation system, if intended to persuade customers to order ahead or away from the peak, will have to offer alternative dates and prices. Otherwise awareness will be limited and the value of lead-time differentiation will be lessened.

One of the primary aims of a responsive pricing system is to obtain best spread of prices from resources being sold. For example, the busier request periods will be estimated based on previous sales by time, and updated according to current queries (Abe, Kamba, 1999).

To test elasticity, the offer to each customer query must spread a certain breadth of price offers. If the customer were simply quoted one price in response to a query, the price offered would be the maximised price only for that query. If the system is designed to maximise total revenue obtained in the long run, a variety of alternatives should be displayed to trigger the required price elasticity. In this way optimal prices and therefore expected maximum revenues, can be estimated (Abe, Kamba, 1999)
7.2 Internal Optimisation: integration of ‘front-end’ and ‘back-end’ systems

There are several elements in integrating capacity utilisation with revenue management.

Cost Monitoring Systems

Software vendors such as SDRC have developed a global system for clients for increasing the speed of New Product Development of product from boardroom idea to product launch. These systems co-ordinate new product development by keeping all suppliers and other interested parties, such as production sequence designers, working off a single, continually updated blueprint. This system can be designed to incorporate costing, as is the SDRC-Ford system. They have a running total of both the accumulated cost of NPD and price per part, at any point in the development.

Such principles could be applied to ongoing production for build to order purposes. The calculation can become an estimation of marginal cost and profitability per potential sale. The marginal costs estimated for a sale based on actual relevant data could be balanced against the revenue management generated price; an evaluation could be made, on the marginal value of each sale. The marginal value of each sale could be compared to the cost of increasing capacity to achieve whole system optimisation. An inquiry can be priced accordingly, or in cases where profitability or loss of contribution to assets is unacceptably low, be rejected.

"Two elements are used by car manufacturing firms as the basis for control and performance measurement – the time base and the cost structure (money). Product mix, sales volumes, capacity, efficiency, utilisation and productivity are measured by time. At the corporate level, forecast activity levels, performance measures, levels of investment and similar activities use the money base. Hill (1995), emphasised the importance of getting the correct links between the time-based and money-based measures in terms of accuracy, and in terms of key factors associated with car manufacturing." (Omar, 1997)

Capacity utilisation and volume maximisation is considered the basis of profitability in car manufacturing. However, the cost of capital per car on average does not reflect the marginal cost per car in a real production scenario. As discussed earlier, there will be a break-even point, manageable in terms of both pricing and capacity setting. The break-even point should become clear with more information on marginal profits and costs. Variable and marginal costs are not the same; manufacturers have used variable cost based pricing systems for at least 30 years. The problem is to know the marginal cost on a real time basis, which requires whole new data flows.

Price Quote Management

Management of pricing requires real-time information to be passed along the supply chain. It also requires analysis of achieved sales, including achieved price and product mix, and production slots filled.
Managing Demand/Selling Time

The ordering system will have to follow process logic as outlined in Fig 45. The IT requirements generated by this process will be covered in detail in the forthcoming IT for Build To Order Report (Ben Waller and Mickey Howard).

![Process Logic Diagram]

Figure 45: Process Logic for the Ordering System

The manufacturer will need to set a matrix of product and price targets, plus a revenue management based profit mix (on sales) target. Expert analysts specialized in detailed product range, will monitor system performance by examining the actual achieved against target, and the balance of revenue versus capacity optimization.

Understanding Product Mix Richness and Demand Volatility

The mix of product will be a category that requires monitoring. The average mix over a year should be relatively stable, although show trends, (bar product introductions, run-outs, specials and promotions). However, the detail of the mix varies significantly, particularly at low volumes, as statistical theory would predict; this issue is the subject of a paper on demand volatility that will follow this paper.

The profile of year’s sales can be mapped to understand the relationship between elements of the mix. For example, the correlation and co-dependence between trim level and engine size is clearly demonstrated in the model in Figure 46.

Looking at the mix, it can be demonstrated that even a small shift in the mix towards the richer segments from the base segments would greatly improve profitability of sales.
Managing Demand/Selling Time

Figure 46: Engine size and Trim Level mix for a model over 12 months. The percentage is of annual sales. Source: 3DayCar data, from Manufacturer via SMMT

Short-term (Operational Control)

Expert analysts who could be product range managers will be delegated a certain pre-agreed flexibility in terms of setting prices, marketing spend and targets. They would monitor the revenue management system and the order schedule and adjust the pricing, marketing programme and the communication to sales channels of all changes. They would also adjust the rolling sales targets for sales channels, and the targets for the revenue management system;

- Product mix target; certain product mix may be more desirable – effective and directed pricing and promotions can be used to r ichen the product mix, as illustrated in Fig 46.
- Price mix target; a certain revenue will be forecast for a period, which can be segmented into expected price segmentation profile
- Future order schedule fill targets; for example, at this time of the year, the order schedule for production in 24 days time should be booked to x%
- Measurement of the profit mix: which sales are generating the highest revenues?
- Measurement of marginal cost targets: what is probability of the forecast demand for a certain period, and what is the likely costs of flexing capacity to account for several possible demand levels. Late capacity setting and optimisation will make this less of an issue, but the costs need to be forecast for a certain capacity level with a certain mix (i.e. for staffing implications along the supply chain).

