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Managing Information in a Service Industry to Enhance Buyer/ Supplier Relationships

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ABSTRACT

Information technology has allowed motor carriers to enhance the visibility of the service process to provide shippers an incentive for shipper/carrier partnerships. In today's business environment, information technology offers customers the ability to take an active part in the service process, without actually being present in the service setting. Since the transportation industry represents a service characterized by low customer contact, little information exchange and a lack of influence over the production process; marketing challenges are great and high sales opportunities are minimal. In an attempt to overcome these problems, motor carriers have installed satellite communications systems to increase customer contact and interaction that will lead to greater customer satisfaction and long term relationships. A number of case studies of shippers that currently use carriers employing satellite communications are examined and the potential benefits discussed. An inventory-theoretic model of transportation choice is developed and future research directions are discussed.

INTRODUCTION

The information revolution has made it possible for more manufacturers and vendors to be linked to one another only by computer. This trend has convinced many people that we are headed toward a future of virtual corporations—companies comprised primarily of vendor relationships [28]. A key issue in service management is to develop methodologies that will enhance and maintain relationships between service providers and their customers [16]. According to Sheth [33], the greater the competitive intensity faced by a company, greater is its desire to cooperate and collaborate with other industry partners. As competitive forces lead to lost customers, there is a growing need to retain these customers. Reichheld and Sasser [27] have demonstrated across a variety of service industries that when a company successfully lowers its customer-defection rate, its profits climb steeply. The shift in priority towards building relationships is extremely important for logistics [4]. The basic premise of relationship management is that cooperation between all participants in a supply chain will result in synergism leading to the highest level of joint achievement. The underlying paradigm is that all parties will be better off if emphasis is focused on joint problem solving to improve overall efficiency and effectiveness [4].

Transportation is one of the most visible and largest cost expenditure elements of logistics operations [4]. Motor carriers are very much a part of any firm's logistics supply chain. The motor carrier can provide transportation service to virtually all shippers [8]. Schmenner [31] classifies transportation, especially motor transportation, as a service factory. He defines a service factory as, "a service process that has relatively low labor intensity and a low degree of customer interaction and customization." Schmenner [32] goes on to say that companies with the characteristics of low customer interaction and customization face a stiffer marketing challenge. Gentry [14] found that buyer/supplier partnerships for motor carriers are more likely to develop when open communication and information sharing are present. Chase and Aquilano [7] developed a service design matrix to illustrate the relationship between production efficiency and sales opportunity as a function of service delivery options. Service delivery options were ordered from low sales opportunity to high sales opportunity as richness of

information transfer increased. Chase [6] also argued that service delivery systems can be separated into low and high-contact customer operations. The low contact operations are run as a plant, where all the production management concepts and automation technology are brought to bear. Fitzsimmons and Fitzsimmons [13] define customer contact as "the physical presence of the customer in the system. The degree of customer contact can be measured by the percentage of time that the customer is in the system relative to the total service time." According to Fitzsimmons and Fitzsimmons [13], consumers in low-contact systems have no direct influence on the production process, because they are not present. In today's business environment, information technology offers customers the ability to take an active part in the service process, without actually being present in the service setting. Since the transportation industry represents a service characterized by low customer contact, little information exchange and a lack of influence over the production process; marketing challenges are great and high sales opportunities are minimal. In an attempt to overcome these problems, motor carriers have installed satellite communications systems to increase customer contact and interaction that will lead to greater customer satisfaction and develop long term relationships. Motor carriers realize that information is the basic building block in the supply chain. Companies demand accurate and timely communication about products, orders and deliveries. Firms must know the availability of products to meet manufacturing schedules and customer orders. This paper will illustrate how satellite communications technology is currently being used by motor carriers and how it can be used in developing long term relationships with customers.

Over the past ten years, more and more motor carriers of freight have installed satellite communications systems on their trucks. Designed to maintain continuous contact with the vehicles, wherever they may be, these systems allow the continuous monitoring of the location and status of inventories in the supply chains for various types of products. Such in-transit visibility fills in a gap that has long existed in supply chains--for traditionally once the product is loaded on a transportation vehicle, it is out of the control and view of the owner. Satellite communications systems, however, represent a new cost for the carrier, and may or may not result in higher prices for the purchaser of the freight service (hereafter referred to as the shipper). Carriers must evaluate the cost of the systems in relation to the benefits/value that customers receive. If the systems improve the productivity of the carrier, there is an opportunity to pass those savings on to the shipper and to develop a win/win situation that will lead to a long term relationship between the carrier and the shipper.

