

FUEL COSTS AND SUPPLY CHAIN DECISIONS

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ABSTRACT

The affect of rising fuel costs on the individual consumer is well documented in current media. Consumers are paying more for their basic necessities. Fuel surcharge, transportation cost, and logistics have become house hold words. The rising cost of crude oil creates an increase in fuel cost, and this creates an increase in the cost to transport products from one location to another. Managers, who are responsible for acquiring products and delivering them to customers, are also feeling the impact of higher fuel prices. This article will outline three significant areas where fuel prices are affecting U.S. supply chain decisions. Sourcing decisions, transportation modes, and product design and packaging practices are all currently being influenced by the cost of logistics.

INTRODUCTION

Individual consumers are well aware of the effects of rising fuel prices on their personal shopping experiences. Numerous news reports, magazine articles, and personal stories recount the sticker shock of seeing consumer goods escalate in price. Consumers, who were once oblivious to fuel surcharges, logistics, and transportation strategies, have discovered how this aspect of supply chain management affects their ability to purchase goods. Families are even struggling to purchase fuel to keep their personal automobiles operational. Gas prices, and even gas availability, has become a significant issue for many citizens.

In the mid to late 1990's, the cost for a barrel of crude oil hovered around the \$20 mark. However, in 2007 crude climbed to \$150/barrel, and currently is priced in the \$70-80 range. These crude oil prices translate to higher refined fuel prices. Not only do personal transportation vehicles rely on fuel, but also cargo jets, container ships, rail cars, and tractor trailers. These vehicles carry goods from manufacturers to the ultimate end customer. As crude oil prices escalate, fuel prices follow. As fuel costs increase, the cost to transport merchandise through the supply chain increases. Fuel surcharges, additional fees added to a standard freight charge, have become a matter of fact for

many companies. Industrial buyers and consumers, who did not know or care where their products originated when transportation costs were low, are now becoming more aware of how the supply chain operates and how fuel costs affect the price of consumer goods.

Supply Chain strategies that were once optimum are being challenged as transportation costs rise and become a larger percentage of a product's total delivered cost (Tirschwell, 2008). Supply Chain decisions related to outsourcing, transportation modes, and product design and packaging are dramatically influenced by the cost to move a product from one location to another. Manufacturers are trying to become more efficient in their business decisions when dealing with options that affect transportation costs. Consequently, there is a positive side effect of the rising cost of fuel. Businesses are becoming more energy conscious and energy efficient when dealing with decisions that affect transportation costs.

Manufacturers are actively seeking strategies to become more efficient in terms of transportation costs. Three key areas being targeted for improvements are outsourcing decisions, modes of transportation, and product design and packaging techniques. Manufacturers are taking a close look at their outsourcing decisions. They

are comparing the savings associated with low cost labor in foreign countries with the transportation cost required to bring products back to the U.S. for sale. When moving products from one point to another, manufacturers consider different transportation modes, such as marine, rail, truck, and air freight. Each option has its own advantages and disadvantages in terms of speed of travel and cost of travel. Firms are also working to become more efficient with the design and packaging of products. The packaging of a product can have a significant impact on the cost to distribute it. The amount of cubic space the product and packaging consumes, and the added weight of the product and packaging materials, are two key considerations that are being addressed in hopes of reducing transportation costs.

OUTSOURCING

In recent years, the media has publicized the trend of manufacturing companies in the United States moving their production operations off shore. U.S. companies found the lure of low cost labor in foreign countries hard to resist. Moving the manufacturing operations offshore could result in major cost reductions, even when the completed products had to be shipped back to the U.S. for delivery to the final customers. Decisions were made to save on labor cost at the expense of transportation costs. As fuel costs rise, and transportation costs increase, the strategy of moving production to far away sources to acquire low cost labor has come under scrutiny. As transportation costs increase, it becomes more important to minimize the distance from original manufacturer to retailer (Semichi-Levi, et al., 2008).

Jeff Rubin, chief economist at CIBC World Markets, says "The cost of shipping a standard 40-foot container from East Asia to the U.S. eastern seaboard has already tripled since 2000 and will double again as oil prices head towards \$200 per barrel." While these shipping costs have come down due to reduced oil prices and the recession, costs are still considerably higher than in the mid

2000's. Oil prices now account for a much larger portion of total freight costs (Rubin, 2008). Higher energy costs translate directly into higher transportation costs. Rubin equates transportation costs to tariff-equivalents. At \$20 per barrel of oil, as seen in 2000, transportation costs were equivalent to a 3% U.S. tariff. With oil at \$70-80 per barrel, the tariff-equivalent rate is 6%. At \$150 per barrel, fuel costs would equate an 11% tariff, comparable to tariff levels in the 1970's.

