



PRACTICE PAPERS

Revenue management for a home construction products manufacturer

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Received (in revised form): 7th November, 2006

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ABSTRACT

KEYWORDS: revenue management, yield management, demand management, capacity management, capacity allocation

The study showcases application of revenue management in home construction industry where major players in the highly competitive environment and consumers can immensely benefit from this powerful management science approach. A major US home construction supplier was chosen to explore, analyse and evaluate the application of revenue management. Pertinent operational data were gathered for this manufacturer to pursue marginal revenue and capacity allocation analysis. Findings indicated that revenue management can be effectively utilised to manage uncertain demand through the allocation and pricing of available capacity and optimise revenues and costs for the manufacturer of home construction products and its supply chain.

Journal of Revenue and Pricing Management (2007) 5, 256–270. doi:10.1057/palgrave.rpm.5160051

INTRODUCTION

Companies that want to succeed, not just survive, must implement strategic tools that will allow them to continuously adapt to

dynamic and real-time supply and demand situations. Pioneered by the airline and hotel industry, revenue management has been and can be a very effective tool in many industries. The future of revenue management was described in the Wall Street Journal as follows: 'Re-engineering has run its course. You manage your quality totally. Where do you turn for future gains? Perhaps to the marketplace, with revenue management. Now with computing costs plunging, revenue management is poised to explode' (Lahoti, 2002).

Businesses worldwide are under tremendous pressure to maximise revenues and minimise costs. Successful implementation of revenue management leads to strategic and competitive advantages in the marketplace by allowing companies to maximise revenues, minimise costs and remain price competitive. The ability to employ revenue management to exploit naturally occurring market segments can significantly impact a company's bottom line (Gupta and Wang, 2004). In an increasingly dynamic pricing and demand environment, gut feeling and intuition are not enough. Companies that effectively employ revenue management will have proven principles of management science and information technology, including historical data analysis, accurate data modelling, and statistical and mathematical optimisation (Lahoti, 2002).

The following analysis was conducted to explore revenue management and its application outside the service industry and in the manufacturing environment; specifically, the window and

door industry. An example company, Andersen Corporation (www.andersenwindows.com), a leading manufacturer and supplier of windows and doors, was analysed and a brief literature review was carried out on revenue management and its applications. The analysis presented provides answers to the following questions:

- (1) Can revenue management be effectively applied to manufacturing companies such as suppliers of the home construction industry?
- (2) How can revenue management be employed to effectively manage demand for a manufacturer in this industry?
- (3) How can revenue management be employed to effectively optimise allocation and pricing of capacity for a manufacturer in this industry?

In the following, a brief overview of the window and door industry will be given and its relevance to revenue management will be discussed. An overview of Andersen Corporation will follow to assist in applying revenue management to specific conditions that exist at Andersen. A brief literature review is also shown to discuss the relevant details of revenue management as well as show examples of its applications. Revenue management applications will be utilised to answer the above questions through an analysis of its application to Andersen Corporation. Through the analysis, conclusions and future recommendations will be cited for research on revenue management and its application to manufacturers; specifically, home construction suppliers.

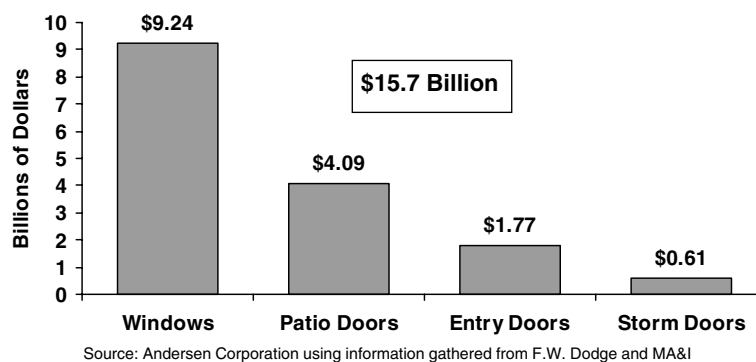
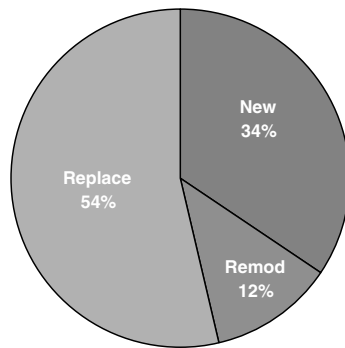


Figure 1: 2004 US residential market segment opportunity (Manufacturer's Pricing)



US Windows		
	Units (Millions)	% of Residential Total
New	24.1	34.4%
Remodel	8.4	12.0%
Replace	37.5	53.6%
Total	70.0	100.0%

Source: Andersen Corporation using information gathered from F.W. Dodge and MA&I

Figure 2: 2004 US residential windows by use

INDUSTRY OVERVIEW

The window and door manufacturing industry is heavily dependent on the new home construction and remodelling industry. The window and door industry is largely driven by interest rates, the economy, land development and real estate prices. Fuelled by mortgage interest rates at their lowest levels in more than four decades, the new home construction industry in the US could not put up houses fast enough to keep up with all the demand (Hagerty, 2005). This led to a significant opportunity for the window and door manufacturers to grow their businesses. In 2004, the window and exterior door market opportunity in the US was \$15.7bn as measured by manufacturer sales (see Figure 1). However, recent trends suggest that housing and new home construction is slowing. This increases the significance for Andersen to increase revenues and profits through such strategies as revenue management to remain price competitive as a leader in the window and door industry.