The purpose of this research is to develop an understanding of the impact satellite communications systems may potentially have on both the motor carriers and the purchasers of freight services. Because of the dearth of prior research on the subject, this effort represents an initial attempt to build a theory for later testing. The paper begins with a review of the nature of satellite communications systems as employed by motor carriers primarily in the United States. We follow this with a discussion of supply chain and relationship management concepts. The next section describes the methodology we chose to ground our theory building in the reality of the supply chain. Then we describe the shippers sampled to get a preliminary idea of how satellite communications systems might affect shippers and their decision making in the supply chain. Finally we propose a theory and suggest how it might be tested in future research.

BACKGROUND

Mobile satellite communications systems

Nature of the systems

Satellite communications systems generally consist of 1) a mobile computer terminal and satellite antenna on each vehicle, 2) a two-way data link with communications satellites and their ground station which provides a global positioning capability, and 3) the host computer at the trucking company's headquarters, [17]; [30]. These systems began to appear in the late 1980's in the United States. Several technologies began to converge, including global positioning satellites (GPS) and LORAN (long range navigation) technology, spear-headed by the US Government and military personal micro-computer technology, and various wireless communications technologies [17]. Further, in 1989, "the US Department of Defence mandated that hazardous materials contractors use mobile communications systems when hauling the department's hazardous cargoes," [26]. Use has grown rapidly since. In 1995 the largest vendor of such systems, Qualcomm, Inc., had over 110,000 units in place [10]. The pace appears to be much slower in Europe. In 1992 the European Commission began a project called "Metafora" (Major European Testing of Actual Freight Operations Using Road Transport Informatics on an Axis). This is a test with a limited number of carriers, with the Commission paying for most of the equipment. One of the participants indicated that his firm would not use such capabilities without subsidy unless the price came down [5]. Admittedly the project encompasses more than just satellite communications systems, including a trip recorder that electronically stores every aspect of the vehicle's journey and electronic data interchange (EDI) of data between the carrier headquarters and clients or other transportation modes such as ferries. These latter technologies are used widely in the United States, as well.

Costs and benefits

Although satellite communications systems cost about $US 100-120 per month per truck to lease and operate--as well as other costs for data processing at the headquarters, they potentially may provide numerous benefits to the trucking firm. For long-haul carriers, these include:

- Reduced telephone expense since drivers no longer have to call.
- Better fuel economy through speed control.

- Reduced driver turnover since they feel less isolated.
- Increased productivity of dispatchers, who can handle up to twenty percent more vehicles since more of the communication is automated.
- Reduced clerical effort due to the automation of data collection and the resulting improvement in the accuracy of that data.
- Capturing operating information to integrate with other company information systems.
- Reduction in liability insurance rates [10]; [11].

Other benefits relate to the quality of service provided to the customer. For example these include:

- Better on-time delivery performance.
- The ability to notify customers in advance when a vehicle will be delayed, so other arrangements can be made.
- The ability to allow customers to reroute the vehicle while enroute if requirements change [10].
- Benefits related to relationship management, such as service customization and service augmentation.
- Possibilities for relationship customization are considerable, when personal service capabilities are combined with information technology capabilities.
- Building 'extras' into the service to differentiate it from competitive offerings.

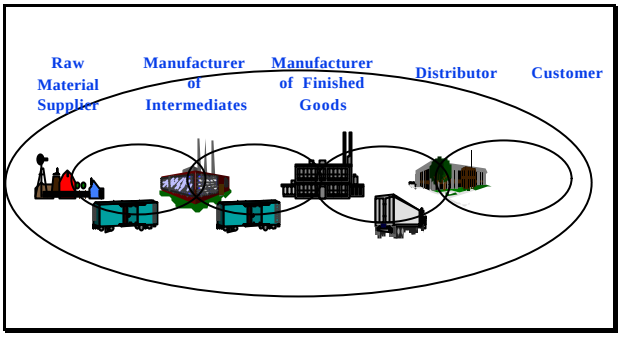
Enhancements

The vendors of such equipment continue to enhance their products. One offers a combination of satellite and radio transmission to insure that the truck is always in contact with the home base. Another has enhanced the display unit to show more characters and allow function keys to take different roles in different applications. Still, the high cost of satellite transmissions puts a premium on short messages. Hence special macros are set up in advance to allow the transmission of only the variable information in a script. Generally most systems only transmit data, but voice transmission will soon be offered as an option.