Bo Anderson, a former GM group vice president of global sourcing and supply chain, states that "on total landed cost for North American consumption, Alabama is our lowest cost country today" (Murphy, 2008). Emerson Electric, which makes various electro-mechanical products, has moved some of their appliance motor manufacturing from Asia to Mexico (Aepfel, 2008). This approach helps to offset the transportation cost of bringing a product to North America, but does not totally sacrifice the savings associated with lower cost labor. Although wages in China are lower than those in Mexico, the wages in Mexico are still considerably lower than those of a U.S. worker.

Of course, the cube and weight of the product being shipped has an affect on how important transportation costs are for that product. Batteries are a relatively heavy item compared to their size. Consequently, shipping costs are an important consideration in making supply chain decisions. Crown Battery Manufacturing Co. recently reversed their decision to manufacture batteries destined to consumers in the U.S., from Mexico back to the US. Crown moved the production operation from a plant in Reynosa, Mexico to a plant in Ohio (Aepfel, 2008). One approach to balancing the cost of labor with the cost of transportation is to target operations in small rural communities in the Midwest or Southeastern United States. Salaries, and cost of living, are lower in these areas than in large urban cities. Labor unions are also not as well developed. Consequently, the labor costs are lower than in other more industrial developed areas of the U.S. Additionally, transportation costs are not as high

as compared to bringing products to the U.S. from foreign countries.

Should fuel costs continue to rise, distribution distance will become a greater influence on outsourcing decisions. A product that can be produced close to the consumer will require less transportation cost than one that is produced a great distance from the end consumer. Consequently, efforts to reduce the transportation distance between manufacturer and consumer are likely to continue. Onshoring, nearshoring, and insourcing are all terms to describe the business practice of keeping, or bringing operations back closer to the end consumer. Heavy or bulky products are especially affected by fuel costs due to the cost of transportation. The affect of distance is beginning to rival the affect of labor costs in many industries. Should this trend continue, outsourcing strategies will shift to a more balanced relationship between labor cost and transportation costs.

TRANSPORTATION MODES

Transportation options in a supply chain have two critical features; the speed at which a product is delivered and the cost to deliver it. Unfortunately, these two features are at work against one another. Transportation modes that allow the fastest delivery are the least efficient in fuel use. Air, rail, truck, and marine have decreasing rates of fuel consumption, but increasing rates of travel time. As transportation costs rise, more focus is placed on the efficient use of fuel. Business logistics costs in 2007 exceeded 10 percent of the U.S. Gross Domestic Product (Wilson, 2009). Consequently, the demand for more cost effective modes of transportation increases. Many manufacturers have indicated plans to shift freight from truckload carriers to rail carriers (Blanchard, 2008). Rail transportation is significantly more efficient than truck. In the first quarter of 2008, 935 trucking companies went out of business (Smith, 2008). On www.freightrailworks.org, the rail industry advertises that the rail system is capable of moving one ton of freight 436 miles on just one gallon of

fuel, a significant savings compared to truck (AAR, 2010).

Of course, transportation by rail alone does not give a company the ability to deliver to unlimited locations like truck transportation does. To take advantage of the fuel efficiency of rail transportation, and still possess the flexibility of truck delivery, many manufacturers are switching to intermodal transportation options. The rail system provides a fuel efficient means of moving freight over long distances and the truck and trailer system provides a means of picking up freight from the origination point and moving it to a rail terminal and moving the freight from a rail terminal to its final destination point.

In another new tactic, some truck carriers are reducing the maximum speed allowed on their trucks. In January, Con-Way Freight dropped the maximum speed on their trucks from 65 MPH to 62 MPH. Con-Way estimates that this reduction in speed will save 2/10 of a gallon of fuel for every mile traveled (Allen, 2008). At \$3/gallon diesel this equates to a savings of \$.60 per mile. In Ontario, long combination vehicles, consisting of a tractor and two 53-ft trailers, are being used to transfer two loads at once with a 30 percent reduction in fuel (Menzie, 2009). This tactic is especially useful when transporting voluminous, lightweight goods.

Transloading, transferring merchandise from marine containers to 53-ft trailers, is another tactic gaining popularity at U.S. west coast ports. On average, the contents of three standard 40-ft marine containers will fit in two domestic 53-ft trailers (Ruriani, 2007). This results in two inland shipments rather than three, a savings of about 30 percent. This trend is most prevalent at west coast ports rather than east coast ports, because the freight arriving in California is moved a longer distance. The transportation savings on these longer inland shipments offset the labor and overhead costs of transloading (Mongelluzzo, 2007).