Window sales are typically broken down into three major use categories (see Figure 2). Replacement windows account for more than half the window market. These windows are purchased either by 'do-it-yourself' customers or by 'do-it-for-me' customers who utilise a contractor or window replacement company (such as Renewal by Andersen) to install the window. The second use category is new home

construction ('New') that accounts for one-third of the window market opportunity. The new home construction industry has seen major changes over the last five years as 'pro' or 'volume' builders such as Pulte Homes and Toll Brothers Inc. have dominated the home building industry. The last use category is remodelling, where new window openings are created to the desire of the homeowner.

ANDERSEN CORPORATION OVERVIEW

Andersen Corporation is a privately owned business founded in 1903 in Hudson, Wisconsin. Today, Andersen is an international enterprise employing over 9,000 people at more than 20 locations with headquarters in Bayport, Minnesota. Andersen annually manufactures more than six million wood windows and doors, with sales worldwide. Tradition and dedicated employees have made the Andersen brand the most recognised in the industry. Brand recognition has also helped Andersen become the top window and door manufacturer in the US (as measured by dollar sales) with 2004 window and door sales greater than \$2bn, approximately double that of its next largest competitor. With increasing competition from its competitors, Andersen is continually looking for strategic advantages to hold and grow its market share.

The window market is generally segmented into four price segments: Price, Mid Band,

Market Segment	Window Price	Home Value
Super-Premium	Over \$1,000	Over \$1 - Million
Premium	\$500	\$300,000 - \$1 Million
Mid Band	\$250	\$200,000 - \$500,000
Price	\$100	up to \$200,000

Source: Authors' estimates from industry knowledge (pricing is based on manufacturers suggested retail price)

Figure 3: Window market product segmentation

Total US 59,318,051 units		Custom Builder	Small Non- Custom	Volume Builder	Pro Remodeler	DIY/ BIY	Replacement Specialist
		138,429			467,160	295,004	33,274
		390,786		372,136			186,682
		2,201,793	777,710	2,095,253	2,616,640	1,655,839	3,372,771
	S Prem 1,696,788 3%				7,041,339	5,314,939	
			1,188,895	2,682,418			
	Premium 9,532,916 16%	2,547,266					3,992,799
				4,007,485	7,907,911	6,250,142	
	Mid Band 22,147,627 37%	2,425,182	1,357,199				
	Price 25,318,051 44%						
		7,565,026 13%	462,233 6%	9,157,292 15%	18,033,049 30%	13,515,924 23%	7,584,527 13%

Source: FW Dodge 2000 and NAHB

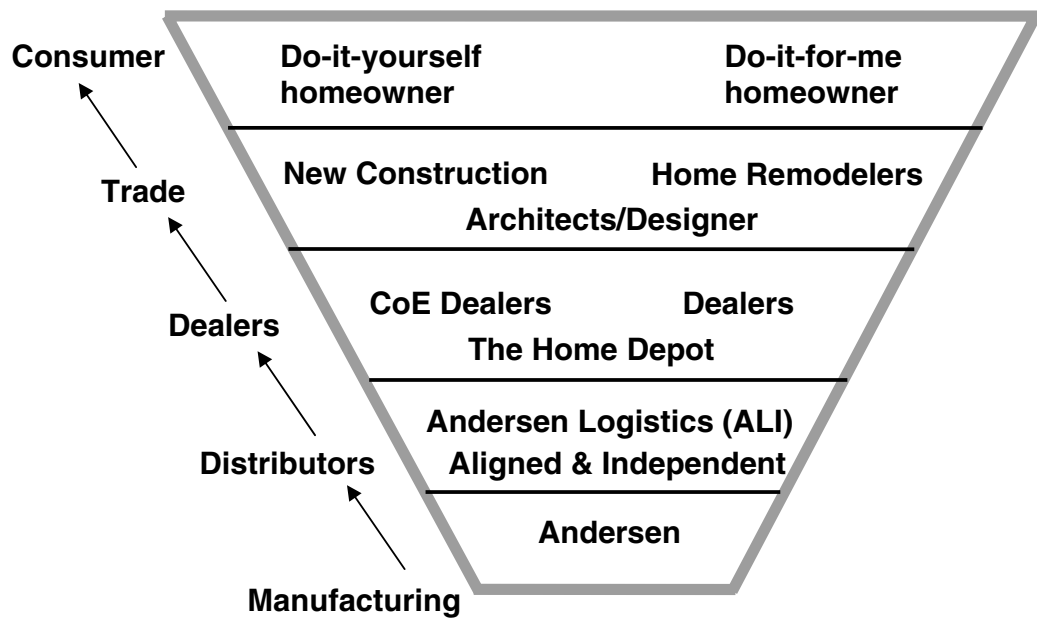
Figure 4: 2000 residential windows: customer groups by price bands

Premium and Super-Premium. These segments are defined by the price of window and the associated home values (see Figure 3).

Like Andersen, most major national brands have different product lines to meet most of these segments. Andersen Corporation has excelled in the premium window market segment where it owns a market share greater than 40 per cent (on a unit basis). Andersen's success in the premium segment is the reason they are the market leader in terms of sales dollars. However, the

premium segment only consists of 16 per cent of the total window units. In 2000, over 80 per cent of the units were in the price or mid band segment (see Figure 4). Thus, there is a great opportunity for Andersen to gain additional market share through strategic revenue management tactics such as creating different versions of a product to target different market segments.