Supply chain concepts

The concept of the supply chain as a key process in the business of providing products and services to customers surfaced in the early 1980's somewhat before the satellite communications applications in transportation [22]. The idea is to view the process of gathering raw materials from their primary sources, converting them into intermediate and then finished products, and distributing them to the final consumer as a total system of inter-related parts. Figure 1 shows this schematically.

FIGURE 1



Such a supply chain consists of many different kinds of activities, with widely varying technologies and economic characteristics. The idea is to make those parts work together as effectively as possible to deliver the final product to the consumer at the lowest possible price, consistent with the overall needs of that consumer. When the supply chain concept is implemented effectively, major benefits often result [23].

One of the keys to effective supply chain management involves the sharing of information throughout the chain. This sharing includes demand projections, actual shipments and production, and current inventory levels for each item in each echelon of the chain. One place where such "visibility" of the information disappears is when the inventory is in-transit between echelons. Here there may be uncertainty as to the location of the vehicle carrying the inventory, as well as the expected time of arrival (ETA) at the destination. This is where satellite communications systems can assist the supply chain coordinators in their planning of supply chain operations. The coordinator may be concerned about maintaining sufficient inventory to meet demand at a destination, about scheduling receiving labor, or about re-routing the shipment to a location in more dire need than that originally planned. As one carrier president puts it, "Ten years ago a customer was happy when the shipment arrived on time. Yet now , since production, shipping, and inventory management are tantamount to a company's fiscal success, they want efficiencies, details, times and locations," [29]. Furthermore, to the extent satellite communications systems allow the carrier efficiencies of operation, the carrier may pass these savings along to the shipper of the goods.

Relationship management concepts

Relationship management in industrial markets has been given significant attention in the past decade. Firms are becoming more oriented towards understanding the factors that establish, maintain and enhance relationships with customers [15], [16], [21]. Han et al. [18] view close relationships as a part of the shift toward partnering with single source suppliers, resulting in benefits that include enhanced performance, purchase cost reduction and increased technical cooperation. However, most empirical research contributing to the body of channel of distribution knowledge focused on the management of long-term relationships between firms [1], [19].

The services industries need a relationship approach to marketing because of the inherent difficulties of risk, complexity, continuous nature and customization [9], [24], [25]. Heskett and Evans [20] state, "The primary objective of any service organization must be to deliver good value and foster customer retention and referral. The delivery of good value involves providing excellent quality in relation to the total cost to the customer of acquiring the service. High productivity contributes to service value, but it must be measured both in terms of work performed and results achieved." In the motor carrier industry, the management of relationships with clients is a major concern for shippers because the carrier plays an important role within the shipper's strategy. The shipper depends on the carrier for dependable and reliable shipments to customers, as well as efficiencies in time and cost. The shipper must have continuous status reports on orders to make critical manufacturing and customer order stocking decisions. The increased communication capability of the motor carriers enhances the tracking of shipments, improves shipper scheduling and helps develop long-term relationships.

Satellite communications systems, then, complete a missing link in supply chain information systems. They provide real-time data concerning the location of a given vehicle with a specific cargo shipment. This data can then be used in a variety of ways to make the supply chain more responsive and more efficient.

METHODOLOGY

Because little research has been done in this area, we chose first to do a limited number of case studies of shippers who do use carriers employing satellite communications systems. The purpose of these case studies was to gain a better understanding of the application and value of such systems [12]. Obviously the sample was judgmental, with the goal being to study companies in various situations and locations in their supply chains. Four firms were selected:

A. A manufacturer of industrial intermediates supplying many manufacturers.
B. A large, multi-store retailer buying direct from manufacturers.
C. A manufacturer of packaged consumer goods.
D. A manufacturer of perishable food products.

