

An Assessment of Industrial Shipper's Perceptions  
in the Modal Selection of Air Cargo Transportation

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### Abstract

The process which industrial shippers use regarding freight modal choice is better understood when analyzed within the marketing models of organizational buyer behavior. These models take their origin from the behavioral aspects of consumer buyer behavior and attitude-attribute theory which allows researchers to measure consumer perceptions, predict preferences and then infer choice.

Perceptions about freight modal alternatives and the relative importance of cost, service, shipment characteristics, and distribution pattern attributes were ascertained via a self-administered mail survey conducted in 1982. Using comparisons between mean response scores and multidimensional scaling techniques, respondent perceptions were measured and analyzed.

The air cargo mode was isolated for specific study. The results indicate that air cargo is perceived as a unique transportation alternative providing a means for shippers to meet their customer's special requirements at a premium freight rate. Industrial class shippers, in general, seek low cost dependable transportation methods for the shipment of low value per unit weight bulk commodities, and do not value short transit time as relatively important. However, when the customer dictates and the shipment allows, the air cargo mode is the ideal method of transportation.

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Today's transportation infrastructure provides a variety of choice alternatives from which industrial firms must choose for the movement of freight between facilities and markets. Bowersox (1978) describes transportation as a means to provide logistical system geographical closure, a necessary link in the industrial economic system. If an industrial firm seeks to exist and remain viable, transportation choice decisions are made; the process cannot be avoided, ignored or denied.

Shippers meet their physical distribution needs for the movement of domestic intercity freight using one or more of the five major modes of commercial freight transportation; railroad, motor carrier, air cargo, water (barge) and pipeline. Traditionally within the air cargo industry the use of air transportation is generally explained through the use of terms such as, "nature of the cargo." Cargo descriptions such as high value per unit weight, perishability, high technology and delicate or fragile product are often used to target markets for air cargo. Service descriptions such as improved customer service levels, speed of product delivery and increased utility are said to result from the use of the air mode. Emery (1983) recognizes the need for a marketing approach to air cargo describing the need for predictable, reliable and dependable service. From earlier research, Jackson and Brackenridge (1971) draw together a listing of some fifteen product/market attributes for air cargo to better explain the nature of commodity movements by air.

Understanding modal choice is vastly more complex than generating

listings of revealed modal, product and/or market attributes. Street (1983) emphasizes the changing role of the corporate traffic manager and the need for a more sophisticated process of modal and carrier choice. Cunningham (1982) summarizes freight modal choice analysis techniques into four major categories of which the behavioral approach is the only which offers any comprehensive insight into modal choice. Therefore, in order to expand the understanding of modal choice in relation to the air cargo mode it is the purpose of this paper to draw upon the behavioral aspects of marketing research to 1) determine the salient modal attributes and 2) to assess the attitudes and perceptions of shippers towards air cargo in relation to other competing modes of freight transportation.

The conceptual framework used for this study assumes the process of modal selection to be similar to that suggested by the comprehensive consumer buyer behavior model developed by Engel, Blackwell and Kollat (1978), extended for organizational buyer behavior by Sheth (1973) and Webster and Wind (1974) and adapted to modal choice by Craig (1973), Krapfel and Mentzer (1982), Saleh and LaLonde (1972), Slater (1982) and Stock and LaLonde (1977, 1978). Understanding this process requires the collection and analysis of data concerning the factors shippers consider in modal evaluation, the relative importance of these factors in the selection process, and the perception of shippers with regard to how much of each factor is offered by each modal alternative. This framework is also quite compatible with the concept of trade-offs as described in the physical distribution literature.

#### Method

##### Subjects

The subjects for this study were selected from a 1982 survey directed towards a national sample of industrial shippers (users) to acquire perceptual data regarding modal choice. Data were derived from a 274 item self-administered single-wave mail survey. The survey elements were identified as industrial shipper/users of the United States inland waterway system. Segmenting waterway users allowed the gathering of data from multimodal shippers which includes use of each major mode of industrial freight transportation. A total of 407 firms were selected on the basis of their ownership of inland river terminal facilities as listed in the Inland River Guide and River Terminals - Ohio River and Tributaries directories. The survey elements were then cross-referenced with the Official Directory of Industrial and Commercial Traffic Executives to more specifically target the appropriate company official receiving the questionnaire, i.e., traffic manager, manager of physical distribution, etc. As a matter of policy the highest ranking transportation official was chosen to receive the questionnaire in any given instance. Of the 407 questionnaires mailed a usable response rate of 30.45% ( $n = 113$ ) was achieved. The usable responses comprise a significant sample and should provide a reasonably accurate representation of the actual population ( $N = 371$ ).