To maximise revenue and minimise costs, one needs to identify and analyse the flow of product to the customer through the supply



Source: Andersen Corporation

Figure 5: Product flow to the customer

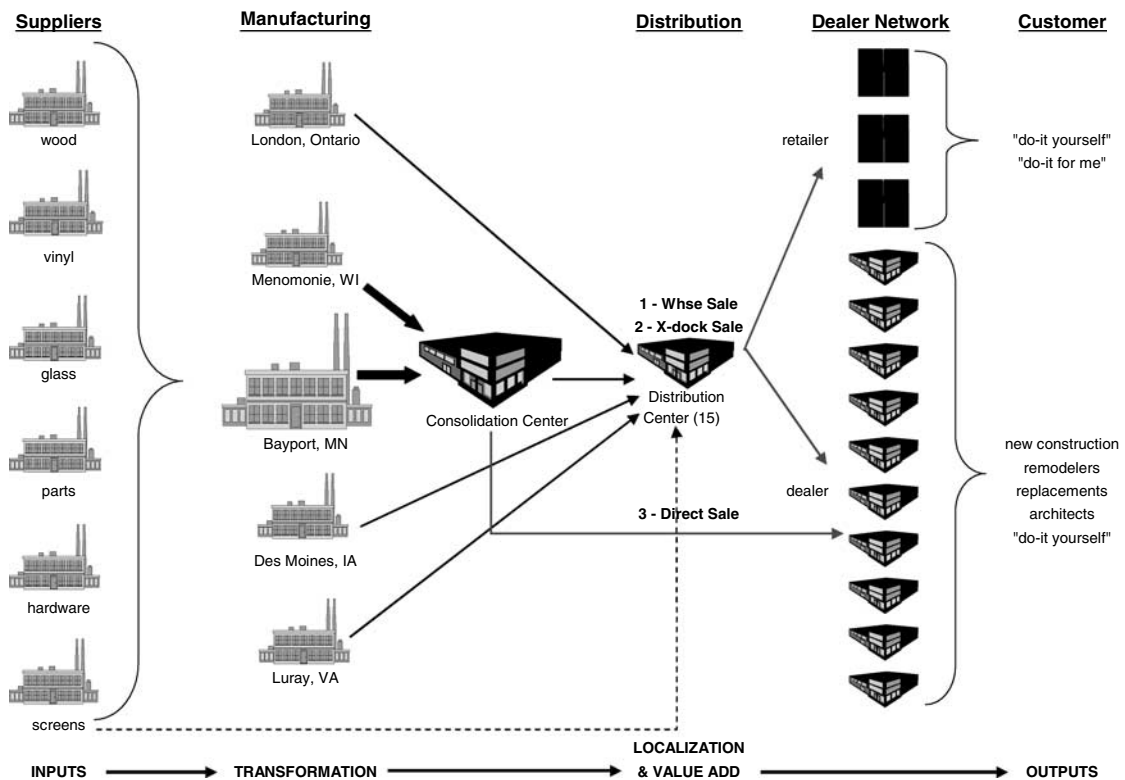


Figure 6: Andersen corporation's supply chain

chain. In the case of Andersen, sales revenue is recognised from product sales to independent aligned distributors and from its company owned distribution channels' (Andersen Logistics Inc.) sales to preferred dealers ('Circle of Excellence' or 'COE'), dealers and The Home Depot (Andersen's exclusive retailer). The dealers and retailers then sell the product either to trade entities who install the product for the consumers ('do-it-for-me' homeowner) or to consumers ('do-it-yourself' homeowners) who purchase the product and install. Note that the 'traditional' Andersen product is sold through a dealer network and The Home Depot who sell direct to homeowners, remodelers, contractors and builders (see Figure 5).

Like most companies, Andersen is constantly looking to increase shareholder value through supply chain management (see Figure 6). Currently, Andersen has aligned itself with its major raw material and component suppliers like wood, vinyl, glass, hardware and screens. These partnerships are driven to increase the quality of the part being purchased, increase flexibility of arrival and lead times, and lower the purchase price. The challenge for Andersen is getting its aligned partners to strive for excellence in quality and design and not rely on the success of Andersen to drive their respective companies.

Raw material and components received from these suppliers are transformed into window or door units at one of Andersen's plants, which is designed for specific product lines. 'Traditional' Andersen products that are manufactured in Bayport, Minnesota, and products manufactured in Menomonie, Wisconsin, are sent to a consolidation centre in Menomonie, Wisconsin. At the consolidation centre, these products are either shipped to a distribution centre in the market area or shipped directly to the dealer if the dealer is able to fill a full truck. Andersen's 'traditional' product sales occur and are priced based on three distinct distribution channels available to its customers: (1) product taken out of the distribution centre's warehouse inventory

('Warehouse Sale'), (2) product manufactured at a plant upon order placement and shipped through a distribution centre ('Cross-dock or X-dock Sale'), or (3) product manufactured at a plant upon order placement and shipped directly to the dealer ('Direct Sale'). Other plants send product directly to the distribution centres for inventory stock replenishment for warehouse sales and/or fulfillment of a cross-dock sales order.

Value-added mulling and assembly take place at each distribution centre. The 'traditional' Andersen products are mulled to other units and extension jambs are applied for ease in product installation at the job site. Some distribution centres offer entry door systems that are assembled to customer specification at the distribution centre. Once mulling and assembly is completed, the distribution centre ships the product order to the dealer or retailer including in the invoice price any value-added services.

