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VALUING THE ATTRIBUTES OF FREIGHT TRANSPORT QUALITY: RESULTS OF THE STATED PREFERENCE SURVEY.

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Abstract.

This paper presents the results of a survey of fifty firms transporting ten commodity groups, using an interactive stated preference game to obtain values of the rate reduction necessary to compensate for longer transit times, poorer reliability and the use of intermodal systems. Generally, the pattern of results is as expected, with the quality of the transport service being less important for low value products in industries with high levels of stockholding, and vice versa. Quality requirements are also generally less stringent when products are moving to depots than to customers.

In a critique of the method, some reservations are expressed both about the reliability of the results, and about the high cost and time of the survey method. Nevertheless, we conclude that overall the approach has worked reasonably well, and yielded much valuable data; we know of no alternative method which could have yielded quantitative valuations in these circumstances.

1. Introduction.

As part of the project on Forecasting Freight Mode Choice fifty firms participated in a survey, the aim of which was to estimate the value manufacturers place on quality of service attributes in the transport of their goods. Apart from the quantitative results gained from the use of computer gaming techniques, qualitative information was collected regarding both the individual firms and the sector of industry of which they form a part. The design of the survey method was decribed in a paper given to the PTRC conference in Bath in 1988 (Fowkes and Tweddle 1988). Most of the interviews were undertaken during the winter of 1988/89.

The range of goods investigated varied from cement and fertilisers, representing low value bulk commodities, to domestic appliances and chilled foodstuffs, which were thought to require a very high quality of transport service. The results seem to largely follow the pattern expected, with high value, or perishable, goods being less attracted by the possibility of using lower quality services at reduced freight rates.

The aim was to visit up to six companies in each of the industrial sectors selected, and seek information on typical long distance (over one hundred miles) freight movements. However, some sectors consisted of very few firms, and less than six were willing to be interviewed. In other sectors few firms moved products over a distance greater than one hundred miles.

In the following chapters, a qualitative and quantitative assessment of each industry is given. This is followed by a critique of the method adopted for the study.

2. Cement, Lime and Plaster. (SIC 2420, NST 64/65).

Until recently, the cement manufacturers in the U.K. had a pricing agreement which resulted in this product being sold on quality of service to the customer because the price for delivery to a location was the same whatever the origin of the product. This encouraged the manufacturers to sell in each others back yards, involving long inter-regional trunk hauls.

Since the price agreement collapsed, the sale of standard cement products has been concentrated on more local areas surrounding each plant, in some cases 50 miles being the maximum distance the product is moved from the plant. This does not apply in Scotland, where the only production source is located at Dunbar. Further south only special grades, such as sulphate resisting cement, are transported over long distances to allow economies of scale from the concentration of production at a minimum number of plants.

The effect of these changes was that, while the firms were willing to see us, only five plants proved to have regular flows of over one hundred miles. With the exception of one small manufacturer, all the companies had several plants each serving a region of the U.K. Some product was imported, but again this was distributed in the area fairly close to the port of importation.

Cement was chosen as a commodity to represent a low value product, generally handled in bulk. Our examples fulfill this requirement as all were moved in bulk by road or rail, even though one flow consisted of an allied product, Hydrated Lime. This has similar value and handling characteristics to cement, though the manufacturer insisted on it being moved in dedicated powder tanks to avoid possible contamination, which may have increased the cost of transport.

Originally it was intended to survey an alternative low value commodity. This was to have included firms producing solid fuels (namely coke) but as the movements from the plants are controlled by a large number of small merchants it appeared to be doubtful whether a structured survey could be organised successfully. Cement is thus the representative of this type of product in the survey.

Table 2.1 Current Attributes of Cement Traffic Sample Flows.

Based on flows examined:	Average	Range
Transport cost per tonne mile	5.3p	
Average distance	180 miles	110-245 miles
Value (per tonne)	£51	£38-£60
Flow (tonnes p.a.)	41k	6-99k
Delivery day	AM.2	
Reliability (% arrive on time)	96%	
Mode used: Road	3	
Rail	2	
Consignee: Customer	3	
Depot	2	

Table 2.2. Valuation of Attributes.

Half day longer/ shorter transit	11.7% (1.3)
1% more/less delivered on time	2.0% (0.05)
Use of Inter-modal system	8.9% (11.4)
Firms accepting	
Transhipment	3
Demounts/Piggyback	1

Note: The percentage expressed represents change the change in the freight rate needed to accept poorer quality service. Standard errors are shown in brackets.

The three flows examined which were direct to customers demonstrated the requirement for a much higher quality of service

than those to the depots, in the case of the former a very reliable service to conform with a booked arrival time next day was being obtained. The flows to the depots were by rail, an average of 88,500 tonnes p.a. The respondents indicated that though a daily delivery would be required, reliability could fall substantially if costs could be reduced.

In the SP game, none of the respondents exceeded their stated maximum lead times, though two broke their stated reliability constraints. However, this occured when very low transport costs were obtainable.

Comments made by the Distribution Managers in the cement industry during the interviews, indicate that the prospects of gaining cement traffic for intermodal systems may be limited. This is partly because any bulk tanks would have to be capable of using existing loading facilities which is thought to restrict the volume of the tank which could be provided. In the case of the small, but still substantial, flows of bagged products, swap bodies would be suitable. However, this traffic only moves over short distances, and an intermodal system is unlikely to be cost effective other than for a small part of the market for the transport of cement.