Manufacturers also may choose to serve a market from a closer production facility. This approach may have the effect of reducing specialized factories in favor of more flexible factories capable of making several products. Manufacturers may also reverse the “make to order” trend in favor of “make to stock,” because this approach is more conducive to large quantity shipments that reduce transport costs (Semichi-Levi, et al., 2008). Another strategy aimed at reducing transportation costs is to use more distribution centers rather than having suppliers ship direct to stores. This strategy allows larger bulk shipments, thereby reducing fuel costs. In 2006, Home Depot shipped 80 percent of their products directly from vendors to stores. Their new logistics model is to decrease that to 50 percent, sending the balance through distribution centers (Maloney, 2009). In the future, retailers may shorten their supply chain by forcing manufacturers to move their distribution centers closer (Goodwill, 2009).

Transportation modes can have a significant impact on transportation costs. In order to reduce transportation cost many companies are shifting to more economical transportation modes. This shift will often result in less delivery flexibility and a reduction in distribution speed, but will reduce delivery costs. The more fuel efficient the transportation option is, the more desirable mode it is when dealing with high fuel prices.

PRODUCT DESIGN AND PACKAGING

Product packaging and containers serve several purposes. The package may be for physical protection of the product, theft deterrent, marketing, storage, or consumer use. However, the packaging of a product consumes valuable transportation and storage space and adds weight to the overall delivered product. When fuel costs were low, retailers may have sacrificed space and weight in order to surround their products with packaging that appealed to the consumer’s eye. There is now a new focus on more cost efficient packaging in terms of transportation and storage cost.

Sam’s Club has recently introduced a new one gallon milk container. The new milk container is square shaped and does not have the traditional spout at the top for pouring. The new containers do not require crates or metal racks for storage. They can be stacked directly on top of one another, because of their flat tops. The square milk jug was introduced in Sam’s Club stores in November of 2007 (Sustainable is Good, 2008). It is estimated that a milk truck can carry 9% more milk in the same space using the new containers compared to the traditional milk jugs. By carrying more milk in each truckload, the shipping cost for the milk is reduced. Of course, not everyone is pleased with the new design. Some customers find the new design difficult to use. It is taking some time for these consumers to adapt to the new containers. Sam’s Club is offering classes on how to pour milk from the new containers. These issues point out the relationship between marketing and logistics, and the need for interaction across these management disciplines.

Wal-Mart’s packaging team worked with one of their private label brands, Kid Connection, to improve the packaging of nearly 300 toys. By reducing the packaging, Wal-Mart estimates that it saved \$2.4 million in freight each year (Wal-Mart, 2009). Radius, a toothbrush manufacturer in Pennsylvania, recently redesigned it’s product to include lighter packaging (Radius Toothbrush, 2010). In transportation, weight equals fuel. The less a product weighs, the less it will cost to transport it from one location to another. Radius estimates that they have reduced their fuel consumption by 30% by using the light weight packaging material. Hewlett-Packard is another manufacturer that has reduced its packaging material in hopes of decreasing shipping costs. They have redesigned their print cartridge packaging with less and lighter materials. The reduction will decrease the truck and ship traffic required to distribute their products. Products can also be redesigned to reduce weight or cubic volume to lower transportation costs. Other examples of this concept are concentrated laundry detergent, flat panel TV’s rather than the larger tube

versions, and knock down furniture rather than assembled units.

Wal-Mart and Hewlett Packard have teamed up to offer a laptop computer in a recycled messenger bag (Gonsalves, 2008). HP won the Wal-Mart Home Entertainment Design Competition by offering their HP Pavilion dv6929 Entertainment Notebook with no box and no Styrofoam. The messenger bag provides the padding for the notebook during shipping. When shipping from HP to Wal-Mart, HP can fit three notebooks in a shipping box. This translates to removing one out of every four trucks required to ship the laptops. HP estimates that they have removed 97% of the product packaging materials.

Retailers are also using computer software to help determine the most efficient way to pack product in cartons, pack cartons in trailers, and combine shipments. When you pay for a trailer to move from one point to another, you want the trailer as full as possible. Additionally, you want each carton as full of product as possible. Nesting is the process of packing multiple products in one box to maximize space utilization (O'Donnell, 2008). Companies like Williams-Sonoma rely on efficient nesting process to minimize the number of cartons used during shipping.

Products still need to be protected during transit. One of the roles of packaging is to provide protection to the product, but there are alternative ways to provide this protection. When a product is placed inside a box and the product does not take up all of the free space, some internal packaging material must be used to fill the void. Styrofoam and other forms of padding are typical solutions to this problem. However, these materials add cube and weight, and therefore shipping costs to the product. The Technical Development Manager for Sealed Air recommends using inflatable air cells (Armstrong, 2009). This approach consumes the excess space and protects the product, but does not add significant weight to the overall package. Shrink wrapping may also

offer product stability during shipment without adding packaging material cube and weight.

