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A BEHAVIOURAL ANALYSIS OF MODAL CHOICE
IN FREIGHT TRANSPORT

by

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SUMMARY

The processes of transport decision-making within a firm have been investigated to ascertain those variables which can "best" explain freight transport modal choice. Although only road and rail freight transport have been considered, this results in nine distinct modal categories available to those wishing to despatch goods.

An overview of physical distribution is presented along with the detailed consideration of the total distribution cost and logistics concepts. The approaches that have been used to date to study freight transport modal split are exemplified under the three main headings of: (1) the aggregate flow approach; (2) the consignment approach; and, (3) the market research approach. A critical review of these approaches has been undertaken as well as of their theoretical underpinnings. This has culminated in the finding that the most appropriate approach to the study of freight modal choice is from the standpoint of the transport decision-maker within the firm.

A major problem which has beset research in freight demand-modelling has been the lack of a suitable data-base. In order to choose firms which are suitable for intensive study, it was important to minimise

variability as much as possible and for this reason all the firms belong to one industrial category - namely the Paper, Printing and Publishing sector in West Yorkshire. The data-source used to form the sample frame was the Market Location Limited Directory. For each of 100 firms making up the sample, a detailed in-depth interview with the transport decision-maker then was carried out.

The type and size of firm was found to exert considerable influence on transport decision-making, reinforcing the appropriateness of taking the firm and the transport decision-maker within it as the relevant starting point for analysis. From this, the conclusion is that the major determinants of modal choice in freight transport in the Paper, Printing and Publishing sector of West Yorkshire are: (1) the reliability offered by a transport mode; (2) the control over despatch; (3) the control that the establishment can exert over timing of delivery to the customer; (4) the avoidance of damage to goods when in transit; (5) the security of the product in transit; (6) the transit time; (7) ready availability of a transport mode when required; (8) length of haul and (9) size of consignment.

Minimum cost, the most widely used criterion of choice assumed in conventional methodology, did not feature as

a significant variable in determining modal choice. An alternative approach is therefore required to forecast freight demand and it is suggested that this may be achieved by: (1) subdividing freight transport activity into appropriate categories (for example, in terms of size of firm); (2) obtaining a suitable data-base by using a suitably-designed attitudinal questionnaire; and (3) using factor analysis to enable the explanatory variables to be identified and quantified.

More detail on the operators' licensing system, national freight organisations and data-analysis techniques used is given in the appendices. Finally, in the last appendix, the questionnaire that was used to obtain the data on transport decision-making is shown.

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CHAPTER ONE

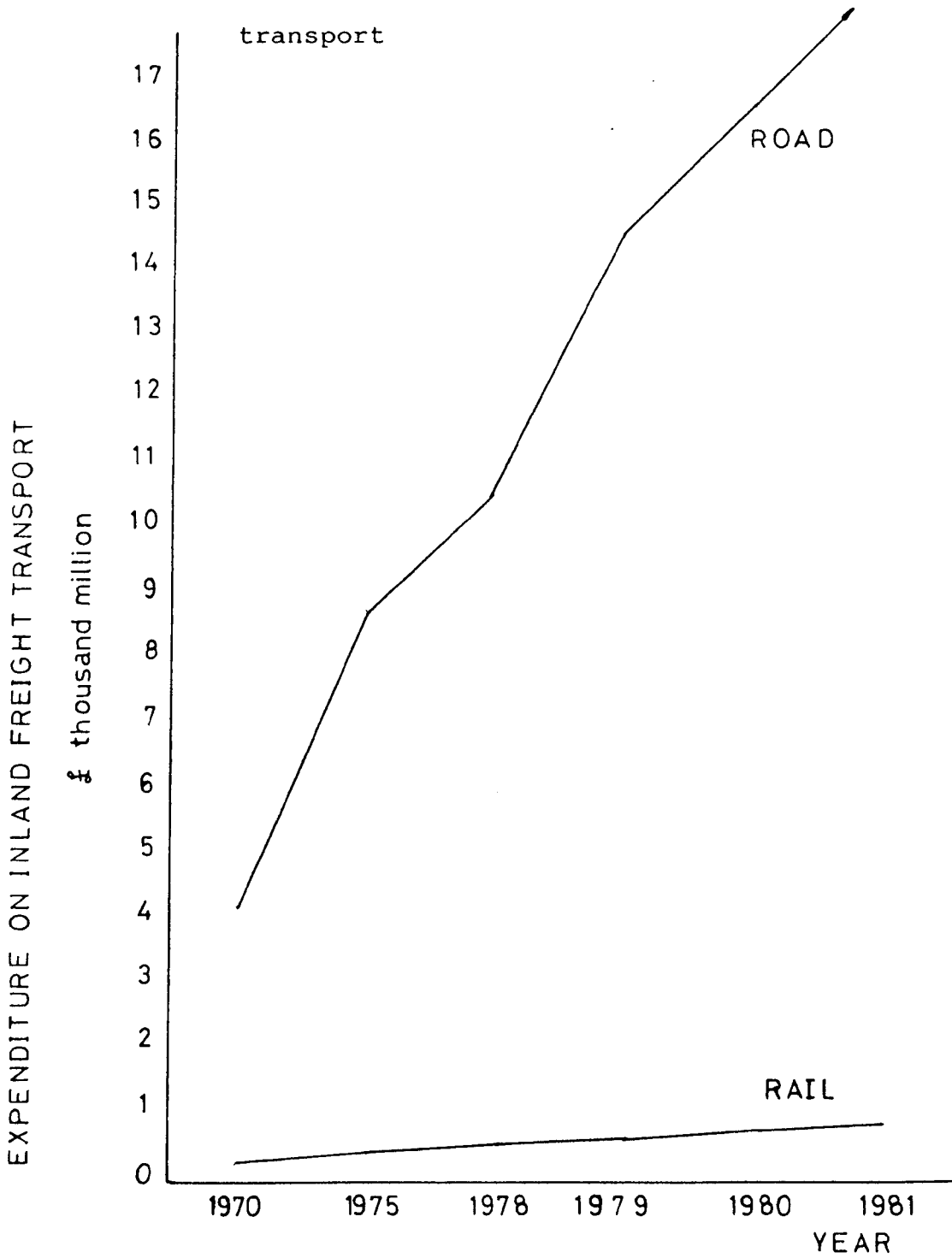
INTRODUCTION

Freight demand-modelling is a rather new field of interest for both researchers and policy makers (E.C.M.T., 1982). In most countries, its development has lagged behind passenger demand-modelling. However, forecasts of the demand for freight transport are required by Government for many different purposes, such as estimating future road-design requirements. There are two possible reasons for this lack of an accepted approach compared to that for passenger transport; namely, the complexity of freight flows compared to passenger flows and the lack of a consistent and comprehensive data-base for use in model-development. Despite this, in recent years, there has been a growing awareness of the importance of freight transport as part of the national economy.