3. Tubes, Pipes and Fittings. (SIC 2220)

Six companies were interviewed in this sector, all manufacturing within the selected commodity group. Unfortunately the range of goods proved not to be homogeneous, represented by everything from seamless precision tubes to large diameter pipes, semi-finished and finished tubes, as well as joints, angles and valves. The different products demanded various transport services and this probably contributed to the large variance in the results of the SP data. The largest typical flow was over five hundred times the volume of the smallest.

The six flows examined as being typical mainly consisted of consignments consolidated and delivered as part loads by road. One was a trainload movement. All were lifted on to vehicles, though not only by cranes, but by fork lift trucks as well. The average characteristics of the flows are shown in Table 3.1. while Table 3.2 contains the results of the SP game.

In general the tube industry aims to produce most of its output to the order of individual companies. This means that the delivery requirements may be very tight, coming at the end of the process and being expected to absorb delays in the production cycle. A high priority has thus been allocated to the speed of transit, many of the consignees of the tubes carry little if any stock and rely on 'just in time' delivery from the tube manufacturer to fit in with their own production schedules.

The main reason stated for the lack of interest in using swap body bi-modal sytems was experience of damage from the transfer of containers, which caused dents in precision tubes in particular. Given this attitude, together with the small flows apparent in the industry and the JIT delivery constraints, rail would seem to have an up-hill task in tempting tube manufacturers

to switch to either bi-modal or wagon load transport. B.R. can compete for trainload traffic where the flow of product can generate such quantities on a regular basis, whether the consignee is a customer, depot, or stockholder.

Table 3.1 Current Attributes of Sample Flows of Tube Traffic.

Based on flows examined:	Average	Range
Transport cost per tonne mile	9.4p	
Average distance	158 miles	100-230
Frequency of dispatch	9 per month	2-20 per month
Flow (tonnes p.a.)	28,350	250-135,000
Value (per tonne)	£725	£100-£1,500
Delivery day	2	AM.2-PM.3
Reliability (% arrive on time)	96%	90-99%
Consignee: Customer	5	
Depot	1	
Mode Road	5	
Rail	1	

Table 3.2. Valuation of Attributes.

Half day longer/ shorter transit	25.1% (1.7)
1% more/less delivered on time	6.1% (0.2)
Use of Inter-modal system	13.9% (12.1)
Firms accepting	
Transhipment	3
Demounts/Piggyback	1

4. Oil and Petroleum Products. (NST-325)

In this sector only four companies were interviewed, which was partly because of a lack of willingness on the part of some of the large companies, or of finding an interviewee with suitable knowledge. Most of the major products are only distributed regionally, one manufacturer drawing from another's plant (or importing product) for delivery in areas where there is a shortage of production capacity.

As was the case in the cement industry, only specialist products are moved over long distances on a regular basis. The typical flows examined were of a variety of products including lubricating oil, and fuel oils. All but one were of bulk movements, the other being partly in bulk with the balance in palletised goods. The sample can thus reasonably represent the movement of bulk liquids. In general, relatively large stocks

seem to be held in the distribution system, whether by the manufacturer or the customer/retailer. All the flows were to depots or large users, one being by trainload or part train load.

The availability of stock meant that poor quality transport services could be accepted if this resulted in a cost reduction, though on some occasions a high quality operation would be required to cover stock shortages. The average current distribution performance is shown in Table 4.1, with the result of the SP trade offs in Table 4.2.

In general, the use of bi-modal techology was acceptable to the respondents, provided equipment suitable for the carriage of hazardous goods on rail could be made. Most of the long distance flows moved on a regular basis, though to win the traffic rail would be required to attain a high level of utilisation of specialised vehicles, such as those used for the movement of liquid petroleum gas (LPG).

Table 4.1 Current Attributes of Sample Flows ofOil Products Traffic.

Based on sample flows:		Average	Range
Transport cost per tonne mile		7.4p	
Average distance		267 miles	118-520
Frequency of dispatch		6 per week	0.5 to 11
Delivery day		AM.2	PM.1 to AM.3
Reliability (% arrive on time)		96%	95% to 99%
Flow (tonnes p.a.)		5,920	480 to 11,200
Value (per tonne)		£330	83-800
Consignee:	Customer	2	
	Depot	2	
Mode	Road	3	
	Rail	1	

Table 4.2. Valuation of Attributes.

Half day longer/ shorter transit	10.5% (0.7)
1% more/less delivered on time	1.1% (0.01)
Use of Inter-modal system	13.7% (8.3)

In playing the SP game, all the respondents exceeded the level of unreliability they had stated would be the worst that they could accept. In the case of the lead times, two of the respondents exceeded the lead times though only when very large discounts were on offer. This indicates that many movements in the oil

industry could have lead times extending to four or five days if the transport cost was very low, or reliability falling to the order of 75% on time for some 20% discount on the rates. These fairly liberal service demands probably reflect the level of stock held within the distribution system, which allow customer service levels to be maintained even with poor trunk movement operations.

Given the low priority for high service levels, and the acceptance of bi-modal technology by the respondents, rail should be attractive for the movement of oil products if suitable equipment can be developed and utilised effectively. Only one of the respondents would accept transhipment of the product, and this was already being moved by rail.