As fuel costs continue to rise, product design and packaging methods will continue to be refined. Less packaging material and lighter product and packaging material reduce the overall product size and weight. Organizations will continue to optimize product design and packaging methods to minimize the fuel costs required to move products from one point to another.

SUMMARY

Rising fuel prices are making supply chain decision makers look carefully at their transportation strategies. Although most of what is reported in the news and research literature is the negative impact of the rising fuel costs, there are some positive aspects of the situation. Businesses are placing a more detailed focus on being energy efficient when establishing transportation policies. This new found focus on energy efficiency will reap benefits in years to come. More efficient strategies to conserve fuel will make a positive impact on earnings no matter what the cost of crude oil. Many of the transportation strategies to conserve fuel, will also make the supply chain more environmentally friendly. Using less fuel makes the supply chain greener.

On the other hand, there are some negative consequences of transportation demand management. Higher transportation costs effectively limit the range at which manufacturers can market their products. This distance limitation forces manufacturers to be generalists, at the expense of increasing specialization. This restriction on specialization in turn limits productivity growth. In addition, limits on the distance at which a manufacturer's goods can remain competitive, reduces the level of total competition in a given market, potentially leading to increased spatial monopoly.

In summary, three significant areas of concentration are outsourcing decisions, modes of

transportation, and product design and packaging techniques. Outsourcing decisions that chase low cost labor and ignore transportation costs are being scrutinized. Businesses are now focusing on total delivered cost and attempting to balance the cost of labor with the cost of transportation. Several U.S. companies have reversed decisions that sent manufacturing jobs to offshore operations, in favor of bringing the production work closer to the end consumer. In a world of instant gratification, consumers would like to have their goods as soon as possible, but as soon as possible can come with a hefty price. With rising fuel costs, many companies are transferring deliveries from less fuel efficient, faster modes of transportation to more fuel efficient slower modes. This may result in waiting longer for goods or the need for more advanced planning, but yields lower transportation costs.

Product packaging has also been an overlooked cost dimension for many companies. Packaging was viewed as a means of advertisement, theft deterrent, and product protection. The added weight and bulk of the packaging was not always a consideration for manufacturers. Focusing on transportation costs has driven some manufacturers to redesign their product packaging. Using lighter materials, using less material, and optimizing containers for increased space utilization has resulted in less packaging weight to transport. Similar strategies have been deployed for product design. Often the product can be redesigned to reduce its weight or cubic volume. This, in turn, lowers transportation costs.

These strategies, that reduce transportation costs, are a positive outcome of the increased fuel prices experienced by so many companies. Fuel is a limited energy resource and strategies that maximize the efficient use of that resource will help businesses be more efficient overall.

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Journal of Transportation Management

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MANUSCRIPT SAMPLE

A FRAMEWORK FOR EVALUATING SUPPLY CHAIN PERFORMANCE

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ABSTRACT

Managers require measures spanning multiple enterprises to increase supply chain competitiveness and to increase the value delivered to the end-customer. Despite the need for supply chain metrics, there is little evidence that any firms are successfully measuring and evaluating inter-firm performance. Existing measures continue to capture intrafirm performance and focus on traditional measures. The lack of a framework to simultaneously measure and translate inter-firm performance into value creation has largely contributed to this situation. This article presents a framework that overcomes these shortcomings by measuring performance across multiple firms and translating supply chain performance into shareholder value.

INTRODUCTION

The ability to measure supply chain performance remains an elusive goal for managers in most companies. Few have implemented supply chain management or have visibility of performance across multiple companies (Supply Chain Solutions, 1998; Keeler et al., 1999; Simatupang and Sridharan, 2002). Supply chain management itself lacks a widely accepted definition (Akkermans, 1999), and many managers substitute the term for logistics or supplier management (Lambert and Pohlen, 2001). As a result, performance measurement tends to be functionally or internally focused and does not capture supply chain performance (Gilmour, 1999; *Supply Chain Management*, 2001). At best, existing measures only capture how immediate upstream suppliers and downstream customers drive performance within a single firm.

Table 1 about here

Developing and Costing Performance Measures

ABC is a technique for assigning the direct and indirect resources of a firm to the activities consuming the resources and subsequently tracing the cost of performing these activities to the products, customers, or supply chains consuming the activities (La Londe and Pohlen, 1996). An activity-based approach increases costing accuracy by using multiple drivers to assign costs whereas traditional cost accounting frequently relies on a very limited number of allocation bases.

$$y = a^2 - 2ax + x^2$$

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