1.1 FREIGHT TRANSPORT AND INDUSTRY

The amount of money spent on transporting freight is one indication of its importance to the economy (see Figure 1.1 and Table 1.1). In 1981, consignors spent over

Figure 1.1 Users' expenditure on inland freight transport



Source: British Road Federation. Basic Road Statistics, 1983

£18,622 million on road freight, £637 million on rail freight and £22 million on inland waterways freight. Expenditure on all freight transport accounts for 10-15% of the Gross Domestic Product [*] (Armitage, 1980).

Table 1.1 Users' expenditure on inland freight transport

		£ million				
		Year				
Mode	1970	1975	1978	1979	1980	1981
Road	4,212	8,820	10,448	14,607	16,708	18,622
Rail	279	342	517	578	606	637

Source: British Road Federation. Basic Road Statistics, 1983

In the Twentieth Century, apart from the two World Wars, demand for freight transport has been growing. This growth has been due mainly to increasing levels of economic activity. Changes in the content and location of economic activity have also affected the demand for freight transport. The relatively faster growth of industries which need little freight transport, for

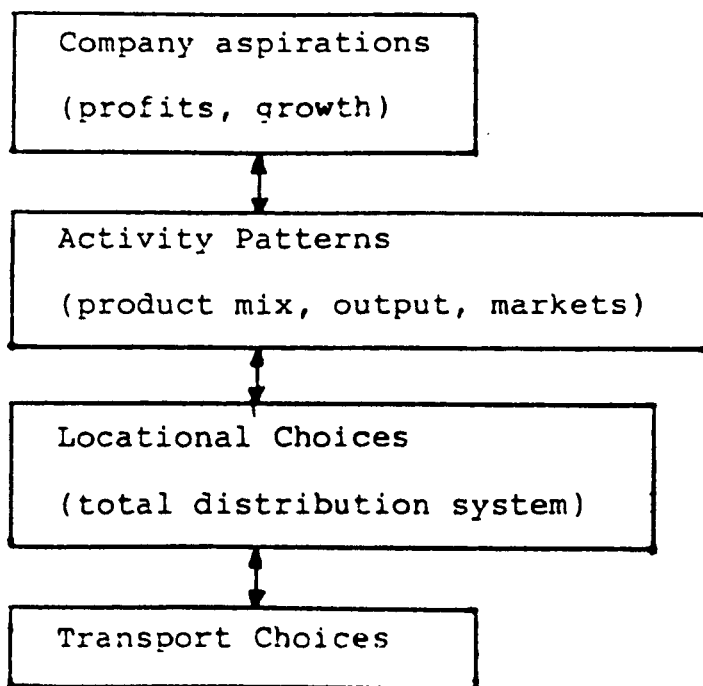
[*] This includes all users, whether private individuals, business, or Central or Local government.

example the computer industry, and a decline in industries of bulk commodities are factors which tend to reduce demand.

On the other hand, greater industrial specialisation and concentration and the further development of national marketing and retailing, tend to increase demand for transport, and particularly, lengths of haul. Changes in industrial structure have been particularly important in expanding the demand for freight transport. Increasingly industry makes components in plants in many different parts of the country and then transports them to one place for assembly. Demand for freight transport has been heavily influenced by its relatively low price. Apart from some bulk commodities, the cost of freight transport as a proportion of all costs is low for most industries. Thus, making freight transport efficient is often given low priority by manufacturers. For example, in studying long-run locational decisions, transport may well not be a prime determinant. Factors such as proximity of markets and labour supply may, on the other hand, be of paramount importance. The transport department of a company is often considered to be less important than the production, marketing and purchasing departments. An attitude that tends to prevail is that "profits are not made in the Transport department,

although they may be wasted away there". Figure 1.2 illustrates some of the choices that a firm has to make. The primary choices made by commercial enterprises include which products to produce, which general markets to pursue and the magnitude of economic activity (sales, employment, investment) to engage in. In order to achieve a desired pattern of economic activity, the firm must make locational decisions for its production facilities and select specific markets (geographic regions) to be served and sources of raw materials to be exploited. These choices determine the commodity transportation choices: which commodities to ship, from where, to where and by what means.

Figure 1.2 Levels of choice for a firm



The amount of attention paid to transport will vary from firm to firm. It is likely also that there will be wide variations in the managerial abilities of transport managers and persons responsible for running transport. The calibre of the people involved may not always reflect the size, complexity and importance of the firm's transport needs. The nature of the firm may well have an impact, too, on the freight transport strategy employed. For example, a firm can consist of a single plant or many. In the case of a multi-plant firm, it is possible that the branch factories may have local managements who are tightly constrained by head-office, whereas others are allowed almost complete autonomy in decision-making.

The effective distances between markets and producers are changing, due to the growth of the network of motorways, of the Freightliner network, of roll on/ roll off ferry services and of air freight routes (Wentworth, 1970). The structure and organisation of industry itself has changed rapidly in recent years. Horizons have widened, bigger markets have opened up and this has resulted in the growth of huge conglomerate businesses on a supranational scale. These conglomerates provide for economy of scale in resources and facilities and provide the means by which the increasing

diversification of consumers' tastes in an affluent society can be met.

Thus, relationships between transport and the rest of the production process may well have an impact on modal choice. Freight transport must not be looked at in isolation but viewed as part of the total industrial process.

This study is directed at improving our understanding of transport decision-making within a firm and to provide a better explanation of the process of modal choice in this context.