#### Procedure

Product choice behavior, whether involving consumer goods, industrial products or services, such as modes of transportation are generally believed to be best described in terms of salient attributes. Freight transportation modes are often described in terms of quantitative attributes such as freight rates, transit time, etc., and qualitative attributes such as dependability, reliability, consistency

of service, etc. Previous research conducted by Gilmour (1976), Krapfel and Mentzer (1982), Mallen and Pernotte (1972), McGinnis (1979), Slater (1982), and Stock and LaLonde (1977) have identified and outlined the generally accepted salient transportation attributes used in describing modal alternatives.

Although a collection of standard attributes are consistently used as descriptors of alternative transportation modes the relative importance of each attribute differs depending upon situational variables and individual perceptions. For example, with regard to choice of mode versus choice of carrier within one mode, Mallen and Pernotte (1972) found that cost (freight rate) becomes a recessive attribute in carrier selection and customer service becomes dominant. This emphasis shift results from the generally greater reduction of price competition between carriers than between modes.

Models of modal choice highlight the fact that the transportation decision process is built upon individuals' attitudes and perceptions of information polarized or constrained by internal factors such as management preferences, the product and external factors such as customer specifications, equipment availability and modal presence. Thus "transportation specifications" are established creating boundary conditions within which modal choice decisions are made based upon perceptions of transportation attribute profiles.

Given the attribute profile of the various transportation modes, to predict and/or explain preference, the relative importance of each of the attributes must be determined. An attitudinal approach was used seeking importance measurements directly from survey respondents, as suggested by Wallace and Sherret (1973).

The importance of factors (attributes) shippers use in their evaluation of alternative modes, as well as shipper perceptions of each mode for each factor, influences preferences for alternatives and therefore choice. Factors were identified from an extensive literature review and a pre-test applied to industrial shippers. Importance ratings were obtained from respondents for each of eighteen factors using a 5-point Likert scale with 1 being very unimportant and 5 being very important. Perceptions of the amount of each important factor offered by each modal alternative is a major determinant of choice behavior. These perceptions were also evaluated by the respondents using a 5-point Likert scale, with 1 being definitely does not offer and 5 being definitely does offer. Mean response scores were calculated for the factors.

The multidimensional scaling (MDS) approach was taken to depict a spatial configuration of respondent perceptions. Data were analyzed using the MDPREF algorithm to develop the perceptual map for shippers as proposed by Carrol and Chang (1970).

## Results

The initial research design which targeted users of inland waterways provided data from respondents which are truly multimodal in nature. The reported average transportation mix reflects the recent national domestic intercity freight modal mix with the exception of pipeline which is lower than average. Table 1 shows the average transportation mix used by respondent industrial shippers for inbound, outbound and total movements. Air cargo makes up approximately 0.90% of the shipper's volume compared with a national average of 0.22% in 1982.

**Table 1**  
**Industrial Shippers-Transportation Method Mix**  
**Used to Meet Physical Distribution Needs**

Type of Transport	Volume (%)		Total
	Inbound	Outbound	
Motor Vehicles	39.3	46.7	37.4
Railroad	32.3	31.0	33.8
Domestic Barge	21.3	18.9	23.8
Pipeline	2.5	1.5	2.2
Deep Draft Vessel	3.7	1.3	1.9
Air Cargo	<u>0.9</u>	<u>0.6</u>	<u>0.9</u>
TOTAL	100.0	100.0	100.0



As a result it can be generally assumed that the respondents were familiar with the physical and operating characteristics of all modes of domestic freight transportation and the respondent mix generally reflects the actual mix occurring in practice.

Shippers were asked to indicate the importance of factors (transportation attributes) used in the evaluation of alternative modes. The most important factors as described by industrial shippers shown in Table 2, include; satisfies customer's requirements, has equipment

Table 2  
Shippers' Perceptions  
Importance of Factors in selecting a Transportation Method