5. Fertilisers. (SIC 2513).

Of the six typical flows examined in this industry one consisted of semi-finished product (moved in bulk) for use in liquid applications, the others were all finished product to either depot or customer moved in 'big bags' or bags on pallets. One producer made blended fertilisers, the other four were compound maufacturers. Production of the latter has been concentrated on a few large plants in recent years. The sample reasonably represents the chemicals industry for dry bulk and palletised goods, though not bulk liquids, except in so far that the freight rates may be lower than the average for the chemical industry.

The main problem for distribution of fertiliser is the severe peak of application of the product to the land in the spring, and to a much lesser extent in the autumn. The peak is alleviated in a number of ways, allowing production to take place all year. Farmers are offered discounts to take delivery of product during periods of low demand, the manufacturer thus avoiding long term storage. The product can be kept outdoors under sheets, though most depots have covered warehousing, and the industry incurs substantial storage costs as a result, most firms quoting more than 25% of their fertiliser distribution budget being spent on storage alone. This figure does not take account of the discounts given to avoid storage.

These factors contribute to an industry which does not require a high quality of transport service, at least for movements to depots. Separate results are given in Table 5.2 for delivery to customers. The figure of 96% reliability for on time delivery given in Table 5.1 should be treated with caution as the time bands for arrival at the depots are usually generous (within three days in the case of one typical flow). As the main pressure on distribution of this product is to reduce cost, most manufacturers use the backloading of lorries extensively to minimise cost, or trainload operation to rail connected depots, this being reflected in the low cost per tonne mile.

Given the pressure to reduce costs, possible savings from improved materials handling seem to have been ignored by the industry. Almost half the finished product is now transported in 'big bags', a type of intermediate bulk container (IBC), containing 1.25 tonnes of fertiliser. These are not generally

stowed more than one high, which results in both road and rail vehicles being unable to carry their maximum payload. There seems to be a reluctance to increase the height of the individual bags to overcome this problem, which also applies to firms who do not allow 50kg bags on pallets to be overstowed. Again, transport economies would ensue from adding an extra layer of bags to each pallet, though some resistance in the market may be encountered.

Table 5.1 Current Attributes of Sample Flows of Fertiliser Traffic.

		Average	Range
Transport cost per tonne mile		4.2p	
Average distance		177 miles	154-234 miles
Frequency of dispatch		16 per week	
Flow (tonnes p.a.)		27,000	12,000 to 48,000
Value (per tonne)		£117	£100-£120
Delivery day		AM.2	PM.1-PM.3
Reliability (% arrive on time)		96%	90-99%
Consignee:	Customer	2	
	Depot	4	
Mode	Road	4	
	Rail	2	

Table 5.2. Valuation of Attributes.

	All firms	Customer delivery	Depot movement
Half day longer/ shorter transit	4.9% (0.1)	6.5% (0.7)	4.6% (0.1)
1% more/less delivered on time	0.7% (0.004)	1.2% (0.1)	0.7% (0.004)
Use of Inter-modal system	0.0% (1.8)	(+)1.7% (16.8)	0.3% (1.9)

As was the case with oil products, the large stocks held in the distribution system allowed the manufacturers to use low quality transport services in order to reduce costs, at least in the case of deliveries to depots. Here lead times of up to ten days could be accepted, depending on the stock at the individual depot, while reliability could fall to only 80% on time. In the SP game such service levels would be accepted for discounts on the transport rate of between 5% and 20%. Deliveries direct to the customer demonstrated much higher constraints, in excess of 95% reliabilty being required. Lead times could be extended to the third day, but in the case of the customer deliveries the respondents indicated this would only be attractive if large discounts could be obtained.

B.R. already carries substantial quantities of fertilisers, mainly from the producer plants to an extensive network of depots. The main constraint on expanding this trainload and wagonload traffic is that many of the road served depots are not rail connected. The concentration of production at fewer plants, together with larger depots has increased the routes which can be served by company trains, though partly at the expense of wagonload traffic to smaller depots which genrally gave comparitively poor wagon utilistaion

However, there does seem to be some interest in a more centralised approach to stock holding, with more deliveries direct to the farm if this is possible. This seems to be the distribution method used by most of the blended fertiliser producers. Bi-modal techniquies would allow rail to compete for this type of movement over long distances.

Of the products in the sample, fertiliser was the most homogeneous not only in terms of value, but also materials handling methods, distribution systems, and cost of transport. All the respondents were keen to reduce costs and willing to accept alternative services, particularly for movements to depots.

6. Domestic-type Electrical Appliances. (SIC 3460, NST 93).

Of the six flows examined as typical, two were to depots usually in full loads, and four were to customers either as full or part loads. Four of the flows were movements of white goods. Generally the trunk movement was of goods of low density and the cost in Table 6.1 is based on a vehicle mile, though one flow was of part loads, where the consignor paid a flat rate per item (of any size) to that destination. Generally products were handled loose in cartons, with some palletisation.

Of the attributes examined speed of delivery was the most important, mainly because retailers in reducing their inventories put pressure on the supplier to shorten order/lead times. This is considered to be necessary because of the severe competition in the domestic appliance industry and the fact that consumers choose from a range of goods on display at a retail outlet. It is

Table 6.1 Current Attributes of Domestic Appliance Traffic.