1.2 FREIGHT TRANSPORT MODES IN GREAT BRITAIN

The level of freight transport depends on the level of economic activity and the composition of industrial output. The modes of freight transport in Great Britain are Road, Rail, Coastal Shipping, Inland Waterways and Pipeline, as shown in Tables 1.2 and 1.3. Air transport is not considered as it is much less significant even than Inland Waterways. Over the period 1970-1982, goods moved (tonne-kilometres) by all modes increased by 23%, whereas goods lifted (tonnes) fell by 12.5%. The measure of goods lifted is one indicator of how much freight is

being handled by each mode. In the case of road transport especially, loads of certain commodities may be moved several times between the place of production and the place of final sale or consumption. This is largely attributable either to the system of distribution or to the geographical separation of different stages in the production process. The measure of goods moved takes account of the distance travelled by each load. For many purposes this measure is a more suitable indicator of transport activity. Thus rail accounts for a greater share of goods moved than of goods lifted. On the whole, rail tends to lift loads only once but moves them over much longer distances than road transport. In Table 1.3, there appears to be a substantial increase in goods moved by coastal shipping and inland waterways in 1982 compared to previous years. This has been caused by the redefinition of the term "inland waterways" and the use of a new tonne-kilometre estimate for coastal shipping. Inland waterways no longer consists just of British Waterways Board canals but now includes navigable rivers and estuaries as well. The tonne-kilometre estimate for coastal shipping is now based on a 700 kilometre average haul length (previously 450 kilometre). The increase in the average haul length is due to the growth in the coastwise movement of North Sea oil.

From Tables 1.2 and 1.3 some general trends can be discerned. For road transport between 1975 and 1981, the increase in goods moved (6%) together with the fall in goods lifted (12%) tends to reflect the changing pattern in distribution over the same period. Table 1.4 shows this trend in greater detail. Over the period 1975-1982, for length of hauls over 100kms, goods moved by road have increased by 13.6% but decreased by 6.5% for distances less than 100kms. In 1981, the total volume of goods lifted by road was divided more or less equally between public hauliers and own account operators, but public hauliers accounted for 62% of goods moved. The implication of this is that companies are more likely to use public road haulage rather than their own when transporting their product over a great distance.

Table 1.2 Goods transport: by mode: goods lifted

Goods lifted (MILLION TONNES)

Year	Road	Rail	Coastal Shipping	Inland[1] Waterways	Pipeline	All Modes
1970	1610	209	51	6	39	1915
%	84.1	10.9	2.7	0.3	2.0	100
1975	1519	175	44	4	52	1794
%	84.7	9.8	2.4	0.2	2.9	100
1979	1504	169	59	5	85	1822
%	82.5	9.3	3.2	0.3	4.7	100
1980	1418	154	63	5	83	1723
%	82.3	8.9	3.7	0.3	4.8	100
1981	1339	154	60	5	75	1633
%	82.0	9.4	3.7	0.3	4.6	100
1982	1390[2]	142	> 69[3]	<	75	1676

[1] British Waterways Board canals only

[2] Figures shown for road are provisional

[3] Figures not on the same basis, includes all internal traffic on waterways and coastal shipping

Source: Department of Transport. Transport Statistics
Great Britain 1971-1981, 1972-1982

Table 1.3 Goods transport: by mode: goods moved

Goods moved(BILLION TONNE-KILOMETRES)

Year	Road	Rail	Coastal Shipping	Inland[1] Waterways	Pipeline	All Modes
1970	85.0	26.9	23.2	0.1	2.9	138.0
%	61.6	19.4	16.8	0.1	2.1	100
1975	91.8	20.9	18.3	0.1	5.9	137.0
%	67.0	15.3	13.3	0.1	4.3	100
1979	104.6	19.9	27.0	0.1	10.3	161.9
%	64.6	12.3	16.7	0.1	6.3	100
1980	95.9	17.6	28.0	0.1	10.1	151.7
%	63.2	11.6	18.5	0.1	6.6	100
1981	97.1	17.5	27.0	0.1	9.3	151.0
%	64.3	11.6	17.9	0.1	6.1	100
1982	100[2]	15.9	> 44.4[3] <		9.3	169.6

[1] British Waterways Board canals only

[2] Figures shown for road are provisional

[3] Figures not on the same basis, includes all internal traffic on waterways and coastal shipping

Source: Department of Transport. Transport Statistics
Great Britain 1971-1981, 1972-1982

Table 1.4 Goods transport: road

Goods lifted: 1975-1982 [1] (MILLION TONNES)

	1975	1977	1979	1980	1981	1982[2]
<u>By mode of working</u>						
Mainly Public Haulage	764	734	712	677	655	681
Mainly Own Account	675	619	724	672	615	640
<u>By length of haul</u>						
Not over 100kms	1181	1069	1128	1065	983	1022
Over 100kms	258	284	308	284	287	299

Goods moved: 1975-1982 [1] (BILLION TONNE-KILOMETRES)

	1975	1977	1979	1980	1981	1982[2]
<u>By mode of working</u>						
Mainly Public Haulage	56.5	63.2	62.0	57.1	58.5	60.1
Mainly Own Account	32.5	32.2	39.9	36.1	35.9	36.9
<u>By length of haul</u>						
Not over 100kms	33.1	32.2	34.3	32.2	30.9	31.8
Over 100kms	55.9	63.3	67.6	60.9	63.5	65.2

[1] Figures do not include estimates for work done by vehicles under 3.5 tonnes GVW

[2] Provisional estimates

Source: Department of Transport. Transport Statistics
Great Britain 1972-1982

The volume of traffic by freight train has been generally decreasing for many years, in terms of tonnes lifted and tonne-kilometres moved. Thus, over the period 1975-1982, tonnes lifted fell by about 19% and tonne-kilometres fell by 24%. The 1982 results have been affected, however, by industrial action which took place during that year. Parcels traffic which is carried in passenger trains has also been declining over the last few years (Table 1.5). The sharper decrease in 1981 is due to British Rail withdrawing its collection and delivery service.

Table 1.5 British Rail: parcels by type (passenger train traffic)

Parcels (MILLION TONNES)

	1975	1977	1979	1980	1981	1982
Parcels and other merchandise	1.0	0.9	0.8	0.8	} 0.9	0.7
Postal parcels and letter mails	0.7	0.5	0.4	0.4		
All parcels	1.7	1.4	1.2	1.2	0.9	0.7

Source: Department of Transport. Transport Statistics Great Britain 1972-1982

Since 1979 the economy has been in recession but the demand for road transport has continued to expand such that, in 1981, 82% of all freight carried was by road.

In terms of the size of the freight transport market, it has risen steadily in tonne-kilometres from 138 billion in 1970 to an estimated 169.6 billion in 1982. Of the principal modes of transport which compete in the domestic market, road and rail dominate the pattern of inland freight movements. It is reasonable, therefore, to limit the research to these two modes.

1.3 OBJECTIVES AND LIMITATIONS

In choosing suitable firms for intensive study, it is important that they are similar in type and operation in order to understand how transport decisions are reached. One method of selection is to use firms which are within one SIC category.