The sample was limited to those who do use carriers with satellite communications technology and who were willing to share information for this study.

We prepared a detailed questionnaire to guide structured, but open-ended personal interviews with each of the four companies. The objective was to understand the following:

- How these firms select carriers
- How shippers measure carrier performance
- The importance of satellite communications in the shipper's decision making process
- The amount, type, and mode of transmission of data received from these carriers
- The benefits they perceive from this technology.

CASE STUDY FINDINGS

Firm A

This manufacturer of industrial intermediates formerly operated its own fleet of trucks. A few years ago the company decided to outsource this activity, choosing a large carrier well-known for employing satellite communications technology. Like many firms these days, Firm A faces the fact that its customers do not want to hold very much inventory, and several are on true just-in-time systems. The firm buys highway transportation services from forty-four different carriers, but nine haul sixty eight percent of the total volume, which is about 10,000 truckloads per month. Firm A's forty largest customers can view the status of the shipments they will be receiving on-line.

Firm A does not currently require all its carriers to have satellite technology, but they believe that all carriers will have the technology in the not distant future. The firm requires all carriers to have the ability to communicate with it by EDI. It communicates with carriers primarily through this mode, including the following transactions: load tender and acceptance; advance shipping notices; actual carrier pickup, ETA, and delivery times; exception notices regarding problems; and freight bill tendering and payment. Those carriers who have satellite technology produce the pickup, intransit, and delivery EDI messages automatically from their satellite systems, thus making the data more timely and accurate than that from carriers not using such technology. The intransit messages provide the location of the vehicle.

The benefits Firm A sees from satellite technology include providing better service to their customers, decreased costs for the carriers, and the integration of delivery data into their overall quality process. They have not quantified the values of any of these items.

Firm B

This large, multi-store retailer buying direct from manufacturers has thousands of traffic lanes between those suppliers and the firm's distribution centers. Firm B is the buyer of transportation services, as well as, the receiver of thousands of shipments. The firm places high demands on its suppliers to provide on-time shipping. As is common these days, the firm has concentrated its volume with a limited number of carriers.

All truckload carriers (those who haul full loads directly between the manufacturer and the receiver's distribution centers) must be using satellite communications systems in order to do any business with Firm B. As is the case with Firm A, Firm B communicates with these carriers via EDI technology. They have tested the concept of accessing one carrier's database directly, rather than waiting to receive an EDI message. While they do not see any major advantages to this currently, they may well do more of it in the future.

The benefits Firm B sees from satellite technology are more direct than those of Firm A, since Firm B owns the inventories at the destination. They see the technology allowing them to reduce inventories at the distribution centers because of better information about ETA's, as well as, better on-time performance by the carriers. They too believe that this technology makes the carrier more efficient, and helps them to act in ways that insure better productivity on the part of the carrier. Firm B has the buying power to negotiate lower rates with the carriers as a result of these savings.

Firm C

This firm is the manufacturer of packaged consumer goods for the very demanding retail grocery business. The firm's overall goal is to develop a "seamless" information flow with the customers to reduce supply chain inventories and increase flexibility. EDI and satellite communications technology are key enablers in this objective. Eight carriers haul fifty percent of Firm C's volume, and another nineteen carriers haul the next thirty percent. The firm also has very close relationships with the fifty largest customers who buy almost eighty percent of Firm C's product (in dollars). The firm's current focus with regard to truck transportation is to reduce the time the truck spends at the customer location either waiting to unload, or unloading. Two factors drive this: first, the average truck carrying Firm C merchandise spends seven hours at the grocery warehouse; second, a truck driver costs $50 per hour while the grocery warehouse personnel only cost $30 per hour. Therefore better scheduling, and the use of customer labor for unloading could substantially reduce costs. Firm C also wants to go to "dynamic" channels, with some mix of direct store delivery with warehouse delivery varying by customer, product and season. Satellite communications are seen as an enabler here, as well.