Based on sample flows:		Average	Range
Transport cost per vehicle mile		£1.09	
Average distance		191 miles	120-300
Frequency of dispatch (loads)		11 per week	1/month-30/wk
Delivery day		AM.2	PM.1 to PM.4
Reliability (% arrive on time)		96%	90% to 99.9%
Value (per load)		£24,300	£10,000-£50,000
Consignee:	Customer	4	
	Depot	2	
Mode	Road	6	

thus of paramount importance to always have one item in stock at each outlet. Reliability seemed less important (see Table 6.2), though in the case of customer deliveries this currently is very high even though many receivers have one hour booking-in slots.

None of the respondents would allow transhipment if they could possibly avoid doing so, as this is a major source of damage to the cabinets. All six were willing to accept demounts or swap bodies, though it was thought that they would not be economic because of the volume constraints, and piggyback trailers would certainly not be suitable for this reason. In the SP game there were a few responses for services outside the contraints stated, when a very low rate was offered.

Table 6.2. Valuation of Attributes.

Half day longer/ shorter transit	14.2% (0.8)
1% more/less delivered on time	3.0% (0.03)
Use of Inter-modal system	8.9% (5.8)

Four of the companies interviewed used either own account or contract hire fleets for most of their distribution requirements. This gave additional control over valuable stock, and as part of the trunking operations gave loads of goods or components in both directions the costs were not high.

Given the combination of high service levels, volume constrained loads (only 7-9 tonnes in a 12 metre trailer), and own account operation, rail is likely to find this a difficult market in which to compete, at least for domestic traffic. There are however, large flows of domestic appliances from the continent, especially Italy, and the greater distance may give rail a competitive edge when the Channel Tunnel is opened.

7. General Goods.

In the section covering a variety of general merchandise four commodity groups were selected to reflect various degrees of urgency. All the goods were expected to be palletised by one means or another, though some of the paper was moved in large reels. The other three commodities included in this section were foodstuffs (chocolate, beer, and temperature controlled foods represented by processed meats).

7(a). Pulp, Paper & Board. (SIC 4710, NST 841/972/973).

Within this group the products selected for the typical flows varied. One consisted of resin impregnated board transported in

skips, one of coated paper, and one paper product manufactured under the food and hygiene regulations. Two of the sample flows moved as large reels, the remainder as palletised rolls or boxes which could not be overstowed resulting in volume constrained loads on a 12 metre trailer.

All except one flow was to a customer and all these, as well as the depot, held only sufficient stock of each type or grade of paper to fulfill planned production requirements. The suppliers order/lead times were generally short as a result of this factor, next morning or next day delivery being essential to remain competitive. The short lead time is reflected in the valuation of the speed of delivery.

Of the typical flows examined, only two used road haulage on a spot hire basis. The other companies either used own account or contract hire vehicles to gain a high level of service. This factor may be reflected in the resistance to using intermodal transport because of the loss of control.

Table 7(a).1 Current Attributes of Sample Flows of Paper Traffic.

Based on sample flows:	Average	Range
Transport cost per tonne mile	9.4p	
Average distance	158 miles	120-290 miles
Frequency of dispatch	4.5 per week	1-12 per week
Delivery day	AM.2	AM.2-PM.2
Reliability (% arrive on time)	96%	95%-100%
Value (per load)	£24,200	£4k-50k
Consignee: Customer	4	
Depot	1	
Mode Road	5	

Table 7(a).2. Valuation of Attributes.

Half day longer/ shorter transit	25.1% (1.7)
1% more/less delivered on time	6.1% (0.1)
Use of Inter-modal system	13.9% (12.0)

The prospects for movement of finished paper and board products depends critically on the level of service which can be provided, especially for next day delivery to customers. The firms in the survey would not allow transhipment of the product, except for one flow which was moved in skips. They would all accept either demounts or piggyback trailers, though some with reservations. In the case of raw and semi-finished products in the form of timber

or pulp, B.R. already has gained significant movements within the industry. This may be partially because the paper mills hold relatively large stocks of a few input materials, whereas the stocks of a large range of finished goods are minimal.

7(b). Chocolate & Sugar Confectionary. (SIC 4212, NST 132).

This industry was used in the pilot study for the project. As a result, the data was collected in a slightly different form, mainly with regard to the intermodal technology aspect.

Most of the firms interviewed were of medium or large size, and together supplied a large proportion of the British market. All of these had an extensive network of depots in their distribution system. Even the small companies used a few depots operated by third party distributors.

Although all the typical flows were of traffic to these depots, usually in full vehicle loads, the manufacturers did point out that in recent years an increasing proportion of their output was delivered direct from factory to the Regional Distribution Centre (RDC) of a supermarket chain as a consolidated load of various products. Some manufacturers also built up consolidated loads from factory to depots in order to fill trunk vehicles both by weight and by volume. This can be done by mixed loads of solid chocolate products together with less dense lines such as selection boxes.

In general the firms required a fairly high quality of service, even to their own depots. As most held reasonable levels of stock at the depots, this would appear to be mainly for reasons of stock control and mimimising the time the product spent in vehicles (which in many cases were insulated). In hot weather, certain product lines would not be moved to avoid deterioration in transit.

The large firms expected a much higher level of service than the smaller manufacturers. This may be mainly because the large firms are in a position to gain greater savings in the area of stock and inventory control if the transport movements can be made faster and more reliable.