The objectives of the study are, as follows:

- (1) to investigate the processes of transport decision-making within a firm;
- (2) to ascertain those variables which can best explain freight transport modal choice; and

(3) to discover the underlying relationships (if any) between these variables.

The main limitations to be imposed on the study are:

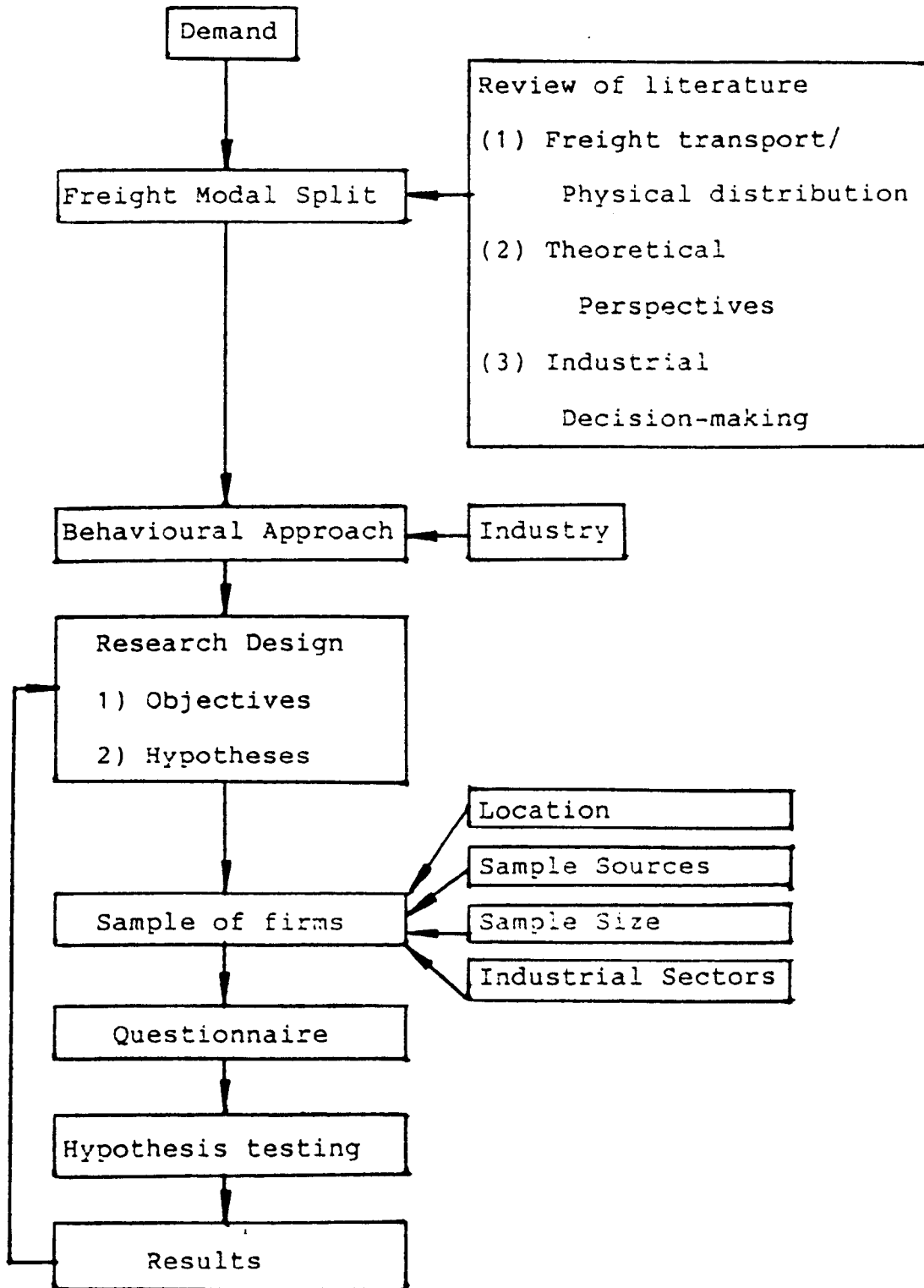
- (1) it is confined to the United Kingdom economy;
- (2) it is concerned with decisions between road and rail freight;
- (3) it is concerned with manufacturing industry and transport of the product to retailers, final consumers and wholesalers; and
- (4) it is confined to those commodities despatched by the firms under study.

1.4 SCOPE OF THE STUDY

A conceptual framework, within which the research has been carried out is given in Figure 1.3. Investigations into the nature of physical distribution and transport supply are carried out and are to be found in Chapter 2. This is followed, in Chapter 3, by a critical review of the approaches taken to date to analyse modal choice in freight transport. A review of pertinent theoretical considerations, such as classical and behavioural perspectives, is given in Chapter 4. These chapters culminate in the development of hypotheses. The hypotheses are given in Chapter 5. This chapter also

contains the design of the questionnaire and the survey method to be employed in collecting the necessary data for testing the hypotheses. The analysis of the questionnaire is undertaken in Chapter 6. The results of testing the initial hypotheses are given in Chapter 7. Finally, the main conclusions, their interpretation and recommendations for further research are given in Chapter 8.