These analysts should have operational control of the order schedule and prices paid, balancing strategic objectives for managing demand and capacity.
Strategic Control

Beyond the operational pre-agreed flexibility, key decisions will have to be made, weekly, monthly, annually as now, on sales. However, set targets for the year will have to be continually assessed and re-addressed. The management team will need to consider capacity, their own and that of suppliers, the performance of price and product mix, the profit mix generated by revenue management, and the order schedule fill against target for reaching sales objectives, (in particular for meeting sales peaks).

Balancing Price against Capacity Flexibility

For whole enterprise system performance to be optimised, the pricing calculations offered by revenue management need to include consideration of the costs of flexing the system capacity. This capacity flexibility needs to be estimated in a way that genuinely costs in fixed costs and variable costs, plus time; less notice given will inevitably mean less potential capacity flexibility, and once capacity is fixed, then less notice means less time for price optimisation.

The capacity costs of flexibility should not exceed the cost of the alternative solution of holding finished goods inventory at any stage prior to final assembly. Also, the costs of capacity should not exceed any margin realistically achievable through pricing against known limits of price elasticity. There is the problem here that capacity increase is often only changeable in discrete blocks (i.e. a minimum shift cover), and rarely continuous and incremental (i.e. potentially the individual load-journeys that could be traded online by a logistics company). However, in principle, the known limits to price elasticity for each segment of consumers should limit the possible increases in capacity. Equally, if return on capital is considered unviable at a rate of production of less than 80% capacity utilisation, then the pricing system (and NSCs) must take account of this in achieving a base load. The mix of the bill of materials that can be built to order or must be made to stock will by implication be the constraints on the ability of the system to respond to changes in the mix in real demand. The revenue management system will therefore have to include mix rules that take account of these differences.

There are several areas for consideration when wanting to achieve variable capacity. The costs of flexibility are both fixed and variable. Flexibility must be understood in the context of both volume and mix variation. Most suppliers are able to accommodate mix variation, but not volume variation. Cells may represent more flexible fixed costs since they can be switched from one task to another, and be placed on or off line sequence. There is an additional cost per cell for purchase that effectively makes up a flexible production line. Furthermore, suppliers may wish to invest in moulds for subcontracting out production of certain quality reliable lines to third parties in order to overcome capacity constraints. All these cost constraints need to be built into the revenue management model.

Labour flexibility is hard to achieve, particularly with a highly skilled workforce. In terms of manning production facilities with variable line speeds, cellular reconfigurability, etc, there are two major obstacles to being flexible enough to move
production closer to market demand requirements; first, variation of working hours without overtime, second, notice period of change to employees. The first issue can be addressed with annualised hours, and manufacturers are experimenting with versions of this approach, (although there may be limits to flexibility given that there exist for good reasons maximum hours worked per employee per week). However, there are still limits to the notice given to employees, with the most flexible changing under an annualised hours agreement with a four weeks minimum notice period, (as opposed to overtime notice for a Saturday\textsuperscript{15}). There may be a ‘yield management’ solution to this. In parallel to annualised hours, employees could be given a notice period prior to the shift pattern change; the closer to the day of production, the higher a marginal increase or convenience payment. Equally, if changes are made four weeks out, no additional payment is due. This may make flexibility of the production capacity possible until the point at which the schedule and sequence is fixed one day prior to production, through demonstrating consideration of employee resources. This is unlikely to be on the table for discussion, but demonstrates the applicability of time-based pricing to many areas.

Skilled workers are preferable to unskilled temporary workers. Therefore numerous part-time skilled workers on different levels on annualised hours may represent one solution. Furthermore, they may have different requirements over shorter periods; this may result in the end of shifts, and replacement by continuous hourly changes of multi-skilled personnel. The more multi-skilled the workforce, the more flexible the variable costs. Whatever the approach taken, the costs of labour flexibility, along the supply chain and not just in the assembly plant, will need to be measured and integrated into the revenue management system.

Determining the costs of flexibility will be difficult and essentially will be an estimation. However, the range of capacity and the fixed and variable costs at different utilisation levels should be known, and the required level of aggregate revenue to generate profit. Absolute capacity limits will be the maximum utilisation possible by the system, and the minimum should be based on fixed costs. Some limits will be determined by quality issues, for example, how big does a painted body store need to be to offset quality issues in the paintshop? All of these issues are currently taken into consideration, but critically the marginal profitability and therefore the price is not decided prior to build. Equally, as stated, the labour flexibility costs of for certain levels of plant production and mix will need to be known. The optimisation equation in part revolves around the mix of time profiles\textsuperscript{16}, aggregate revenue and the known cost of flexibility.

Optimisation Software and Forecasting

Manufacturers use optimisation software to improve sequencing and scheduling. Consultancy i2 have been producing interesting systems for BMW that attempt to link production with ordering and forecasting more closely. In fact in Europe, sequencing and scheduling optimisation software has been used for some time in maximising the efficiency of plant performance. This has been the main area of focus for VMs.