The difference in valuations between large and small firms was most marked in relation to the physical transhipment of the goods. Most manufacturers only use very light packaging, the product being ready for presentation in the shop. The result was that on average, they considered each additional lift to be worth over 40% of the freight rate. On the other hand, the small firms were using more robust packaging because their products, despatched in small consignments, were being transhipped between a carrier's vehicles en route, and an additional lift made little impact.

The large chocolate manufacturers were moving away from own account trunking operations, though tending to retain control if not ownership over secondary distribution operations. Nevertheless the industry retains some very large own account fleets.

One manufacturer had until recently used rail for some movements. The reason for the change to road was mainly the alterations to the pattern of distribution. Another firm does still use Freightliner, though not in the summer months.

The dislike of transhipment of the goods would indicate that rail cannot gain chocolate traffic, unless it is direct from factory to depot. Although the questionnaire did not specifically ask for information on acceptance of intermodal systems, it would appear the piggyback trailers, and particularly swap bodies could be used on some of the long distance routes.

Table 7(b).1 Current Attributes of Sample Flows Chocolate Traffic.

	Large firms	Small firms
Transport cost per tonne mile	9 pence	12 pence
Transport cost per pallet mile	7 pence	6 pence
Average distance	183 miles	160 miles
Frequency of dispatch	19 per week	1 per week
Delivery day	AM.2	AM.2
Reliability (% arrive on time)	98%	90%

Table 7(b).2. Valuation of Attributes.

	Large firms	Small firms
Half day longer/ shorter transit	13% (1.0)	7% (3.3)
1% more/less delivered on time	5% (0.2)	0.4% (0.3)
1 extra/less collection per week	1.5% (0.2)	1.5% (0.3)
1 extra/less lift in transit	42% (1.7)	2% (1.9)

7(c). Meat Processing. (SIC 4122, NST 141/147).

Only three manufacturers were interviewed in this sector. The reason for this was that the typical flows were of fresh chilled product, which had a delivery requirement of only a few hours from production, generally for consumption the next day. This meant that the interviewee was unable to trade (except within very small margins not discernable on the software used), because delivery outside a very narrow transport and delivery window would result in the receiver rejecting the load. Therefore, the goods moved at predetermined times or not at all. This is reflected in the levels of service and rates shown in Table

7(c).1. While the stated preference exercise produced no useful data if analysed in the usual way, inspection of the responses together with the subjective answers given in the interview did provide some useful information. It established the high level of service which can be achieved by road transport when it is required of it, at a price. Even compared to the reasonably good quality of service demanded by the domestic appliance manufacturers, the rates for chilled goods are about 45% greater, which can be partly explained by the specialised equipment used.

The firms contacted also had a small frozen goods operation, but this was only a marginal activity resulting from spare capacity at the processing plants being used for frozen as opposed to chilled output. Over the last decade there has been a steady move in demand from frozen to chilled processed meats.

In all the typical flows, the firms were delivering at least one trailer load per day to the RDC of a supermarket chain. All were by road using refrigerated trailers, two using own account vehicles. As the trunk haul cost only forms about 1% of the value of the load, whereas the profit at risk through missing a delivery window may be some £10,000, apart from the cost of disposing of the returned load, for a transport service to be considered it must be able to offer extremely high levels of service consistantly without failure. It is doubtful whether rail could conform to the delivery window required, except in the rare case of a trainload movement. Movement of chilled goods by a mode other than road transport is therefore unlikely.

Table 7(c).1 Current Attributes of Chilled Foodstuffs Traffic.

Based on Sample Flows:	Average	Range
Transport cost per vehicle mile	£1.59	
Average distance	191 miles	160-250
Frequency of dispatch	6 per week	6 per week
Trailer utilisation (volume)	82%	70%-90%
Delivery day	PM.1 (ave. 6 hours from despatch)	
Reliability (% arrive on time)	99.66%	99.1%-99.99%
Value of load	£32,000	

7(d). Brewing and Malting. (SIC 4270, NST122).

Within the brewing industry there remains some movement in bulk tankers (as well as container tanks) to canning plants. However, all the typical flows examined in the survey were mainly of palletised kegged beer with a proportion (say 20%) in the form of cans or bottles, shrink wrapped on pallets. All the brewers interviewed operated an own account fleet for trunking operations. This could be justified because of the return of empty kegs to the brewery for refilling, though in most cases any imbalance of traffic was sub-contracted to third party hauliers.

It became apparent that there exists a considerable amount of interworking between breweries because of specialisation of

product lines at production sites. Of the six flows examined, in one case the vehicle returned loaded, in another case two out of three returned loaded. In this, and other cases, most of the remaining returning vehicles carried empty kegs.

The value of the kegs in which most beer is delivered to public houses and other outlets are worth some £90, whereas the value of their contents is £60-70. A large inventory cost is thus incurred from the holding of kegs and other similar containers, and as a consequence the brewers require an efficient transport service for return empties, as well as product being delivered. This factor is reflected in the fairly high valuation given to speed of service in Table 7(d).2.

Table 7(d).1 Current Attributes of Brewery Traffic Sampled.

Based on sample flows:	Average	Range
Transport cost per vehicle mile	£1.39	
Average distance	175 miles	166-212 miles
Frequency of dispatch	7 per week	1-37/week
Delivery day	AM.2	PM.1-AM.3
Reliability (% arrive on time)	95%	90%-99%
Value per load	£15,400	£6,700-£25,000
Consigned by road	6	
Consignee: Depot	2	
Another brewery	4	

Table 7(d).2. Valuation of Attributes.