<u>Factors</u>	<u>Mean Response Score</u>	<u>Standard Deviation</u>
1. Satisfies customers' requirements	4.69	0.58
2. Has equipment available	4.54	0.80
3. Has low freight charges	4.53	0.63
4. Provides dependable transit time	4.49	0.74
5. Provides consistency in service	4.43	0.72
6. Allows for large shipments	4.16	0.92
7. Has loading and unloading facilities	4.15	1.29
8. Satisfies suppliers' requirements	4.07	1.06
9. Provides a low frequency of cargo loss or damage	4.07	0.96
10. Offers flexibility in meeting special customers' needs	3.98	0.93
11. Provides on time pick up and delivery	3.96	1.15
12. Has employees with positive attitudes and good manners	3.95	1.00
13. Provides information concerning shipment	3.79	1.02
14. Has short transit time	3.66	1.18
15. Offers convenient pick up and delivery times	3.64	1.18
16. Offers assistance in claims handling	3.57	1.20
17. Can carry large and/or odd sized freight	2.97	1.40
18. Offers promotional/entertainment	1.39	0.86

available, has low freight charges, provides dependable transit time, provides consistency in service and allows for large shipments. Other factors were considered important, however, the degree of importance and the large standard deviations indicate considerable variation in the importance of these factors across respondents.

To gain an understanding of modal perceptions and the amount of each important factor offered by each mode, a perceptual map was produced and is shown in Figure 1. With the MDS approach each factor is

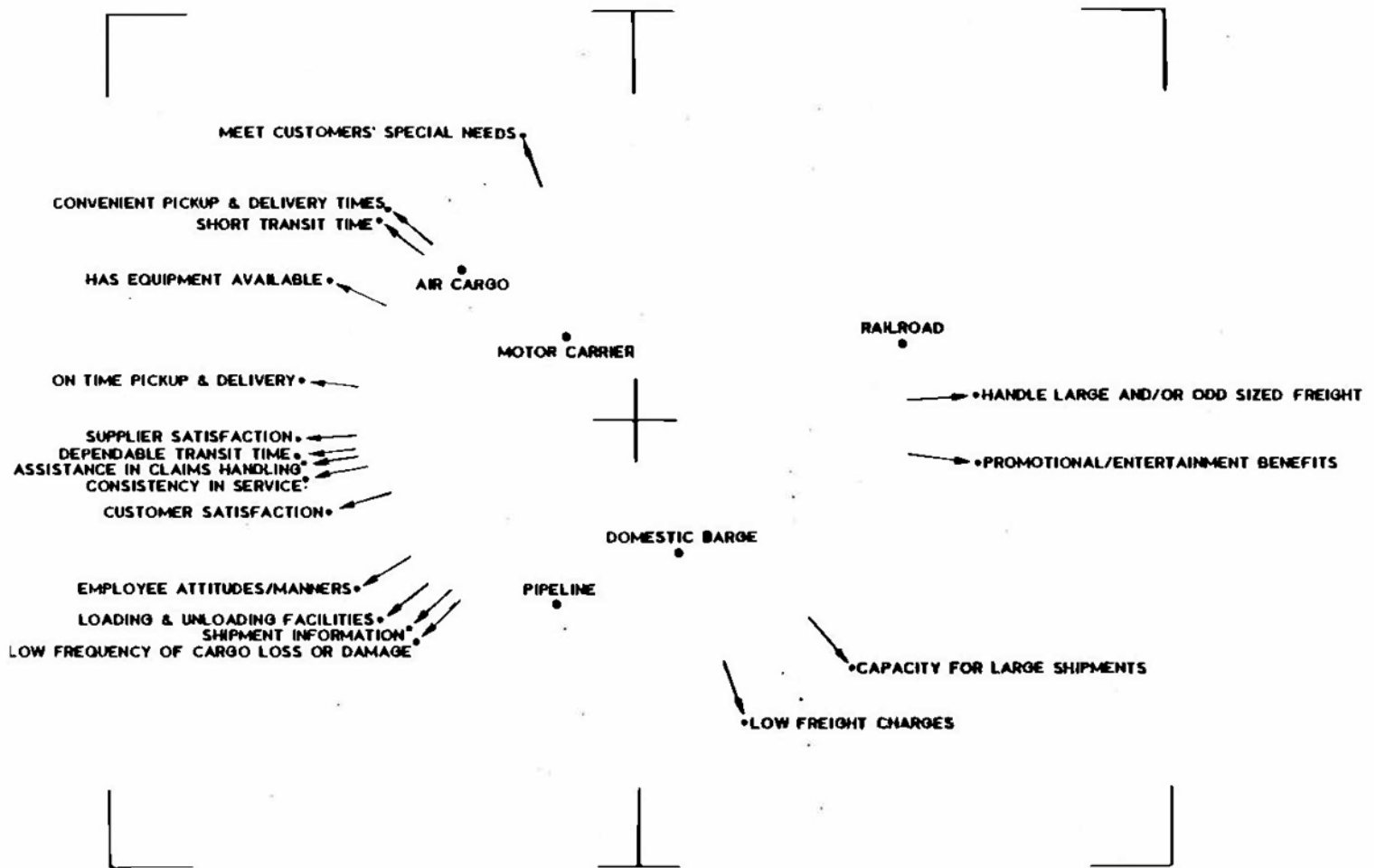


FIGURE 1

MODAL PERCEPTUAL MAP OF INDUSTRIAL SHIPPERS (USERS)