\textsuperscript{15} This area will be discussed in more detail in a forthcoming paper by Geoff Williams on Capacity for 3DayCar.

\textsuperscript{16} The percentage of 3-day lead-time orders, 4 days, 5 days, 6 days etc.
Another area of traditional focus is on supplier coordination, in particular route optimisation and collection. GM has been fairly advanced in Europe in this regard. As with production planning, optimisation software has been moving towards systems that use genetic algorithms\textsuperscript{17} to recalculate likely performance, and also which are able to learn from previous system behaviour.

Optimisation in sales and marketing is the focus of revenue management. Target pricing has been employed by a VM in the US to some effect, which is a form of revenue management. Revenue Management and Capacity planning are the two main pillars of optimising whole system performance. As outlined earlier, the American Airlines project is currently looking at how to vary capacity (by not assigning a particular size of aircraft until close to departure date) and operate yield management pricing as a single process. This combined approach is required in the automotive sector to overcome the optimised islands characterised above.

### 7.3 A Combined Capacity and Selling System for BTO

Capacity allocation should be fixed as close to the build date as possible. For absolute flexibility the capacity should not be fixed until orders can no longer be received, so for a 3-day car system, 3 days before build. However, there are considerations that make fixing capacity earlier preferable. At a certain period before production, labour hours, whether driver hours or production personnel, will have to be fixed. Despite the current four weeks notice mentioned earlier, the aim should be a minimum of seven days notice. Some elements will have to be fixed earlier however; an example would be high value and low volume parts with a long transit time.

Adapting the current planning system for build to order requires consideration of the reasons for the various stages. The redesigned system is shown in Figure 47.

#### Proposed Forecasting And Optimisation Process For Build To Order

From twelve months prior to production the proposed process is focused on forecasting and optimisation, with capacity fixed as late as possible, driven by actual sales.

The long term forecast is set twelve months out, and is a continuous rolling twelve month forecast. This forecast is made using a combination of historic sales data, (including information on channel, market, price, promotions, volume and mix), and long range forecast data sources, such as the used car market and market economic indicators.

This twelve-month forecast will feed into the budget; this may be the annual budget, or a rolling twelve-month budget. The sales channels will be asked to input long range forecasts, which will be considered by the long range planners that set target volumes.

\textsuperscript{17} Genetic Algorithms is a term for systems programmed to recalculate and learn from past performance the best solution to a forecasting and optimisation problem. Logistics is an area where this is being currently applied.
for plants and markets. The absolute limits to the flexibility of the production schedule are set at this point.

The next phase is from twelve to nine to six months out from build date. The revenue management system starts taking orders twelve months out, with planning concentrated on market-by-market forecast revisions. Capacity remains unfixed, although market targets are still decided as now in monthly programming meetings between production and market sales planners; although these meetings will be very different from now, focused on market opportunity rather than allocation of production.

The next phase begins at around three to six months out, with more detailed monthly NSC forecasts of actual demand volume and mix. This feeds into and responds to the automatic daily reforecasting by the revenue management system monitoring attainment against target. The data used for forecasting is now becoming more season and date specific. Reforecasting at this stage produces new market targets, which are set in this period, which set the objectives for the sales channels; an example would be the rolling future sales targets for dealers. Another result of the reforecasting is that the revenue management price base is reset significantly at this point. One by one, suppliers may have to start setting capacity limits and/or inventory targets even this far out. Sales results and forecasting is passed to suppliers, albeit in the obscured form of aggregate demand for their parts.

This balancing of sales with capacity planning intensifies in the next phase, from three months to forty-five days from build date. As the build date approaches, the combination of order schedule filling and capacity constraints make the capacity more fixed. At this stage price optimisation and booking ahead is focused strongly on achieving best volume and price.
However, it is only in the last stage that near-term capacity fixing occurs for manufacturer production. The more flexible suppliers and the logistics companies will fix their capacities at this stage. From here on, with capacity unchangeable, the revenue management system aims to maximise the utilisation of the set capacity.

The whole system requires passing of relevant data and use of the same data and assumptions by all functions, both inside and outside the manufacturer. The sales channels, sales planners and marketers, production planners, suppliers and logistics partners should all be working from the same data and the same plans. In this way an integrated planning and sales system should be able to optimise performance. The optimisation is of the whole enterprise, not just price or capacity utilisation.

However, regardless of internal system optimisation, the price offer must remain one step ahead of the competition. The combined capacity and demand management system for build to order described above will have to make a judgement call on positioning of price and market strategy. As stated earlier, revenue management can be used to either maximise revenue on a smaller base load, (or capacity utilisation), or can be used to maximise capacity utilisation. The main aim must be to optimise revenue on demand for profit maximisation, but with consideration of capacity costs. Response to competitor action will be in part determined by the strategy employed in this regard.