Figure 1.3 Conceptual Framework of the Research



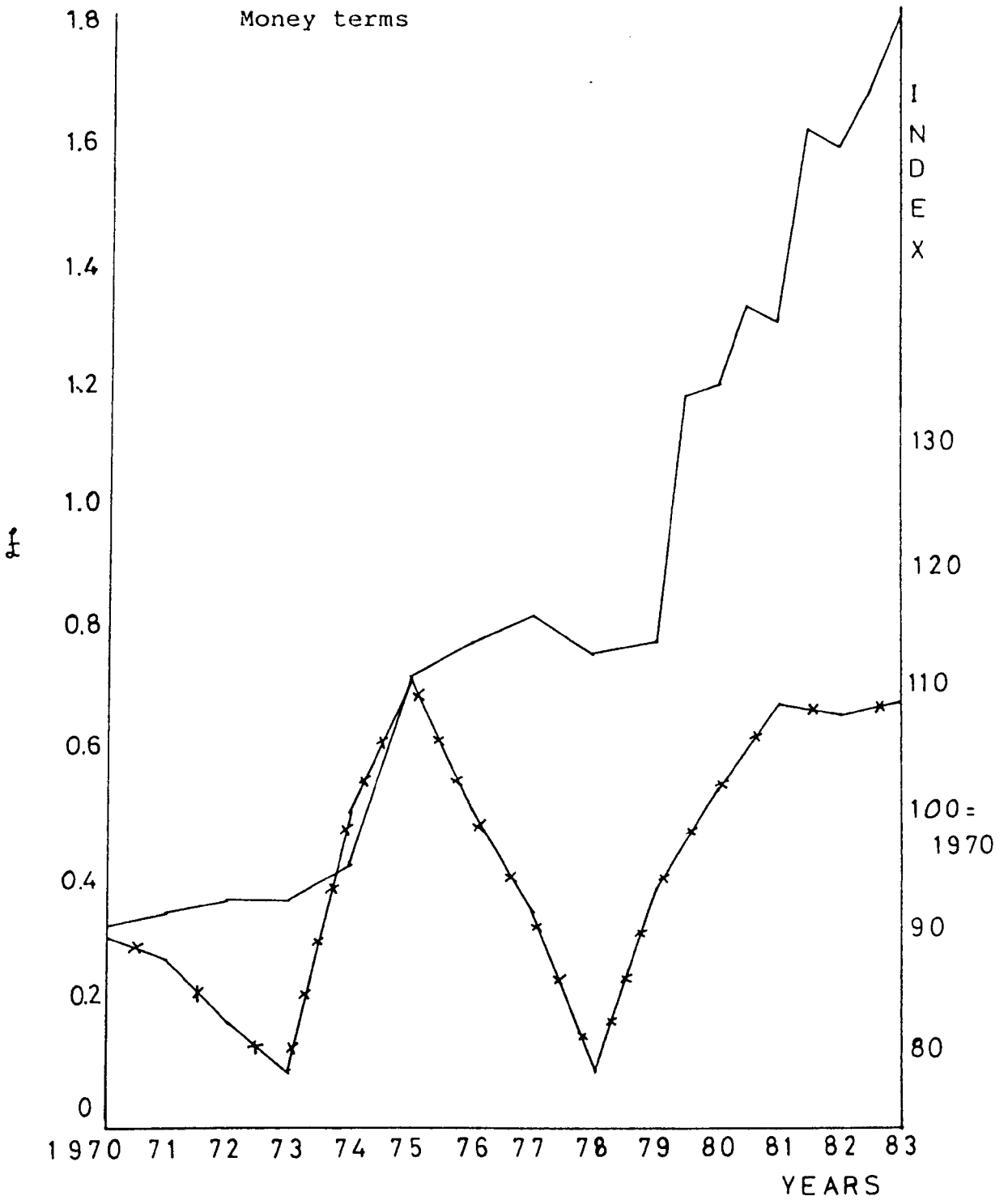
CHAPTER TWO

PHYSICAL DISTRIBUTION AND TRANSPORT SUPPLY INVESTIGATIONS

For too long, the physical distribution of goods has received little attention in the literature. When compared to the efforts devoted to improving their production and marketing, the attention paid to distribution can only be described as scant. However, recent price increases both in real and in money terms are starting to induce a more critical examination of this area by corporate management (Kelly, 1979).

To answer the question as to whether or not distribution costs are rising, the problem is to define what is meant by "real" prices as opposed to "money" prices, for example of fuel (Figure 2.1). The term "real" is used to mean the price of fuel in relation to the price of other relevant commodities over any given time period. The concern with real prices over a period of time, therefore, is to consider the change in the resource value of the goods rather than the money price paid for them. Whereas, the money price of fuel refers to its

Figure 2.1 Price of fuel over time, in both Real and Money terms



Money Price of Fuel (as at January and July) —
 Real Price of Fuel (Price of fuel relative to Retail Prices Index) —x—

Source: Department of Transport, 1983

actual price paid by the customer at any given time, the real price is determined by weighting the money price by an index which reflects the change in the purchasing power of that money over the period concerned.

Up until quite recently, although money prices of most items have been rising inexorably year after year, the real price of road haulage has (if anything) been falling. This trend, however, may now be reversed, as the economy expands.

There are perhaps three reasons why costs of road freight distribution may have stopped falling in real terms. These are, as follows:

- (1) the increasing price of fuel (inclusive of taxes);
- (2) the increasing status of HGV lorry drivers; and
- (3) reduced journey time savings.

Each reason is examined now in turn.

(1) The increasing price of fuel. This is difficult to assess because, despite the efforts of OPEC, there is a persistent tendency for it to decrease in real terms over time. However, the 1981 Budget, with its 20% rise in tax on petrol, 10% rise in tax on derv and 15% increase in vehicle excise duty means that transport costs are being scrutinised by many companies (Chapman,

1981). The real price of fuel, shown in Figure 2.1, is derived as in the following example: In 1970, retail price index = 100

petrol and oil price index = 100

In 1979, retail price index = 305.7

petrol and oil price index = 317.1

Therefore, real price increase (1970-79) = $\frac{317.1}{305.7}$

305.7

= 1.04

= 4 per cent real increase over the period

The money price of fuel is taken as being the average retail price per gallon. In fact, the price of fuel in real terms had been falling steadily until 1973/4 when, due to the original OPEC "energy crisis", it increased sharply. The fuel crisis resulted in both shortages and cost increases, which were reflected in price increases both in real and money terms. Similar price hikes have recurred in 1978/9 and again in 1981. Thus, it can be seen that the price of fuel in real terms follows a "saw-tooth" profile, as compared to the endlessly increasing money price.

(2) The increasing status of lorry drivers. The work of driving a heavy goods vehicle requires more highly skilled and trustworthy personnel than previously as load size and value increase. This results in the

workforce becoming more highly rewarded, with higher pay to attract people of the right calibre. The statutory provisions for working conditions as laid down by the EEC, especially concerning hours of working, will also increase real labour costs. Thus, productivity has to increase if real increases in costs in terms of labour are to be offset.

(3) Reduced journey time savings. There are now major roads to all regions of the country and so, as and when further improvements are made to the motorway and trunk road network, journey time savings tend to be relatively small. With the present road network, it is possible to do very long hauls within a working day. So, as the road network becomes more efficient in terms of time taken from origin (loading) to destination (unloading), this may attract less expenditure on behalf of employers. Conversely, legislation and non-exploitation of drivers by limiting their hours has caused more expenditure, owing to the payment of more personnel to deliver goods. For long hauls, the operator therefore sustains a greater cost; but the driver gains because he suffers no loss in pay, has a shorter working day and easier driving conditions.