Half day longer/ shorter transit	29.2% (5.2)
1% more/less delivered on time	5.0% (0.2)
Use of Inter-modal system	3.3% (20.8)

Rail already has some traffic from the brewing industry, including substantial flows of container tank traffic. As a result most of the companies interviewed either had knowledge or experience of using rail. None had any resistance to the use of inter-modal systems, and four of the repondents would accept transhipment, at least of kegged beer. The main reason for not using rail was lack of volume in containers for packaged and kegged products, and the slower speed of round trip time of kegs sent by rail which would add considerably to the brewers already large investment in these containers.

This assessment would seem to indicate that a high quality swap body or piggyback service, which could provide more volume, would

be attractive to brewers. However, because vehicles are currently loaded in both directions own account operation predominates. To change mode, the operator would require a considerable inducement to dispose of their fleet.

8. Container Traffic.

For the purposes of the survey it has been assumed that commodities moved in containers require the same service and cost levels as when they are moved by other modes, or sub-modes. As far as domestic traffic is concerned this is probably the case. However, it may not hold true where maritime export traffic is concerned, where a poorer service within the U.K. may be acceptable, given that stocks of the goods are kept in export markets to cover the long order/lead times in replenishment.

All the firms interviewed were asked if they used containers either domestically or for exports. In the case of internal traffic very few used them, the main problem being the small cube which precluded the acheivement of an economic payload. An exception to this was the movement of bulk beers in Isotanks to canning plants.

Although companies had rejected containers for domestic traffic, they were using them for exports. In this case the uneconomic part of the movement to the docks was more than compensated for in overall shipping charges, and avoiding multiple handling of the goods. The volume constraint was not of paramount importance.

9. Machinery & Miscellaneous Goods.

Within this sector the commodity chosen was Electrical Equipment for Motor Vehicles and Aircraft (SIC 3434, NST 931). Unfortunately it proved difficult to find manufacturers in this sector who had regular flows of traffic moving a distance greater than 100 miles, because most of the components are made in the Midlands for the local car assembly plants, or the vehicle manufacturer takes responsibility for the transport of the parts. As a result, only four successful interviews were completed.

The method of handling was either caged pallets or skips. Consignments were often small, being used by manufacturers on a 'just in time' basis whether the frequency of delivery was once a month or once a shift. The typical flows examined were to smaller producers, outside the Midlands, who probably held relatively high stocks compared to the major manufacturers. This may mean that the results given in Tables 9.1 and 9.2 are not an accurate reflection of the situation when applied to large volumes over either long or short distances.

Given that most of the typical flows moved by consolidated vehicles loads by road to customers, small demountable bodies trunked by rail would seem to have a possible role to play in the transport of components for car and other manufactured goods. The distances are generally fairly short, most flows being from the West Midlands to the South East which would probably exclude rail from being competitive.

Table 9.1 Current Attributes of Sample Flows of Electrical Equipment Traffic.

Based on sample flows:	Average	Range
Transport cost per pallet mile	15.2 pence	
Average distance	127 miles	100-200 miles
Flow (pallets per month)	4	1 to 8
Delivery day	AM.2	PM.1-AM.3
Value per pallet	£2,500	£356-£15,000
Reliability (% arrive on time)	96%	90%-98%

Table 9.2. Valuation of Attributes.

Half day longer/ shorter transit	25.8% (2.8)
1% more/less delivered on time	2.6% (0.1)
Use of Inter-modal system	3.8% (10.9)

10. Mode Choice for the 'Typical' Flows Examined.

Of the fifty flows examined, five use rail in the form of company trains. In addition, one flow mainly by road used rail wagonload for 20% of the volume for product going via a storage silo. Three of the trainload flows had parallel road movements which formed between 3% and 33% of the total flow. The reasons given for using a mixture of modes where a combination of the following:

- Materials handling problems of various grades.
- Utilisation of own account vehicles.
- Taking advantage of return loads rates by road haulage.
- Dual sourcing of the purchase of transport.

Rail was chosen for flows of cement, fertiliser and oil, where the typical flow was a large volume of relatively low value goods which was for delivery to a stockholding depot. Although the brewers did not provide any rail movements as being typical, several did use either rail wagonload or Freightliner for some long distance movements to depots.

In order to determine whether the service requirements for traffic actually using rail are lower than flows of the same commodity using road, data gathered from the cement and fertiliser manufacturers was combined to give average results for the two industries. The data was then split by mode of transport. This process produced the results in Table 10.2; generally the traffic by rail had a lower threshold at which service attributes would be traded for changes in cost, as well as lower rates.

Table 10.1. Fertiliser and Cement Traffic Flows Combined.

Attribute	Average	Rail	Road
Transport cost (index)	100	84	109
Ave. delivery time	AM.2	AM.2	AM.2
Worst acceptable (range)	AM.2-AM.8	AM.2-AM.8	AM.2-PM.4
Average reliability	96%	95%	97%
Worst acceptable (range)	99%-70%	90%-70%	99%-85%

Table 10.2 Combined Valuation of Attributes.