**7.4 Foresight and Competitor anticipation**

Most sales incentives are actually hidden in the UK system so all the competition sees is promotions and list prices, as opposed to transaction prices. If the agents are selling an actual non-negotiable price, that this does make the pricing more transparent to competition, if the competition have the ability to bombard the system with enough queries to actually build up a true picture. Assuming that they can, there are actions that can be taken to avoid unsustainable pricing at a loss, particularly if the revenue management systems is: (a) based on bid price calculation rather than just booking limits, (b) able to vary capacity, and most importantly of all (c) able to game into the future, as the model designed using Deep Blue for American Airlines has been designed to do.

In a market where competing real-time price algorithms set prices, each tracking competitors, frequent and cyclical price wars can develop that deteriorate the revenues generated (Kephart et al, 1998). What is required is some form of game theory, where the action generated is based upon 'deep look-ahead' into outcomes that avoid 'infinite recursion' of preventative counteraction (Kephart, Tesauro, 1998); “the introduction of even the smallest amount of look-ahead in the agents' pricing algorithms can significantly reduce or eliminate the occurrence of price wars” (Kephart, Tesauro, 1998).

In their study, Kephart and Tesauro investigate two approaches to developing algorithms that are capable of deep look-ahead, which avoid the classic problem of infinite recursion of opponent models; “The two approaches are based on adaptations of: (i) the classic minimax fixed-depth search algorithms used in two-player games such as chess; (ii) dynamic programming (DP)-style algorithms, that have recently
been extended to the domain of two-player zero-sum Markov games (Littman, 1994).”

The best analogy is the software and computational hardware developed to play chess. However, whilst the best chess playing devices such as Deep Blue can calculate principle variations 20 to 30 moves ahead, the outcomes are not evaluated in exact detail, but the top level calculations and therefore risk management is highly accurate (Ibid). However, it is interesting to note that Kasparov stated that the playing style of Deep Blue was completely unlike that of a human, lacking the entrapment mentality of a grand master in creating a seeming future weakness only to masquerade a trap. This may be a weakness in the gaming of pricing decisions. Also, at the micro level, again the question of the power of multiple individual salespeople is brought into question when compared to a centrally managed automated system. The point is that a booking system has to be optimised and managed, and only centralised pricing management has the benefit of aggregated demand information of seeing the whole picture.

18 “Our proposed algorithms for agent foresight are designed to avoid the classic problem of infinite recursion of opponent models. That is to say, when modelling other agents, one needs to take into account the fact that those other agents are themselves using models of other agents, and that those models need to take into account that the other agents are using models, etc.. This can lead not only to logical problems in setting up the agent models, but also to greatly increasing levels of computational complexity with the depth of recursion.” (Kephart, Tesauro, 1998).
8. Implementation at the Retail Level: Agency Fees or Variable Wholesale?

As demonstrated earlier, there are different ways of approaching demand management, but a key issue regarding control of the order schedule is managing price. If the retail channel has a trading function then the management of the pricing is in part undermined. There is therefore a pressure to set prices uniformly, without trader intervention. However, with built-in discounts on volume through channels, this does not mean that the same price will be obtained through every sales channel.

Retail Models: Trading Risk and Price Control

One key question here is whether pricing should be based upon RRPs (Recommended Retail Prices, list prices in the automotive sector), or centrally controlled actual prices. In the context of 100% build-to-order, there is no need for the retailer to take ownership of the product, except in the capacity of handling the goods, in the way that a logistics provider handles the goods. Since what the retail channel must sell is orders, then the retailer can be awarded fees for handling the order, rather than margin for selling goods. It would give the dealer a revenue stream, as now, and would allow separation of the new car price from the used car price, thereby introducing a much needed transparency into the buying of a new car. The dealer would be able to run a parallel used car business as a trading operation, alongside the sales agency operation for new car sales. Currently, manufacturers do not know exactly what proportion of sales one sells at what price; this information is essential for understanding real customer demand.

The second key question, related to this, is what is the level of control the dealer or retailer should have. There are benefits as well as drawbacks at allowing dealers to price: a dealer judgement is more immediate and close to the customer, and can do things a quantifiable system cannot do, such as instinctively know what kind of deal would be attractive to the particular customer type. However, the drawbacks of a non-centrally managed price are potentially very destabilising if you are trying to implement demand management in a short lead-time environment. Essentially, it depends on what level of 'preciseness' you want to exert over your pricing in order to manage your demand and order schedule. However, moving to centrally managed pricing would require culture change by the manufacturer, in that the VM takes on all the risk of getting the pricing and order schedule right, and does not 'dispose' of mistakes on other players downstream through special promotions. Since the pressure will be for the order schedule to be filled, rather than stock shifted, promotions and pricing can be integrated to fill production slots. The sales system should anticipate when the threat of distress selling is arising, or whether a sale is worth making. In a real-time controlled pricing model, orders made over the last ten minutes help to determine current prices…
8.1 Retail Model #1: Agency Fees

In the context of selling new cars, a fee for sales agents mean a form of margin, but one that is a proportion of a changeable price.