LITERATURE SURVEY

There are many ways to manage demand and supply to grow supply chain profits. Supply can be changed by altering capacity and inventory levels known as yield management. Marketing and advertising is used to spur demand for products and services. Pricing can also be an effective tool to influence the demand, especially if the customer is price sensitive. These are all forms of revenue management. The textbook definition of revenue management is the use of pricing to increase the profit generated from a limited supply of supply chain assets. (Chopra and Meindl, 2004) In application, it is a business process designed to maximise revenue at all levels of demand and allow a company to strategically manage that demand throughout the year (Buckhiester, 2005).

The key to revenue management is selling the right product to the right customers at the right time for the right price, this is also commonly referred to as yield management (Chase *et al.*, 2006, p. 576). To effectively execute revenue management one must

understand the 'seven core concepts of revenue management' (Payne, 1997).

1. Focus on price rather than costs when balancing supply and demand
2. Replace cost-based pricing with market-based pricing
3. Sell to segment micro-markets, not to mass markets
4. Save your products for your most valuable customers
5. Make decisions based on knowledge, not supposition
6. Exploit each product's value cycle
7. Continually re-evaluate your revenue opportunities.

Revenue management adjusts the pricing and available supply of assets to maximise profits. Supply chain coordination is essential for companies that seek to implement dynamic pricing and revenue management (Bichler *et al.*, 2002, Maglaras and Meissner, 2006). Revenue management has had a significant impact on supply chain profitability when one or more of the following four conditions exist: (Chopra and Meindl, 2004)

1. The value of the product varies in different market segments
2. The product is highly perishable or product wastage occurs
3. Demand has seasonal and other peaks
4. The product is sold both in bulk and the spot market.

Airline seats are good example of a product whose value varies by market segment. A business traveller is willing to pay higher fares to match his or her schedule. Meanwhile, a leisure traveller will often look for the lowest fare. Through allocation of discounted seats, overbooking flights and management through hub cities, airlines look to maximise revenues on each flight. American Airlines used revenue management to save the company \$1.4bn from 1989 to 1992, about 50 per cent more than its net profit of \$892mn

for the same period (Davis, 1994). Today, airlines, transportation companies and hotels view revenue management systems and related information technologies as critical determinants of future success (McGill and Van Ryzin, 1999).

Fashion and seasonal apparel are examples of highly perishable products. In the seasonal apparel industry, prices are adjusted over time to maximise the profit obtained from the available inventory and capacity. Excess inventory at the end of a season is reduced in price to attempt to maximise profits and minimise the loss of items that are not selling. Major retailers use discount stores in an attempt to sell items at the end of the season or even out of season. Retailers also limit supply of seasonal apparel in an attempt to sell items at a higher price for a longer time.

At Christmas time, some Internet retailers apply revenue management by offering free shipping or discounted prices early in the Christmas shopping season to encourage customers to purchase earlier during the out of peak time when the processing capacity costs are cheaper. Processing capacity at the end of the shopping season during peak time is more costly and creates challenges in getting the product out to the customers in time for the holiday season.

Companies that sell products in bulk often under contracts employ revenue management. Increased competition and consumer's appetite for quick delivery have created opportunities for companies to extract more revenue from a fixed capacity (Gupta and Wang, 2004). These companies sell bulk products under contracts at reduced rates and with pre-determined lead times to contractual customers and one-off orders to transactional customers. The supplier fulfills one-off orders at higher prices and different lead time combinations, as it is able to pick and choose what orders it takes given its capacity.

Are these revenue management practices applicable in the world of physical goods and, if so, why have manufacturers been so slow to

adopt them? (Boyd, 2001) There are numerous examples of revenue management applications in the service sector, especially in the airline, hotel and retail industries. In the manufacturing industry, supply chain management has consistently proven its value by saving numerous manufacturing companies hundreds of millions of dollars. Supply chain management, however, focuses on only one side of the equation, the supply side. Equally important yet frequently neglected is the demand side, an area where the service industries have focused intensively with revenue management techniques.

In theory, the revenue management concept of differential pricing should be applicable to manufacturing companies. However, there are two fundamental issues. How can the company differentiate between the two segments and structure its pricing to make one segment pay more than the other? How can the company control demand such that the lower paying segment does not utilise the entire availability of the asset? These are a few of the challenges in employing revenue management at manufacturing companies.

To take advantage of revenue management, in most situations the supplier must limit the amount of capacity committed to lower price buyers even if sufficient demand exists from the lower price segment to use the entire available capacity. Limiting capacity creates the risk of

spoilage and spill. Spoilage occurs when the capacity reserved for higher price buyers is wasted because demand from the higher price segment does not materialise. Spill occurs if higher price buyers have to be turned away because the capacity has already been committed to lower price buyers (Chopra and Meindl, 2004).

With the employment of revenue management tactics, such as differential pricing and yield management, there are new challenges within organisations. Generating revenue from multiple sources with differential pricing will increase the need to manage that revenue properly. Untangling and streamlining a company's revenue activities is a mandatory daily task as it must have clear, automated revenue management and reporting procedures that comply with current revenue recognition regulations. When a company is unable to clearly delineate the revenue streams that sustain its business, it is most likely losing revenue, increasing operating costs and decreasing vital cash flow (O'Connor, 2002). The most crucial element is the high risk for error and negative exposure.