Attribute	Average	Rail	Road
Half day longer/ shorter transit	5.5% (0.1)	4.3% (0.2)	8.6% (0.4)
1% more/less delivered on time	0.8% (0.004)	0.7% (0.005)	1.4% (0.2)
Use of Inter-modal system	1.2% (1.6)	0.8% (2.3)	2.2% (5.2)

In all the other commodities examined, road transport predominated, even when the number of loads despatched averaged thirty per week. The main reason for rail not being suitable seems to be a combination of the distance being less than 200 miles, together with goods of high value and low density. In a number of cases manufacturers were also able to load own account vehicles in both directions, working on multiple shift patterns to minimise cost.

All except one of the firms interviewed who were connected to the rail system made use of the siding. One firm with a depot situated on a canal used solely road transport. However, several firms had been rail users but no longer used this mode because B.R. could no longer provide a competitive quality of service compared with road.

A very high proportion of the flows of more valuable commodities are direct deliveries to customers, few of whom are rail connected. Most companies were very strongly against having their goods physically transhiped because of the risk of damage and delay. They were generally willing to accept inter-modal technology in the form of demountable bodies, or larger swap bodies if suitable types could be provided with much larger volumes than current Freightliner containers. A few firms would only accept piggyback trailer systems which avoided the unit being lifted. The worst acceptable service levels, which are typical for each commodity, are given in Table 10.3.

Table 10.3. Typical Worst Acceptable Service Levels.

Reference Commodity group	2 Cement & Lime		3 Tubes	4 Oil Products	5 Fertilisers	
Consignee	Customer	Depot	Customer	Customer	Customer	Depot
Delivery day	AM.2	PM.2	PM.2	AM.3	PM.2	PM.4
Reliability (%)	97	80	95	95	95	90
Inter-modal	Units	Units	Piggy-back	Units	Transhipment	Units

Reference Commodity group	6 Consumer Durables	7A Paper	7B Chocolate	7C Chilled goods	7D Beer	9 Automotive electrics
Consignee	Customer	Customer	Depot	Customer	Brewery	Customer
Delivery day	PM.2	PM.2	PM.3	PM.1	PM.2	PM.2
Reliability (%)	96	93	92	98	95	92
Inter-modal	Units	Units	n/a	Units	Units	Transhipment

Only two firms completely rejected the use of any form of inter-modal technology. However, many were sceptical about whether an economical system could be provided offering the quality of service required. Generally the minimum quality demanded overall is for delivery next day (preferably morning) with 95% on time reliability.

It seems that while trainload traffic has gained a large number of satisfied customers by meeting these service demands, both actual and potential wagonload and Freightliner users are more sceptical about the service provided. If the inter-modal technology currently being developed is to be successful, then the quality of service must also be improved, particularly with respect to reliability and control.

11. A Critique of the Survey Method.

The survey undertaken proved to take more time than was anticipated. This was partly because an attempt was made to contact the companies in the order in which their name had been generated randomly, which resulted in numerous phone calls and letters to trace a suitably qualified interviewee, and arrange an appointment. With such small sample sizes we felt that to drop firms at the first hint of difficulty and trying the next firm would have potentially permitted bias in the results.

11.1. The Interviewee.

Within companies, each department has its own priorities regarding the production and delivery of the goods they make. Thus the Sales Department tend to place a lower priority on the cost of transport than their colleagues in the Distribution Department. It was generally a senior member of the latter function (often the Distribution Manager himself) who had a broad knowledge of the firms costs and objectives in the distribution of products.

Many senior personnel are reluctant to give valuable time to be interviewed, even when they are satisfied that information given will be held in confidence. As a result, some companies would not state they would not take part, but used delaying tactics in the hope that the survey deadlines would be reached first, adding to the cost and time of the survey organisers in finding alternative firms. This situation could be avoided by contacting a larger number of firms, not aiming to keep to any particular sub-section in the industry.

In general, once a company had decided to take part they were very forthcomong and cooperative. In several cases three or four senior personnel took part in the interview. However, this created its own problems in that disagreements arose between the interviewees about which quality was more important given a range of alternatives to choose from. This tended to extend the length of the interview, and also tended to produce results with larger standard deviations because one person would, in effect, rate one iteration whereas another (with other priorities) would rate another iteration.

11.2. Costs of Survey.

As the senior managers had fairly full diaries, appointments with more than one company in the same area proved difficult to arrange; except in London and the West Midlands, where a large concentration of companies exists. This meant that the interviewer spent a great deal of time travelling for the purpose of a one hour interview. The survey method thus incurs heavy costs not only in travel expenses, but in staff time.

11.3. The Interview.

The first part of the interview did not create any problems, apart from some managers not having all the information immediately at hand. Concentrating on one typical flow of traffic also minimised problems of confidentiality. The only information some companies were reluctant to divulge were those relating to costs. In such cases either an approximate figure was given, or the interviewer estimated a trunk movement cost on the basis of a 38 tonne lorry costing 85 pence per mile to operate; this figure being excluded when calculating the averages given above. Although the 'typical' flow selected was typical in most respects, some had special requirements imposed mainly by customers which may influence the results produced.

11.4. Freedom of Choice of Transport Services.

Though not shown by the results of the stated preference game, during the course of a number of interviews it became apparent that many firms select transport services on the basis that they offer a minimum standard which must be met, and within that standard the lowest cost solution was sought. For instance, most firms required next morning arrival time at destination, with a high degree of on-time reliability. Once the service did not meet certain requirements, it would be given a comparatively low rating. The resulting pattern of rating a particular attribute may have a step function not related to any lowering of the cost of the service. The statistical analysis of the ratings used regression techniqies and these would not fully reflect such non-linearities in the data.