With removal of stock as a buffer, and the possibility of empty slots in the order schedule, manufacturers take more trading risk. There is no finished stock in the system, (according to the strict 3DC brief 19), and the manufacturer does not build until an order is sold, therefore there is no product to sell to a retailer.

In this scenario, a sales channel, including the dealer, remains the seller of the product, but is no longer a trader. By trader, I mean the buying and selling of goods, that is the traditional role of the retailer, as discussed in the previous section. The Dealer has been moving towards agency over time, with an ancillary structure of payments made on top of simple trading margins. If the Sales channel sells orders then payments can be made for each sold order, rather than product handled.

The secondary effect is that the new and used prices become visibly separated in the eye of the customer. In such a situation, the dealer retains the trade-in, and gives a valuation for the used car when appropriate. And whilst the dealer can lose part of the agency fee to overcompensate a valuation of the used car, (thereby lowering the price), the new price is being given by the manufacturer, not the Dealer. Such a system would mean that the Used-car valuation and the new price would be quoted from separate sources so increasing price clarity to the consumer, giving the customer much needed trust in the selling system.

Structure of Agency Fees

As discussed earlier, the revision of incentives (such as rolling rather than fixed targets) will reduce the distortion in sales; agency fees could be the next step in removing ‘noise’ in the demand.

An agency system would have to address the key aims of dealers whilst rewarding the right areas of revenue for manufacturers, and encouragement for dealers to place 'optimised' orders in a way more beneficial to production requirements.

Components could include:
- Rolling Future Sold Order Fee
  - This is a fee-based version of the rolling targets discussed earlier.
- An additional fee per order based on the contribution to profitability to the VM of that particular sale. This would include a per unit margin for volume.
  - This demonstrates a commitment to sharing rewards of build to order.

19 If there is a buffer of stock in the system, a hybrid system with an element of build to stock, then there is less of a risk in production, and there will, to varying degrees, be stock for sale. Whether any stock is required at the Dealer at all however, and whether the dealer should actually take possession of the product even if sourced from a distribution centre as present, is an equally valid question. In essence, there is no real need for any sales channel to take ownership of the product; the dealer for example cannot be responsible for fulfilment, just of the customer order.
- Encourages profitability and richness of mix
- Avoids ‘hockey stick’ demand distortion created by fixed targets
- Possibly some payment of direct merchandising costs
- Including VM brand signage and demonstrations (demonstrators owned by the VM). However, all dealer expenditure on premises etc covered in the fees.

With such a retail model operating, price sensitivity / elasticity should more closely reflect actual demand. However, the manufacturer new price can still in effect be marginally altered by a higher than deserved trade-in evaluation, offset against loss in fees, although if the trade-in valuation is also recorded by the system, price elasticity understanding should not be too adversely affected.

There have been objections to the introduction of agency fees regarding European legislation relating to car distribution; however, in principle the Block Exemption rules allow that different sorts of relationship are possible, including an agency selling relationship. Mercedes Benz are currently experimenting with the introduction of an agency fees system for their dealers, and absorbing much risk that their retail network previously had to bear. This aside, there is little room for informal price negotiation and one to one selling. By centralising price decisions, there may well be a better match between price and cost, but there may be an increased risk of less of a match between price and real market conditions?

8.2 Retail Model #2: Variable Wholesale

This model assumes that the manufacturer varies the wholesale price to the Dealer, but not to the customer. The Dealer gets a quoted price for each order query entered, and the Dealer can increase or decrease the price to the customer. The customer still has to consider variable price, but the Dealer, not the manufacturer, quotes the price.

The Dealer quotes the customer price; the rolling volume margin and profitability share also quoted to the dealer will in part dictate the Dealer margin and price objective. The obvious drawback to this system is lack of selling transparency. The price quoted to the Dealer will have to be codified in some way, or via some furtive ‘secondary screen' that conceals the wholesale price! Or, the dealer is upfront about the wholesale price, and then costs a margin and overheads, hoping that the customer will be reasonable about the price!! Although this sounds absurd, some US dealers openly advertise the wholesale price on each car, to demonstrate 'fair deal' trading.

In this model, the dealer remains very much the key trader, but the manufacturer has taken on some trading characteristics by varying the price. There will still be the need to change the payments and targets to rolling forms as outlined previously.

The arguable strength of a variable wholesale model is the utilisation of salesperson skill. The Dealer can judge price maximisation one-to-one, and the art of selling, based on personal contact and negotiation is retained (although the final decision on price may be down to the sales manager rather than the salesperson). However, the striking weakness is that real customer price sensitivity will be less known to the Manufacturer. Therefore, effects of price changes would be less predictable; revenue optimisation would suffer since demand would be less forecastable, although the
recording of all transaction data may alleviate this distortion to some extent. Furthermore, capacity management of the supply chain would be less reflective of real demand.

There may be some doubt in the customer mind over the validity of revenue management if the trade-in value and new car price continues to be quoted by same source, which would be the case here.