ANALYTICAL FRAMEWORK

Revenue management successes have been well documented in the airline, hotel and other service industries. In this section, revenue management tactics and theories will be applied

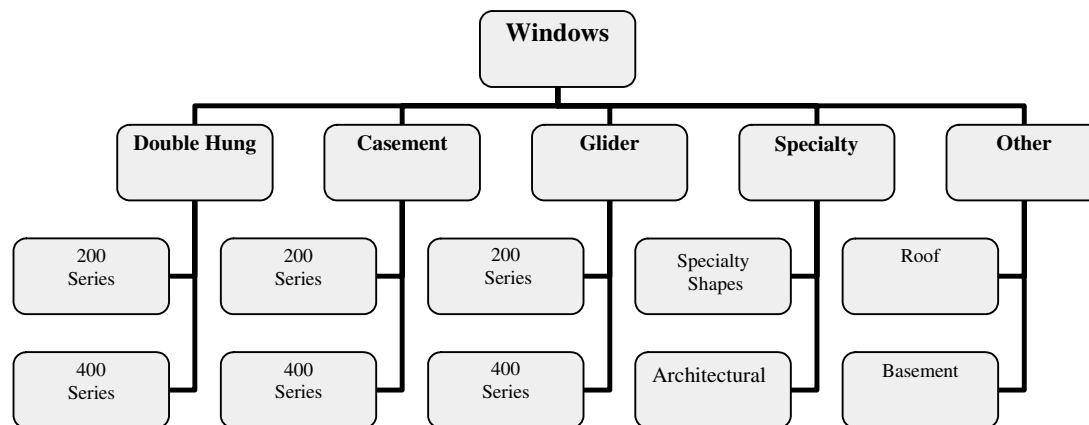


Figure 7: Andersen corporation's Window product lines

to manufacturing to assess the benefits and relevance of its application. Using Andersen Corporation as an example of a manufacturing company, revenue management for multiple customer segments will be analysed by looking at (1) revenue generated by strategic price increases, (2) revenue generated by Andersen's differential pricing to create different versions of product targeted at different price segments, and (3) the basic tradeoff to be considered by Andersen with the capacity it has committed in its distribution warehouses and manufacturing production.

To simplify the analysis of these three revenue management tactics, an example product line will be used to conduct these exercises. Andersen's double-hung window line, which is Andersen's top selling window style, was chosen for further analysis. See Figure 7 for window product-line hierarchy.

Owing to the seasonality of the home building industry caused mostly by winter weather, window and door manufacturers typically, see seasonality in their business. Typically, the industry sees an increase in demand in the late spring as home construction picks up after the Winter and in the Fall, as there is a push to enclose houses being built before winter. Andersen is no different and typically sees even greater seasonality, as

its largest sales region is in the Northeast of US, which is impacted by the cold and snow of winter. Owing to seasonality and system limitations, Andersen typically raises its prices to the customer one time a year during the slower months of January, February and March.

To analyse the impact of demand by the strategic price increases, data were collected from January to April for 2001 through 2005 for demand and price for the three distribution channel prices (Direct, Cross-dock and Warehouse). Andersen's 400 Series Tilt-Wash 3046 double-hung window was used to conduct the analysis (see Figure 9 for an example picture of a 400 Series Tilt-Wash window).

At the turn of the century, Andersen along with other window and door manufacturers were riding the new home construction boom and were successful in achieving record sales and profits. From 2001 to 2003, Andersen was able to keep prices constant with no major price increases due to cost control efforts. However, rising costs of wood and fuel over the last few years were too dramatic for companies not to pass some of the cost on to the customers. In 2004 and 2005, Andersen raised prices to its customers due to rising costs. The price increase was strategically taken in the beginning of period 3 to effectively increase