The impact of the road haulage dispute at the beginning of 1979 and its costly settlement emphasised both the

dependence that is now placed on road haulage and the increasing proportion of the final delivered price of goods which is represented by physical distribution. There have been two conflicting reactions to the strike: one, that "own vehicles" are being acquired to insure against any further disruption; and the other, that transport is a costly headache and hence sub-contracting is seen as the more viable alternative (Kelly, 1979).

2.1 OVERVIEW OF PHYSICAL DISTRIBUTION

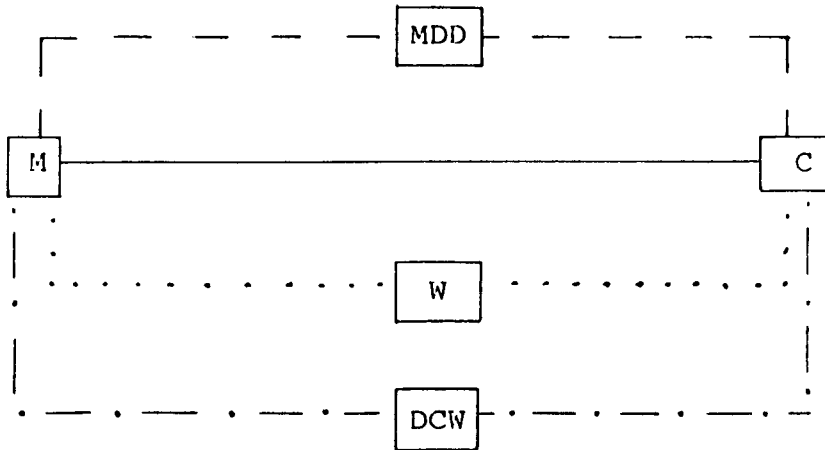
A distribution channel is the route along which a product and its title (that is to say, the rights of ownership) flow from the point of production to the point of consumption. Figure 2.2 shows in diagrammatic form a distribution channel, linking point of manufacture to point of sale.

A physical distribution network necessarily consists of two types of flow: a transportation flow and an information flow.

The pattern of linkage in Figure 2.2 suggests that it may be useful to look at choice of transport mode on particular links in the distribution system. McKinnon (1981) has suggested that one of the advantages of studying transport at this level of resolution is that

the investigation of modal split can be extended beyond the rather sterile road versus rail debate to consider the relative usage of different forms of road and rail transport. He found in a preliminary study of 28 food manufacturers that, despite the fact that they all belong to the same industrial sector, there appears to be great variety in the distribution arrangements of these companies. It has been shown (in Chapter 1) that this poses a major problem to freight transport research, namely the diversity and complexity of distribution systems. If this is the case, then it is extremely difficult to generalise up to the level of aggregation that is found often in freight flow analyses (see section 3.1). Perhaps the disorder and diversity apparent in the distribution of processed food is not representative of other industrial sectors. The opportunity then, should be taken to uncover the structural relationships (if any) and so shed light on general freight transport statistics. This can only be achieved by taking a similar view of transport to that of the transport decision-maker, in other words, seeing transport within the larger context of physical distribution.

Figure 2.2 A simplified representation of types of distribution channel.



Key: M represents the manufacturer

C represents the customer

W represents the wholesaler

MDD represents the manufacturer's distribution depot

DCW represents the distribution contractors depot

Physical distribution consists of five elements and only the last of these concerns the actual movement of the product concerned:

- (1) Inventory (stockholding).
- (2) Storage facilities.
- (3) Communications (order processing system; invoicing system for example).

- (4) Unitisation (size of packages in which goods are originally packed; accumulation of these packs into larger unit sizes; pallets/containers).
- (5) Transport (modes employed; frequency of deliveries to customers; scheduling of deliveries).
- (Christopher, Mole, Rushton and Wills, 1983)

Each of these elements is now discussed briefly.

Inventory or the accumulation of stocks acts as a buffer between an uneven supply and a fluctuating demand. Storage facilities, like warehouses - whose function is to store goods, which are not immediately required, in care and in safety. Storage facilities exist at many points in the distribution flow, ranging from a factory warehouse to regionally based depots to supply whole areas of the country. For small-scale manufacturers, with a large market area, the use of wholesalers is often a convenient alternative arrangement.

Communications - all physical distribution activity relies upon communication between customer and supplier, as well as on an effective internal communication support system. Communications ensure that a satisfactory customer service can be provided at an acceptable cost. Unitisation - no single aspect of physical distribution has had more effect on modern industrial life - is the change to pre-packaged commodities which lend themselves to self-service

marketing by "non-expert" staff (Benson and Whitehead, 1975). Unitisation in fact consists of three types of activity: (a) packaging of the goods; (b) conversion of many small packs into a single unit lift; and, (c) containerisation. The initial packaging of the goods serves at least two purposes. First of all it envelops and contains the product thereby altering its shape to one convenient for packaging. Also, by packaging the good, it is protected hopefully from breakage, distortion, contamination and casual theft. The next stage is to accumulate these packages into larger unit sizes ready for palletisation (if desired). Use of fork-lift handling enables pallets to be loaded into containers, which then can provide a door-to-door service and more than one mode of transport can be used, without having to break bulk. Finally, transport itself which alters the geographical location of the goods from the point of manufacture to the point of consumption.