All retail operations sell. The key tools of salespeople rather than store managers are price control (trading) and 'selling'. Pricing control is essential to trading, as is the pricing expectation of the customer, particularly when negotiation plays a part. Selling encompasses a number of largely intangible factors that include;

(a) Ability of salesperson to persuade the customer to buy
(b) Promotion of one product over another (substitution or selling up)
(c) Judgement of customer needs, requirements, possible compromises
(d) Ability to judge the price a customer is willing to pay for a particular service or product
(e) Knowing the market, in particular loyal and return customers
(f) Price negotiation: understanding the levers of customer price negotiation, knowing the economics of the product, and spotting opportunities within the negotiation to make/accept offers

Compare the independent retailer where significant price reductions can be negotiated off advertised price, say for, example, a HiFi system, - with the superstore (i.e. Dixons in the UK) where negotiation is less available, more likely to be possible on faulty/ex display/end of line product, and even this flexibility is slowly disappearing as store managers lose control over pricing and inventory to automated and centralised systems. However, not all of these qualities would be lost with an agency fee system, or necessarily maintained by variable wholesale. It should be acknowledged that this degree of sales automation might not be appropriate for the automotive sector.

8.3 Retail Model #3: Variable List Price

As a compromise between variable wholesale pricing and agency fee direct pricing, a variable list price may offer a solution. This would effectively be a form of target pricing, and achieve both freedom of dealer to micro manage the sale whilst allowing the customer to see the variation in price resulting from the build to order production slot. This is very much in intermediate system, and may work as an evolutionary step in moving to a real revenue management system. It does however, contain many of the flaws of variable wholesale, and is no substitute for directly managed transaction price. It may be enough to deliver the market responsiveness to manufacturing that is lacking in current systems.
8.4 Which is the best retail model for a Build to Order System?

From a build to order perspective, the less intervention by the sales channel the better, regarding pricing and price elasticity. As discussed earlier, generally the higher the influence on price, the higher the risk associated with profit margin on goods or services traded. Conventional Super-Retailers have a major impact on price, setting highly marginal differences between buying price and selling price, often as high a 50%. Estate Agents, on the other hand, will perhaps make an evaluation, but will sell the product at the price set by the seller, developer or ‘resource provider’.

Travel agents demonstrate characteristics of both approaches; for airline tickets most travel agents will sell at a price dictated by the airline, on which they are paid a commission per sale and take little risk. A limited number are non-airline members of AOLT\(^\text{20}\) who can set prices since they bulk buy from the operators; they also accordingly take on all the risk that would accrue to the airline for not selling those seats. Similarly, some consolidators buy hotel rooms in bulk on the basis that the travel agent can sell at whatever rate but must pay for all bookings regardless of whether they are sold. Usually, with both flight tickets and hotel rooms, a revenue management system employed by the owners of the service provider will be flexible enough to recognise different terms and conditions of different sales channels; agreements can be made between the sales channel and the resource provider.

\(^{20}\) Air Operating Licence Traders: self regulated trade body in the air passenger sector
The Dealer new sales department has been moving along the spectrum from trader to agent over time, whilst used car sales is very much a pure trading activity. Selling of schemes such as PCPs and other finance packages offered by the manufacturer have become quite the opposite, where the dealer is very much an agent selling a product at a manufacturer determined price. New cars occupy a curious zone where the dealer has a limited control over price as discussed earlier. The payment structure allows the retail price to be varied quite dramatically, and to some extent at the manufacturer's behest. The manufacturer can therefore vary the macro-price, by customer, by demand, by promotion, by model etc, and the dealer optimises the sale to prevent margin erosion. The variable price system proposed for Build to Order acts in the same way, but proactively, in real-time and on better information.

The European Block Exemption protocol currently makes no explicit provision for an agency fees based selling system. However, under the General Exemption, a commission based agency system would be perfectly acceptable, so long as the retailer was not expected to take on any financial risk, which is in agreement with the case made here. The risk the dealer takes on is rewarded through trading potential, although these are now so very marginal as to make it only a source of service revenues.

The current balance of risk is questionable in some franchises, particularly where the product is pushed hard with the Dealer having to take ownership of ageing stock, although through discounts the cost of this stock is ultimately managed by the manufacturer. A build to order system where cars cannot be sold without a real

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21 Although this business is changing with more manufacturer interest and involvement in the used sector
22 Agency Fees would be allowable under EU general exemption to vertical restraints, as the agency would still subject to Art 81 of the Treaty of Rome, and would have to prove that the agency system met 81(3), and gave positive benefits to the consumer (By amendment on the application of the Commission Regulation No2790/1999, 22 December 1999).
customer order, removes dealer risk. Subsequently, the ‘gambling’ based incentives structures should also be disposed of as discussed before because of their interference with both revenue optimisation per sale and the distortion in sales patterns. Furthermore, third parties carrying out the PDI may challenge the current liability of the Dealer for the new car condition.

Therefore the question for real-time variable pricing is in deciding which retail model would be best for the profitability of the whole new car enterprise. Whilst two examples have been formulated, there are other options, plus hybrids (such as the current system), which may be the most common practical application. Pure marginal trading is of course a possibility, although this would not afford the manufacturer any control over demand through retail price. From a demand management perspective, bulk purchase and volume discounts through pure marginal trading would be disastrous, particularly when the product does need price management to keep selling, (i.e. mature model, end of product lifecycle, etc). The manufacturer and the market need to be in close contact to maintain build to order.