Firm C requires EDI capability of all its carriers, and estimates about ten to fifteen of the largest have satellite systems. The firm collects satellite communications data in batches via EDI, every two to five hours. The EDI transactions include all those collected by Firm A (load tender and acceptance; advance shipping notices; actual carrier pickup, ETA, and delivery times; exception notices regarding problems; and freight bill tendering and payment). But Firm C goes farther than any of the other three. The firm also receives the time of the truck's arrival at the warehouse gate and the time of exit from that warehouse. This is important for programs to reduce waiting times. The firm also wants to record the times unloading starts and finishes, but does not do so now.

The benefits Firm C sees from the technology lie in the ability to offer better service to the customer, the ability to influence the carriers' cost structures, and the overall ability to measure and monitor overall carrier performance. They see the ability to offer dynamic channels in the future as a strategic advantage for the firm. They can quantify the potential cost improvement from reducing waiting time and will share those savings with their customers as an incentive. However they do not quantify the service benefits.

Firm D

A manufacturer of perishable food products, Firm D owns approximately 350 trucks hauling about half of the firm's freight. These trucks are equipped entirely with satellite communications systems because of the short life of the products--a truck too long in-transit very much devalues the cargo. Therefore, Firm D has a more direct motivation to use satellite communications technology. For those loads hauled by for-hire carriers, the company prefers satellite communications, but does not require the systems. The company does not currently conduct business through electronic data interchange, but expects to in the future. At that point all carriers will be required to use satellite communications systems.

Firm D enjoys all the benefits--and all the costs--of the technology. Its managers believe the system allows them to offer better service and get more productivity from their trucks. In this firm's situation, the high cost of a load of spoiled food far exceeds the penalties the other firms in this study face for delivery failure. Thus the use of satellite technology is almost certainly beneficial to the firm. Since the firm uses the system directly, it gets more frequent updates tailored specifically to its needs than do the other firms. Furthermore, the firm plans to integrate the system into their overall delivery process, for example allowing the drivers to record and transmit the signatures of the customer's receiving personnel, and computing state taxes as the GPS indicates that the truck has crossed a state border.

While Firm D has not quantified the value of customer service provided by the technology, managers claim that the overall savings have paid back the investment in under two years.

Conclusions from case studies

We can draw several conclusions from these case studies. First, many of the benefits of the satellite communications systems, as well as the costs, fall to the company owning or operating the trucks. The benefits such as increased vehicle/driver utilization or dispatcher productivity should be relatively straight-forward to calculate. The more difficult task is to quantify the softer benefits potentially received by the shippers and carriers, often categorized as customer service. The next section suggests a theory for doing this.

In terms of relationship strategy, we can state that shippers value the advantages offered by satellite communications and from the anecdotal evidence, shippers do tend to have long-term relationships with the carriers that use this technology. Firm's A, B, and C use the carriers that have satellite communication technology for a significant part of their shipping and have done so for an extended period of time. Firm A has developed a long-term relationship with one of its carriers and has turned over the management of its private motor transportation distribution

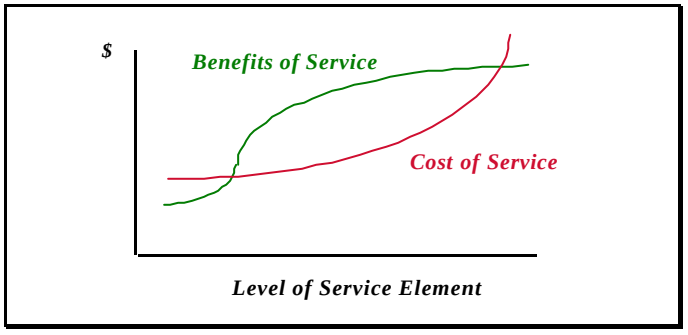
to this carrier. Firm D uses this technology for its private fleet and is considering making it a requirement for the common carriers that it uses. Further research is needed to develop a relationship model that shows the exact value of this technology in selecting carriers and its relative importance in relationship development and commitment. It can be noted that three out of four firms rated the importance of this technology in carrier selection four (4) out of a possible five (5) on a Likert Scale.

Subsequent to the interviews, we developed an inventory-theoretic model of transportation choice, in an attempt to build a theory of decision making regarding satellite communications technology. This model is shown below. At this stage of the research we have made no attempt to quantify this model or to show its impact on the development of long-term relationships.