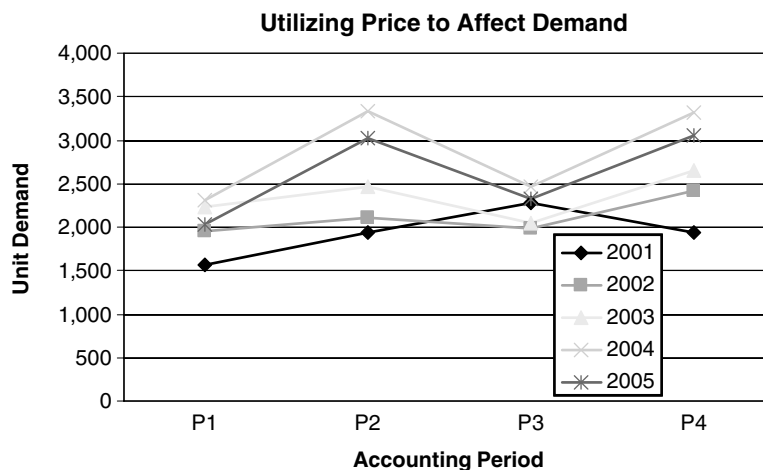


Figure 8: Andersen corporation utilising price to affect demand

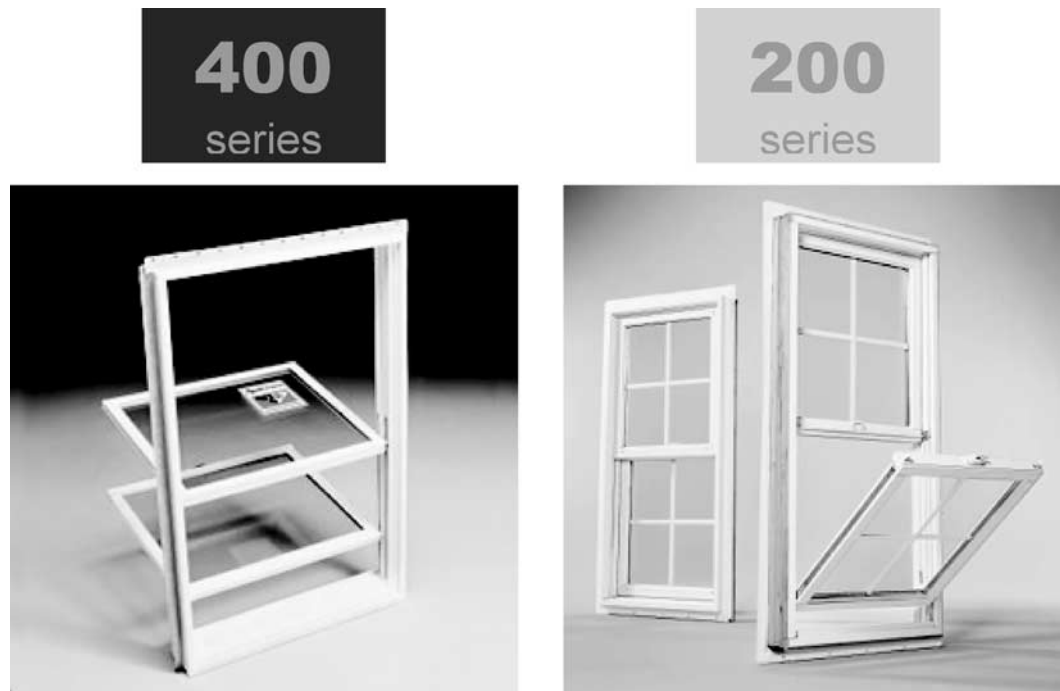
demand during the slowest production time of the year. Pulling the demand forward allowed distribution to conduct physical inventory counts one month later during the lull of the demand peak.

As can be seen in Figure 8, Andersen was successful in stimulating demand in period 2 by implementing a price increase. Essentially, sales that would have come in period 3 and even period 4 were pulled into period 2 as customers took advantage of the lower prices. Shifting demand allowed distribution to clean warehouses, salvage slow moving inventory and conduct physical inventory without incurring much overtime or impacting lead times to customers. However, the price increase had a negative effect on production as it increased variability in the production schedule, which most likely led to overtime.

As discussed previously, the window manufacturing industry has multiple customer segments defined by window price and asso-

ciated home value. The two segments that will be compared for the purposes of this analysis will be the premium and mid-band market segments. Segments in general are differentiated by the window design, options and price, all of which create some value to the targeted customer. In 2001, Andersen introduced the 200 Series and 400 Series line of windows and doors. The 200 Series product line features Andersen's best selling and most popular options at affordable prices. The 400 Series product line offers custom builders the best performing products in extensive sizes and styles (www.andersenwindows.com). The most significant difference between the two, aside from price, is the functionality, high-performance glass and hardware options on the 400 Series double-hung window (see Figure 9 for an example pictures).

For analysis purposes, the 400 Series Tilt-Wash (TW3046) double-hung window and 200 Series (244 DH3050) were selected due to



Source: Andersen Corporation

Figure 9: Example of Andersen's 400 and 200 SERIES double-hung windows

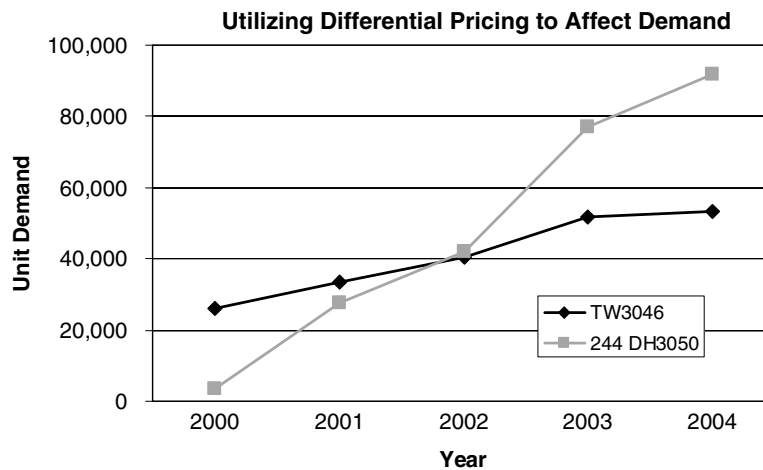


Figure 10: Unit demand for multiple segments

the similar size and style. Data were gathered over a five-year period to analyse the success of generated revenue, and affecting demand through differential pricing to create different versions of product targeted at different price segments has been a great success.

As can be seen in Figure 10, the introduction affected demand and generated significant revenue through differential pricing of double-hung windows by targeting different price segments. Sales from the 200 Series accelerated Andersen’s growth without cannibalising sales from the 400 Series, the higher priced segment. Accelerated growth led to the faster utilisation of production capacity at a new state-of-art facility, which in turns allows Andersen to remain price competitive by spreading more facility costs across greater units.

The final analysis in this section is on the basic tradeoff to be considered by Andersen with the capacity it has committed to production and to inventory at its distribution warehouses. Andersen maintains inventory at its distribution warehouses to expedite orders to customers that cannot wait for the normal production lead time. Products sold out of these warehouses are priced higher than products sold through the direct and cross-dock channels. The differential pricing for

Year	Distribution		
	Channel	Price	Demand
2001	Whse	270	7,005
	X-dock	257	2,765
	Direct	239	23,635
2002	Whse	270	5,347
	X-dock	257	5,019
	Direct	239	29,926
2003	Whse	270	5,383
	X-dock	257	6,252
	Direct	239	40,059
2004	Whse	275	5,484
	X-dock	266	9,145
	Direct	243	38,546

***Price based on manufacturer’s sale price

Figure 11: Demand curve data for TW3046

product sold through the three channels is a direct result of the costs associated between the three channels.