There is a question mark over the degree to which firms are able to react to changes in costs and service levels in freight transport. The estimates of valuations given in this study may therefore only apply over very narrow bands of changes in service, i.e. those over which they were calibrated (which tend to be the typical range anyway).

Apart from the demands for a good delivery service from the customer, changes to the trunk movement also have both service and cost implications in other areas of distribution. These mainly relate to the cost of holding additional stock to overcome deficencies in service not only increasing inventory cost, but also demanding additional accommodation for the product. Where the provision of transport equipment is involved, a slower service may result in poorer utilisation, more equipment being required, thus increasing the investment in the distribution

system. It is difficult for managers adequately to allow for such indirect costs in an immediate response to a hypothetical option.

11.5. Rating the Alternatives.

Most interviewees were able to rank the four alternative services produced by the computer game fairly easily and in a much shorter time than the five alternatives offered in the pilot study. Applying a rating proved more difficult. In particular, assesment of different services on the basis of being twice as good, or half as good as another was problematic, and the same choices given in latter interations of the game could produce completely different ratings. There also appeared to be an initial reluctance to trade between alternatives offered, though once a change of first choice had been taken, resistance to change tended to diminish.

The ability to rate various alternatives at one iteration may also have some limitations. Interviewees seemed to concentrate on a comparison of each individual alternative with the high quality option, rather than all four together. Asking the respondents to rank the alternatives would have been an easier task for them to undertake, but the rankings would not produce the strength of preference gained from relative rating of the options offered.

Interviewees could assess speed and reliability of transport based on their own experience of these attributes. Assessing the intermodal option was more difficult, in many cases being based purely on a description of the system given by the interviewer, and the large standard errors for this attribute partially reflect this difficulty. It was also apparent that firms currently using either rail, or intermodal systems, tended to give the intermodal option higher ratings than firms engaged only in road transport. This may indicate that there is a deficiency in the perception of the quality of service which rail or intermodal services can achieve and that which potential users have of the system.

11.6. Homogeneity of the Product.

Although firms had been chosen for the production of one commodity, in some cases the industry proved to be manufacturing a number of similar products, which were differentiated from the point of view of the distribution service levels required. This became most apparent in the case of tubes. The firms surveyed in this sector made everything from large diameter steel pipes to carry oil and gas to seamless precision tubes for nuclear power stations, while others specialised in the production of joints and valves.

Obviously the value of the products varied considerably, as did their handling requirements and service attributes. These factors almost certainly were in part responsible for the larger standard errors encountered in some products, whereas with cement and fertiliser the product was essentially standard, though the service attributes were more demanding if the typical flow

Table 12. Relative Valuations of Attributes Expressed as a Percentage of the Freight Rate.

Reference Commodity group	2 Cement & Lime	3 Tubes	4 Oil Products	5 Fertilisers (a) All flows	(b) To customers	(c) To depots
Value of:-						
Half day longer/ shorter transit.	11% (1.3)	25% (1.7)	10% (0.7)	5% (0.1)	7% (0.7)	5% (0.1)
Reliability, 1% more/ less deleivered on time.	2% (0.05)	6% (0.2)	1% (0.01)	1% (0.004)	1% (0.1)	1% (0.004)
Use of intermodal systems.	9% (11.4)	14% (12.1)	14% (8.3)	0% (1.8)	-2% (16.8)	0% (1.9)

Reference Commodity group	6 Consumer Durables	7A Paper	7B Chocolate (i) Large firms	(ii) Small firms	7D Beer	8 Automotive electrics
Value of:-						
Half day longer/ shorter transit.	14% (0.8)	32% (4.2)	13% (1.0)	7% (3.3)	29% (5.2)	26% (2.8)
Reliability, 1% more/ less deleivered on time.	3% (0.03)	3% (0.03)	5% (0.2)	0.4% (0.3)	5%	3%
Use of intermodal systems.	9% (5.8)	4% (8.1)	n/a	n/a	3% (20.7)	4% (10.9)
Collections, 1 extra/ less per week	n/a	n/a	1.5% (0.2)	1.5% (0.3)	n/a	n/a
Lifts in transit, 1 extra/less.	n/a	n/a	42% (1.7)	2% (1.9)	n/a	n/a

selected by the firm was direct to a customer rather than a depot.

12. Overall Results.

Though it is apparent that the application of the computerised SP gaming technique has some weaknesses, the overall results produced follow the pattern which had been anticipated. Reference to Table 12 shows that in general, the low value commodities (often produced in very large quantities) tend to require a lower quality of distribution service and their consignors are more willing to trade in terms of accepting a lower service level, if costs can be reduced.

Where the results do not follow the expected pattern, such as tubes and beer producers, then the qualitative part of the interview provides an indication of the reason why higher quality services are demanded. On this basis, the method has given a set of results which are plausible, and at present no other method has been developed to place values on the attributes involved in the complex trade-offs when a system of freight distribution is chosen and when a single mode is currently dominant.

13. References.

Fowkes A.S., and Tweddle G. (1988): 'A Computer Guided Stated Preference Experiment For Freight Mode Choice'. Proceedings of PTRC 16th Summer Annual Meeting, Bath.