represented by a vector passing through the origin of the two-dimensional space, with the modal alternatives represented as points in the same space. To determine how much of a factor a mode is

perceived to offer, draw the vector for the factor through the origin, then draw a line perpendicular to this vector from the mode's position in the space. The relative position of the factor vector represents the relative perception of how much of the factor is offered by the mode. The closer to the head (arrowhead) of the factor vector the more the mode is perceived to offer.

For example, the vector for low freight charges, (see Figure 1) shippers perceive air cargo to have significantly higher freight charges than any other mode. Motor carrier is perceived as having the next highest freight charges followed by railroad, barge and the lowest pipeline. Not only is the ranking relevant, but the distance along the vector provides a measure of similarity. The air cargo mode is perceived as a unique transportation method having distinctly higher freight charges than for example, both pipeline and barge which are perceived together as quite similar.

The respondent profile indicates an average of 15.8 years of seniority with their company having some 18.7 years of transportation experience with 2.2 different companies. While only 16.2% of the respondents had degrees in transportation, 78% had at least a Bachelor's degree of which 31.1% were in business and 14.1% in liberal arts. Most of the respondents were with large firms, 60.8% employed 1,000 or more, 66.7% had annual gross revenues in excess of \$100 million and 58.7% exceeded \$100 million in total assets. Although shippers were concentrated in the agricultural services, food and kindred products, chemicals, petroleum and coal products and utility sectors, users were spread across all varieties of industry.

## Discussion

Using general models of transportation choice as a research framework, buying center members' perceptions become primary to the choice process. Assessing industrial shippers' perceptions via techniques such as multidimensional scaling enables shippers to reevaluate their decision process to insure congruency with corporate goals and objectives and carriers to adjust services and marketing strategy to better meet users needs.

The research indicates that industrial shippers have distinct attitudes on the importance of transportation attributes. Although relatively speaking, the attribute, low freight charges is an important factor considered in selecting a transportation method, on average shippers place more importance on nontransportation costs through their service requirements needs than transportation costs as reflected by low freight charges. The significance of the mean response scores listed in Table 2 is that for this class of shippers, meeting their customer's transportation requirements is the most important criteria in the selection of a transport mode. Hagan (1983) cites how one carrier, Flying Tigers, has altered its service mix from airport to airport to door-to-door to assist shippers in meeting customer's requirements. In general industrial shippers are not overly concerned about short transit time. Their primary shipments involve the movement of low value per unit weight bulk commodities. Low cost dependable consistent service is the key to this class of shipper. Short transit time ranks 14th out of 18 criteria for the typical freight modal choice decision. However, at any time if customer requirements dictate the use of air cargo that mode would be chosen for nonroutine shipments.

The shippers' perceptual map (Figure 1) provides interesting insight into the modal selection process and how users view alternative modes. The air cargo mode is perceived as a distinctive transportation method, quite dissimilar from other modes. Of particular significance is the relatively large distance between air cargo and motor carrier and more so between air cargo and railroad, barge, and pipeline. The large distance indicates that a very large change in the respective attributes would be required before the respondent(s) would consider the other modes to be similar, therefore, a close substitute. The mode most aligned with air cargo which could be considered as the primary substitute for domestic shipments is motor carrier. Alterman (1984) finds that as a result of recent deregulation within the air cargo and motor carrier industries, traditional air cargo companies have expanded their service to include both motor carrier operations and nationwide surface freight forwarding. Air cargo companies now acting as "full-service" carriers have expanded capabilities consistent with this research in an attempt to capture additional commodity shipments that complement the air cargo mode.

The air cargo mode is perceived as a means to meet special customer needs offering short transit time, convenient and on time pickup and delivery schedules, and is always available. The trade-off is that this bundle of attributes is provided at a premium freight rate. The mode is also perceived as being inflexible with provisions for large and/or odd sized freight and shipments. Air cargo although in general does not meet the requirements of the bulk industrial shipper for the majority of freight types and shipments does provide the ideal mode for certain priority movements.

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