The window and door industry is a market with multiple customer segments. Certain Andersen dealers are willing to pay higher prices for product out of warehouse inventory to decrease lead times to the customer, while other dealers prefer lower prices by bundling orders to receive the product directly at a longer lead time. See, for example, the demand curve for Andersen’s 400 Series TW3046 double-hung windows in Figures 11 and 12. The analysis is not as simple as one could derive from the demand curve below, as other factors

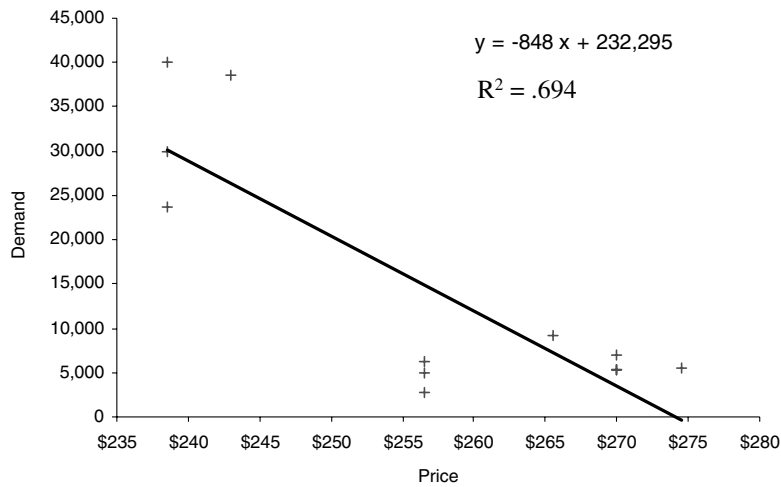


Figure 12: Demand curve for TW3046

play a role in whether a product is sold through the warehouse, cross-dock or direct distribution channels. These factors include production and inventory capacity as well as the cost of moving the product through each of these distribution channels.

The basic tradeoff to be considered by Andersen with production and warehouse inventory capacity is between influencing the customer through lower pricing to order through the direct or cross-dock channel or influence the customer to buy at higher prices from the warehouse by offering product availability and shorter lead times. The two risks in such situation are spoilage and spill (Chopra and Meindl, 2004). Spoilage occurs when the inventory capacity reserved for the higher priced sales (Warehouse Sales) are wasted because demand for these products in the inventory does not materialise. The lack of demand leads to the inventory being written off or sold for a loss. Spill occurs if higher price buyers are turned away because the product is not available in the warehouse inventory and production lead times will not satisfy the customer. The potential in this situation is that Andersen could turn customers to other competitors who could potentially meet their needs and gain their sales. Andersen should decide on the inventory capacity so as to

minimise the expected cost of spoilage and spill.

To analyse this situation, the aforementioned tradeoff is developed in terms of a formula that can be used when Andersen is working with its three customer segments (Netessine and Shumsky, 2002). Let p_D be the price charged to the lower price segment (Direct), p_X be the price charged to the middle-price segment (Cross-dock) and p_W be the price charged to the highest price segment (Warehouse). Analysis of the historical warehouse demand for each sales period for the double-hung window model TW3046 showed that warehouse demand for each sales period followed normal distribution with a mean of μ_W and a standard deviation of σ_W . The goal is to determine the minimum inventory quantity C_W (for the warehouse) that will return an expected marginal revenue from the higher price segment equal to that of the current marginal revenue from the lower priced segments. The decision is illustrated in Figure 13.

Given the above illustration, reserving $(C_W + 1)$ th unit has an expected revenue equal to

$$(1 - F(C_W))p_W + F(C_W)(-Mxi)$$

We should lower the reservation inventory level to C_W as long as the expected marginal

p_D = Price of lowest price segment (Direct)
 p_X = Price of middle price segment (X-dock)
 p_W = Price of highest price segment (Whse)
 M = Cost of product
 i = Inventory Carrying Cost %

F_D = Probability of Direct Sale
 $I - F_D$ = Probability of X-dock Sale
 $I - F(C_W)$ = Probability of Whse Sale
 $F(C_W)$ = Probability of not selling

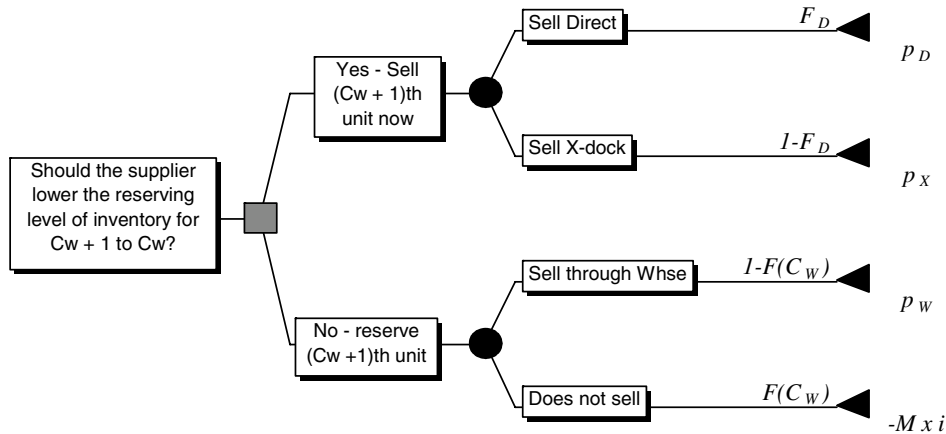


Figure 13: Decision tree illustration of Andersen's Tradeoff

$p_D = \$243$	$F_D = 65\%$
$p_X = \$266$	$I - F_D = 35\%$
$p_W = \$275$	$I - F(C_W) = 67\%$
$M = \$150$	$F(C_W) = 33\%$
$i = 25\%$	$\mu_W = 420$ units/period
	$\sigma_W = 120$ units/period