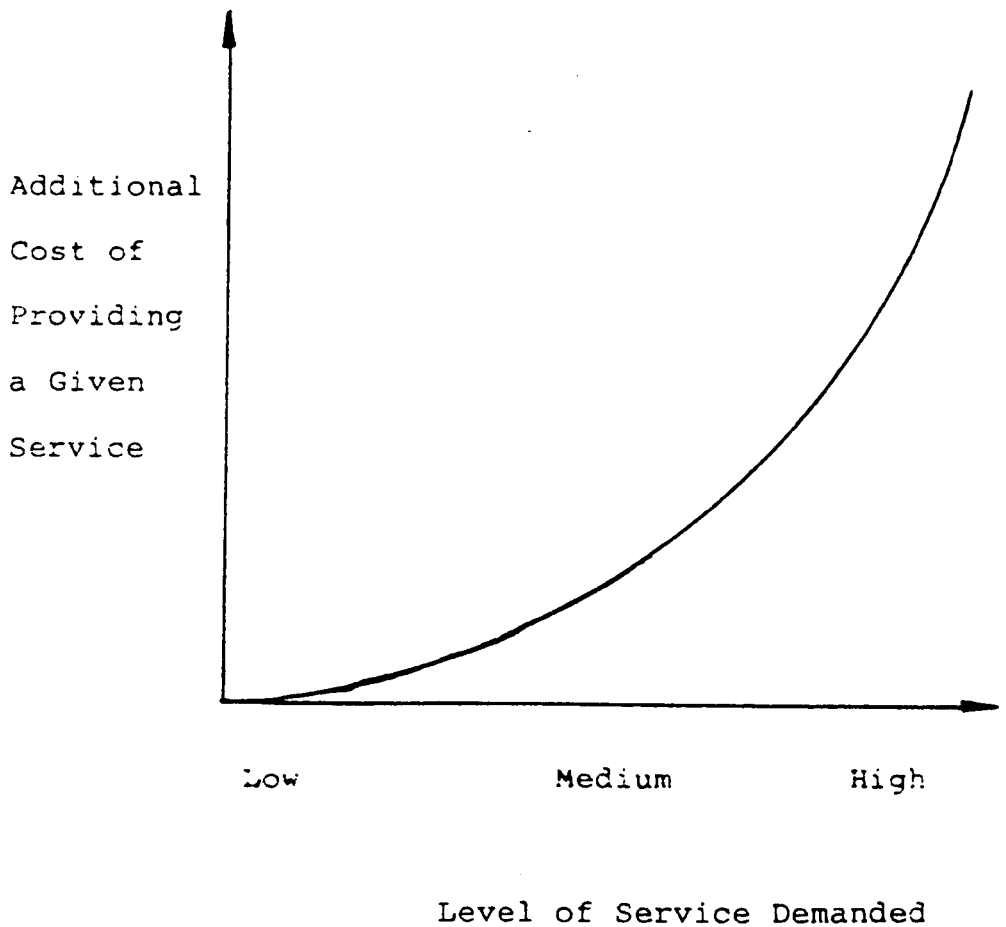
The function of marketing is "to equate the supply and demand for goods to a saleable product specification, at an acceptable method of service and at a price which maximises profit" (Turner, 1966). In this context, it is important to note that maximum profit is rarely the same as minimum production cost. To the extent that a company is supplying goods to meet an existing demand, marketing is the means of interpreting and quantifying the demand,

defining the goods required by the market and the service demanded by the individual customers.

Distribution is a component of customer service. Turner (1966) has gone as far as to argue that each transport method usually will permit several different kinds of marketing policy to be followed. Successful marketing is often seen as the key to a successful business. Physical distribution plays a crucial role in ensuring that products are available in their markets, at the right time. In short, distribution is about getting the right product, to the right place, at the right time. This demonstrates the fact that, however good a product is, it's worth cannot be realised unless it is actually available when and where the customer wants it. The classic illustration is that of newspapers, which are one of the most "perishable" of all commodities in this respect.

Marketing is concerned with demand-creation, whereas physical distribution is concerned with demand-satisfaction (Wentworth, 1970). Thus, a distribution system exists to perform a certain service at a certain cost. These two variables are related and so, if a high level of customer service is of paramount importance, it can only be provided at some cost (see Figure 2.3).

Figure 2.3 General level of service/cost relationship



After: Christopher, Mole, Rushton and Wills, 1983

Most firms "will settle for 95% satisfaction" (Benson and Whitehead, 1975). As Figure 2.3 illustrates, when the level of service increases beyond a relatively high level, the associated costs increase dis-proportionately. What then is meant by the term "customer service"? There is often confusion about its precise meaning but it usually incorporates the ideas of lead-time and "percent order satisfaction". Lead-time is

the total order cycle time, from the moment when the customer first places the order, to the time when he actually receives delivery of the goods. This process consists of a number of separate activities, such as order-transmission, order-processing, loading and delivery. The delivery time aspect is not a fixed component for every customer, as it tends to be proportionate to distance. Percent order satisfaction expresses the extent to which it is possible to meet customers' orders out of stock. This relates to the stock-buffer that is held by many industries but, as is shown in Chapter 6, this does not apply on the whole to the Paper, Printing and Publishing sector which is a "bespoke" industry. In other words, the product is usually "tailor-made" to meet individual customer requirements.

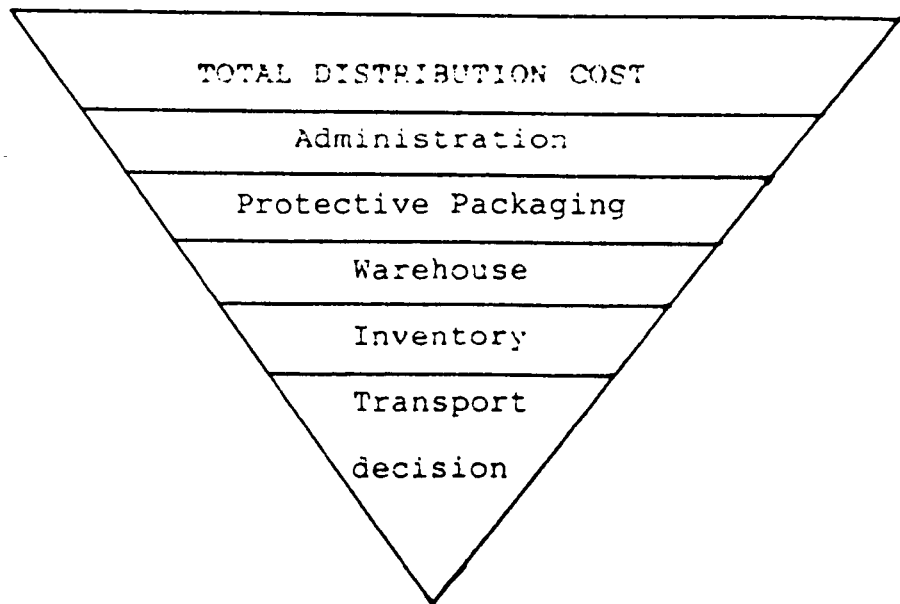
2.2 TOTAL DISTRIBUTION COST AND LOGISTICS CONCEPTS

The total distribution cost approach embraces both transport and distribution. Each aspect tends not to be given the same emphasis in different product markets. For example, if the market for a product is dispersed, then it is usual for stock holdings to be dispersed also in warehouses, to enable distribution to the individual

markets to take place more easily. On the other hand, if the market area is spatially constrained close to the manufacturing plant then it is sensible to maintain high levels of inventory at the plant itself, at the expense even of separate warehousing facilities. Another interaction which takes place is between level of inventory and characteristics of the mode used for transport. Often a firm can decide whether to have low and therefore cheap inventory levels but use a more expensive and reliable transport mode or to maintain high, expensive inventory levels and employ cheap transport. Inventory is not only located at the manufacturing plant and in warehouses but there is also what might be called inventory in transit. In other words, in any distribution system there is always a certain amount of goods that are being moved. One of the establishments surveyed actually claims to use the containers of the public road haulier as their warehousing system.