With this in mind, a variable wholesale model clearly allows the manufacturer less control over behaviour of the market than agency fees, and so is less desirable from a system perspective. However, the adjustments made to price to suit the individual buyer may be the micro adjustments that make the system profitable. The argument ends here on the same question we began with - can the customer negotiation process be formalised to suit manufacturing (and entire system) requirements. The relationship between predictability of demand and price control is demonstrated in Figure 50.

![Figure 50: Predictability of Demand and Price Control](image)

The time and fixed capital resource, which a slot in the order bank represents, is a perishable commodity. Is this perishable commodity price better managed centrally or by dispersed retailers? Currently, a hybrid system, a slow variable price system operates, where manufacturers clear stock, (in build to order it would be slots), through the dealer payment system, whilst the dealer determines the actual price per
unit. The two options are a real-time simplified version of this hybrid, or a form of selling this real-time changing price without dealer influence on price.

8.5 Conclusions: Customer satisfaction and acceptance and understanding of selling systems

Will the customer accept and understand the pricing systems proposed? The current system operates variable pricing, but in a slow and stock reactive way, unconnected to production and other supply chain costs. The key difference under build to order is that decisions on price are being made prior to manufacture rather than after. The two main retail models presented offer two alternatives for delivering a real-time price management system that can deliver pricing decisions prior to manufacture.

Price differentiation and flexibility will remain a key feature of a build to order selling system. Some commentators have suggested that a build to order system will remove the need for price adjustments (or discounting, as it is commonly understood), since there will be no pressure to sell cars that customers do not want. This is clearly not going to be the case; removing the finished stock does not remove the pressure for the potential of finished stock. Pricing will have to be varied to manage demand to ensure a full and profitable order bank. The only change is selling from a point further back in the supply chain. What can be said is that with a variable pricing system prior to manufacture, the discount should be lower for selling a car that a customer has specified, rather than for a car that a customer has not. Under the current system, customers who order what they want and wait are penalised with a lower discount. This has to be translated into a tangible customer benefit. If customers can see that they are able to order exactly what they want rather than compromise, (with the added value of specifying requirements), and that the car could match or even undercut the price of non build-to-order competition, then value of build to order will become clear. Secondly, price flexibility can be channelled into waiting time. If customers are prepared to wait for exactly what they want, they can have the car at a discount.

Customers accept real-time variable pricing in other sectors, including air travel, and most obviously in the financial sector. Whether they understand such as system is another question. Customers can become frustrated by variable pricing and segmentation, particularly when they find that the person sat next to them on a long haul flight may have paid 50% less than they have for the same product. However, the price differentials in the car market could not be this high. Also, the level of price differentiation in the car market in a stocked system is already significant, and customers are becoming increasingly aware of this fact. This proposed system actually rationalises this price differentiation, tying it into the production system, thereby giving a level of justification that is both logical and understandable from a customer perspective.

Will this system deliver what the customer wants?

Customers want to understand the price negotiation 'game'. The proposed system delivers logical and rationalised price flexibility to a process that was somewhat arbitrary before. Customers want an open, clear process for agreeing a deal, and the
agency fee retail model delivers this; the customer can clearly weigh up timing of delivery and other factors to get the best value deal. This also delivers flexibility and some influence over the price paid.

Initial concerns regarding build to order will be addressed by enhanced warranties and advertising, but will eventually be dispelled by the fact that the customer will be able to get what they want at the same price as a product that they didn't exactly specify!

Reform of price negotiation is conceptually possible, but faces the hurdles of any centralised selling method. The precise application of build to order and revenue management will have to be worked out; these retail models are explorations of the theme, and are certainly not prescriptive. However, the benefits of sales channel application based on these ideas for both the efficiency of the whole system and the customer are large enough to make it worthwhile trying.
9. **Final Thoughts**

There are three types of demand volatility; actual customer demand volatility, manufacturer created volatility (i.e. promotions), and unplanned volatility (either due to localised idiosyncratic market conditions such as the UK plate change, or decoupling of demand and supply, caused by current dealer incentives).

There are ways to remove noise in the demand data resulting from sales system distortion. Also required will be measures to reduce variation in demand; this demand variation is critical on both a daily and a seasonal basis, presenting as it does capacity problems for the entire supply chain. The aim of the combined revenue management and capacity management system is whole enterprise optimisation.

Companies use discounts to increase sales when they need to and raise prices when they can. Revenue Management is only a much more sophisticated and systematic approach to discounting and pricing, and is just a refinement, through making pricing and discounting more targeted and more accurate in effect. The advances in information technology over the last decade and the decrease in the costs of their implementation allow the movement to fast build to order systems. The focus of manufacturing can move to profit maximisation rather than capacity utilisation or volume stability.

It may be that the road to such an optimised system will involve many steps. The first may be straightforward differentiation on price by time. However, the implementation of complex systems cost monitoring, along with the integration of capacity setting with demand management, will make possible whole enterprise optimisation.