Figure 14: Data and assumptions

revenue from $C_W + 1$ is less than or equal to the expected revenue from producing one extra unit for direct or cross-dock sales. This is illustrated below.

$$(1 - F(C_W))p_W + F(C_W)(-Mxi) \leq p_D(F_D) + p_X(1 - F_D)$$

This leads to:

$$\frac{p_W - p_X + F_D(p_D - p_X)}{p_W + (Mxi)} \leq F(C_W)$$

Solved in Excel as:

$$C_W = \text{NORMINV}$$

$$\left(\frac{(p_W - p_D + F_D(p_D - p_X))}{(p_W + (Mxi))}, \mu_W, \sigma_W \right)$$

Historical demand data for TW3046 were collected from 2001 to 2005 based on a four weeks accounting period and summarised in Figure 14. Pricing is based on average 2005 pricing through the three distribution channels. Assumption probabilities for demand

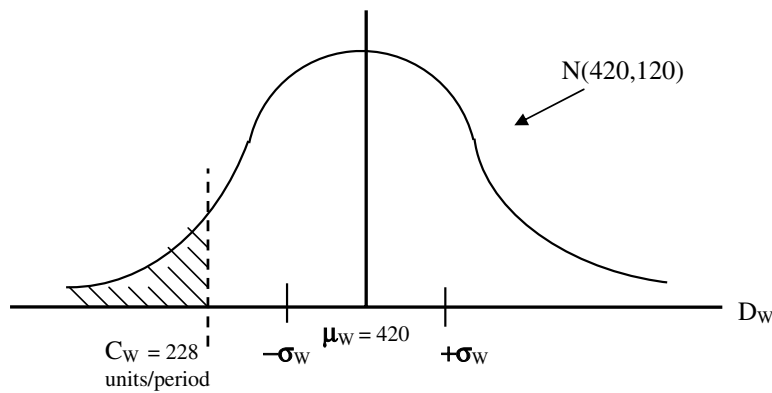


Figure 15: Required minimum inventory level, C_w , in the warehouse

are based on 2005 run rates and estimates are not indicative of Andersen's total demand. Given the above data and assumptions, the aforementioned formula can be solved in Excel as

$$C_w = \text{NORMINV} \left(\frac{(275 - 243 + 0.65(243 - 266))}{(275 + (150 \times 0.25))}, 420, 120 \right)$$

$$C_w = 228 \text{ units/period or } 2,960 \text{ units/year}$$

Given the data and assumptions, the minimum inventory level should be at least 228 units on hand per period (see Figure 15). Realising the inventory level for TW3046 allows Andersen to keep carrying costs down by turning this product's inventory more times in a year. The minimum inventory level will assist Andersen in determining inventory capacity to maintain a high level of service.

STUDY FINDINGS

The analysis has shown that revenue management can be as basic as utilising price increases or discounts to affect demand or improve supply chain efficiencies. Revenue management technique such as this was demonstrated here for Andersen Corporation pulling the demand forward by simultaneously implementing price increases in all channels. Pulling the

demand forward allowed production and distribution to utilise labour more effectively in the slowest period of the year.

Revenue management for multiple customer segments was demonstrated through Andersen's use of differential pricing to create different versions of product, targeted at different price segments. Creating the 200 and 400 Series window lines has allowed Andersen to target multiple price segments and grow sales at a faster rate. New window lines allow Andersen to sell the right product to the right people at the right time and place.

The trade-off analysis of the capacity Andersen has committed in its distribution warehouses and manufacturing production also demonstrated the abilities of employing revenue management. Revenue management allows Andersen to determine a minimum capacity level for a single product line in a given period. Thus, Andersen is able to reduce carrying costs and run a just-in-time approach in the warehouse and throughout the supply chain.

CONCLUSIONS AND RECOMMENDATIONS

The benefits of revenue management can be realised at manufacturing companies. It takes time and money to implement sophisticated revenue management systems but many tactics of revenue management can be implemented to realise quick results. Through benchmarking,

companies need to be proactive and learn how to implement and sustain revenue management systems for future revenue growth and profitability.

Companies like Andersen Corporation should employ revenue management across all product lines to rationalise production and inventory capacity. Using revenue management creates the potential to decrease inventory levels and smooth production variability. Revenue management allows companies to operate a more just-in-time approach allowing companies to free up space in plants and distribution centres. Ultimately, the supply chain should see reduced lead times by utilising this approach.

The analysis conducted for the study has only touched the surface of the potential impact that revenue management can have on manufacturing companies. Further research and analysis should be conducted on other methods revenue management can be utilised to affect demand and supply in a manufacturing company's supply chain. Similar to the airline industry, the ability to sustain long-term growth and profitability of products manufacturers will be dependent on revenue management.

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