THEORY DEVELOPMENT

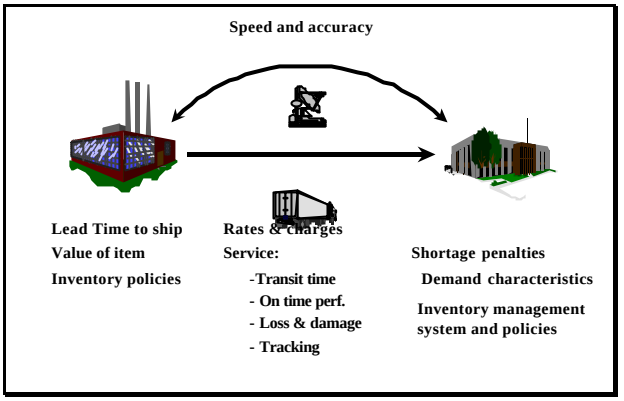
The general theory of logistics and customer service suggests that the main result of supplying good or better customer service--on-time delivery, short delivery lead-times, complete orders, and so forth--allows the receiver (and possibly the shipper) to reduce inventories [2]. Gentry [14] found buyers and suppliers perceive motor carriers to be important in meeting operational goals of the buyer/supplier partnership. Respondents ranked carriers to be "critical" or "important" in increasing on time delivery and reducing inventory levels. Often furnishing higher service levels to a customer raises costs for the firm providing such levels. On the other hand the provider may receive benefits, such as more business from the customer, which offset these costs. Figure 2 shows a schematic of the hypothesized relationship. Quantifying the cost curve is usually straight-forward, but quantifying the benefits curve is not.

FIGURE 2



We propose assuming that the majority of the benefits to the customer will lie in the reduction of inventories at the receiver's place of business. (In future research we will test this assumption.) If that is the case, then we can use standard inventory theory to compute the total costs--supplier, transportation, and receiver--for any lane of traffic (a single origin to a single destination) [34], [35]. What we will be dealing with, then, is the "micro-system" shown in Figure 3.

FIGURE 3



In this system we can compute a total annual system cost (TAC) using formula (1). The symbols used in this formula are defined in Table 1.

$$TAC = (Q/2 + k_Q \acute{o}_{LTFE}) r (v_Q + R_Q) + D(tt_m/360) r_m v_Q + (D/Q) A + D(v_Q + R_Q) \quad (1)$$

TABLE 1
Total annual cost formula – symbols

D	=	Annual Demand (units)
Q	=	Replenishment quantity
A	=	Ordering/setup cost ($/order or setup)
v_Q	=	value of the goods at the origin ($/unit)
r	=	carrying charge at dest. (%/$ inv./year)
r_m	=	carrying charge intransit (%/$ inv./year)
R_Q	=	transportation rate per unit
k_Q	=	safety stock multiplier
$\acute{o}_{LTFE}$	=	std. Dev. Of leadtime forecast errors (units)
tt_m	=	Transit time (days)
k_Q	=	Safety stock multiplier

The total annual costs are the inventory carrying costs at the destination, the carrying costs of the inventory in-transit, the ordering costs (for costs which are fixed per order), and the transportation costs. We assume several of these factors vary with the size of the shipment, thus the Q subscript. Given a stockout criterion, and values for all the parameters, it is relatively easy to solve the equation to find the best Q and k_Q which will minimize total costs [35].

Satellite communications systems should tighten the standard deviation of forecast errors over the lead-time because of either more reliable or shorter delivery times. Carrier productivity improvements may show up in lower rates for transportation. Thus we have a better estimate of the cost savings applicable to satellite communication systems.

Computing the least total cost for the system, however does not solve the total problem. Not all the costs accrue to just one party. Thus a cost-based pricing scheme needs to be developed which compensates each for their fair share of any savings. Finally, a separate estimate needs to be made of the increased volume a receiver might give to the shipper due to the better service provided.

FUTURE RESEARCH

The theory proposed above is a first step to evaluating the value of a satellite communications system for tracking highway freight vehicles. The authors plan to test this theory in the future, as well as build on it to cover more facets of this issue. In addition, the potential for the development of long-term relationships will be implemented into the model, as well as a value determinant in carrier selection. Clearly it is an issue that buyers of freight services and carriers need to explore.

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