A sophisticated financial analysis system will be required to determine the marginal opportunity profit for additional sales. The marginal costs of production and supply vary depending on the volume, timing and mix of sales. Equally, marginal opportunity profits are lost by the sales system when it cannot meet real demand. The manufacturer knows what the supply chain cost position is, but the sales channels (NSC or Dealer) know how best to sell, or how much any customer needs to close the sale. The combination of the forecasting and planning with better data sharing between sales channels and the supply chain should bring the profitability per sale into the spotlight.

In practice the marginal cost of making components also falls though this is rarely reported in the financial system because it is not the way that the manufacture buys parts. The changes required to monitor marginal costs and profits may also change the pricing relationships with component Suppliers, since their marginal costs will also need to be taken into consideration if the whole system is to be optimised.

Furthermore, the price to generate this marginal profit must also be balanced against the long-term impact of price action. The upper and lower limits to price within segments should be controlled so as to not damage to long-term ability to raise price.
In essence, a car is such a large and infrequent purchase that target pricing (i.e. variable list price) through revenue management may be the first step to implementing centralised price optimisation. A mechanism by which a salesperson can adjust the price may be required for the closure of the sale, if the customer cannot be persuaded to change the delivery date. In practice, it will depend on the willingness of the customer to accept the conditions of time based variable pricing as to whether they will be persuaded to order ahead rather than seek a price discount on a particular delivery date. The latter is actually addressed by the price being varied in accordance with real demand. The way prices are advertised to customers will therefore have to change, to allow them to get the most out of a more efficient system.
Appendix I: Volume Discounts

Scale discounting already occurs at the macro level, where the larger the fleet order the better the price per unit. Even at the dealer, a fleet or rental customer will get preferential terms. However, true volume discounts for retail would emphasise the wholesale effect and the manufacturer would lose contact with real demand; the disconnection between manufacturing and demand that occurs presently due to the factors discussed in section 2 would be exacerbated. Possibly, if an agency fee system is employed, then the volume discount will be incorporated into the number of orders sold over time, but the distorting effect on demand management would still occur. Managing demand and revenue management would be less effective in achieving the optimisation that is the greatest potential of BTO. A stockless Build to Order system opens the door on new opportunities for demand and supply management, and volume discounts would present extra obstacles for demand and revenue management.
Appendix II Additional Data

Figure 51: Share of Sales Per Quarter

<table>
<thead>
<tr>
<th>Country</th>
<th>1st Quarter</th>
<th>2nd Quarter</th>
<th>3rd Quarter</th>
<th>4th Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK (1999 only)</td>
<td>28.9%</td>
<td>25.3%</td>
<td>28.6%</td>
<td>17.2%</td>
</tr>
<tr>
<td>JAPAN</td>
<td>30.5%</td>
<td>21.7%</td>
<td>24.0%</td>
<td>23.9%</td>
</tr>
<tr>
<td>USA</td>
<td>23.5%</td>
<td>27.6%</td>
<td>25.6%</td>
<td>23.3%</td>
</tr>
<tr>
<td>SPAIN</td>
<td>23.7%</td>
<td>27.0%</td>
<td>23.6%</td>
<td>25.8%</td>
</tr>
<tr>
<td>ITALY</td>
<td>28.8%</td>
<td>28.2%</td>
<td>22.0%</td>
<td>21.0%</td>
</tr>
<tr>
<td>GERMANY</td>
<td>25.5%</td>
<td>27.2%</td>
<td>23.9%</td>
<td>23.4%</td>
</tr>
<tr>
<td>FRANCE</td>
<td>23.9%</td>
<td>21.1%</td>
<td>28.4%</td>
<td>26.6%</td>
</tr>
</tbody>
</table>

Figure 52: Example 1 of daily Registration Variation on one model – note ‘hockey-stick’ effect created by end of month targets, etc.
Fig 53: Cost of utilisation (Extrapolation Based on IMVP data)

Utilisation (Index: 100% = cost at 100% Utilisation)

Fig 54: Marginal cost of utilisation (Extrapolation Based on IMVP data)
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Full Colour Plate: Figure 53 – Proposed Combined Revenue and Capacity Management System
Managing Demand/Selling Time

- Supplier and Logistics Near-term Capacity Setting
- Schedule Planning
- Revenue Management
- Production Schedule (Flexible Capacity Limits)
- Revenue Management System
- Budget Market Forecasts
- Market Target
- Capacity and Sales Balancing
- Final Optimization
- Interactive Data: Direct Order Booking Schedule
- Production Scheduling & Planning
- Automatic Daily or continuous re-forecasting Volume and Mix
- Monthly NSC Forecasts of Actual Demand Volume and Mix
- Long-term market demand forecasts:
  - Market Targets and Forecast agreed in programming meetings
  - Annual Budgets set target volumes for plant and markets
- Historic Sales Data: Channel, Price, Promotions, Volume and Mix
- Long-term forecast data (i.e. economic indicators, used car market, etc.) -> Date specific data
- Sales Channel Selling (Dealers etc.)