The foregoing gives some indication of the elements involved in the total distribution concept, but it cannot be taken as a blueprint for all companies and all situations. All factors contained in Figure 2.4 are important to the overall performance of a business and they clearly influence and interact with each other.

Figure 2.4 The total distribution cost triangle



Source: Murphy, 1978

Horsley (1981) gives a breakdown of the cost categories incurred in the Total Distribution Cost (Table 2.1). The distribution costs are given as a proportion of the value of sales, averaged over all the industrial sectors and also as a proportion of the total distribution cost. Obviously, the total distribution cost in different companies and industrial sectors can vary from as little as 5% in industries such as pharmaceuticals to over 25% in heavy industries (Horsley, 1981).

Table 2.1 Distribution costs in the United Kingdom

COST CATEGORY	DISTRIBUTION COSTS	
	As proportion of sales turnover (1978)	As proportion of overall cost of distribution (1980)
Administration	2.0	13
Transport	5.5	34
Inventory	3.0	19
Warehousing	2.5	16
Packaging	2.0	12
Order processing and handling	1.0	6
Total	16.0%	100%

Source: Horsley (1981)

In section 2.1, it has been shown that the *raison d'être* of transport and distribution is to provide service to the customer. One factor, over which a manufacturer has little control, is the location and dispersion of the markets to be served. It is clear that a company concerning itself with appropriate inventory levels

should consider location as well as quantity. Thus, decisions on number and locations of warehouses should enable the efficient servicing of a company's customers.

Physical distribution is, of course, only one of the functions that concern the management of a manufacturing company. There is a tendency in small firms, where many management functions are controlled by one individual, to indulge in snap judgements and instant communication and hence to minimise delay and conflict. However, there is a limit to the number of functions that any individual can attend to at the same time effectively. For larger firms, various management functions are delegated to different individuals. The problem then is what organisational structure best meets the needs of the company and what importance does it accord to the different functions? Wentworth (1970) has argued that there are four main reasons for management's interest in physical distribution:

- (1) to avoid the management conflicts which arise in the absence of physical distribution management;
- (2) to control the rapidly rising cost of physical distribution;
- (3) to realise the opportunities for cost reduction in physical distribution; and
- (4) to take the opportunities for physical distribution

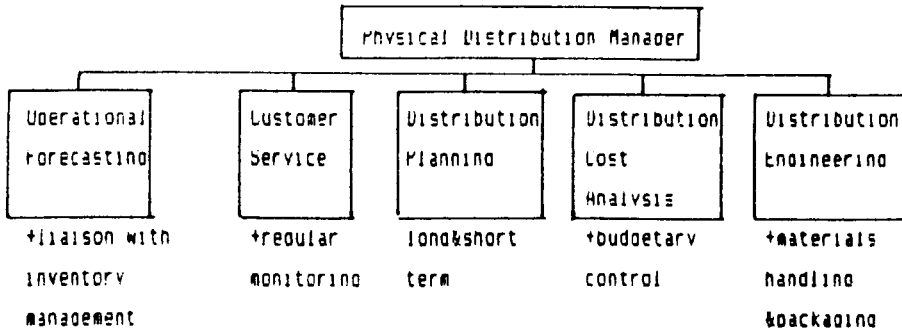
to assist the marketing effort.

One can argue that the place which management gives to transport and distribution within its hierarchy reflects the company's view of its functional importance. Figure 2.5 illustrates alternative organisational structures for a physical distribution department in order to fulfil various staff, line or combined line and staff functions.

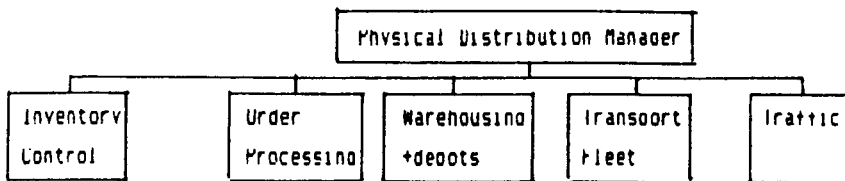
The distinction between staff and line roles is that the former is usually advisory, while the latter is in the direct line of control. So that, in Figure 2.5, the line function shows the physical distribution manager as directly supervising the personnel involved in "doing" rather than "planning". The position of the physical distribution manager then has to be placed in the company hierarchy. For a small company, the role of the physical distribution manager may be contained within other functions, for example, Managing Director. For larger companies, a distribution manager may be on the same level as the Production and Marketing Directors. Another possibility is, for example that marketing is seen by the company as the dominant management function; where this is the case, distribution objectives will often be subservient.

Figure 2.5 The role of a physical distribution manager in staff, line and combined functions within a manufacturing company

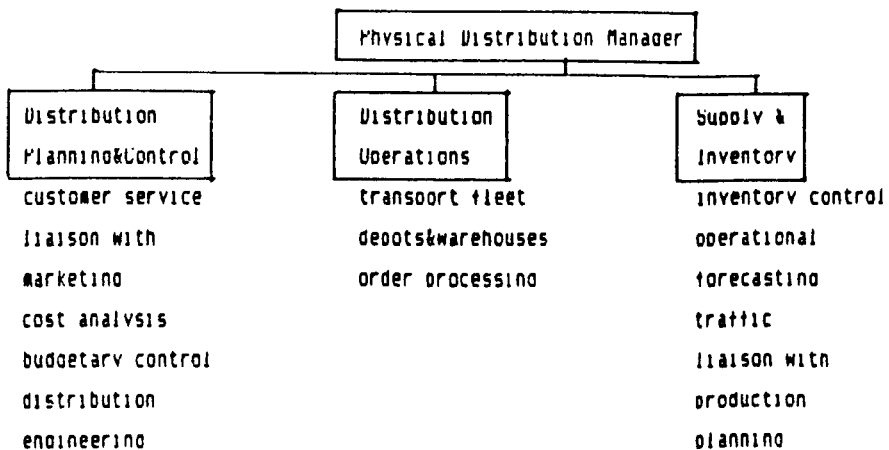
(a) STAFF ROLE



(b) LINE ROLE



(c) COMBINED LINE AND STAFF ROLES



Source: Wentworth, 1970

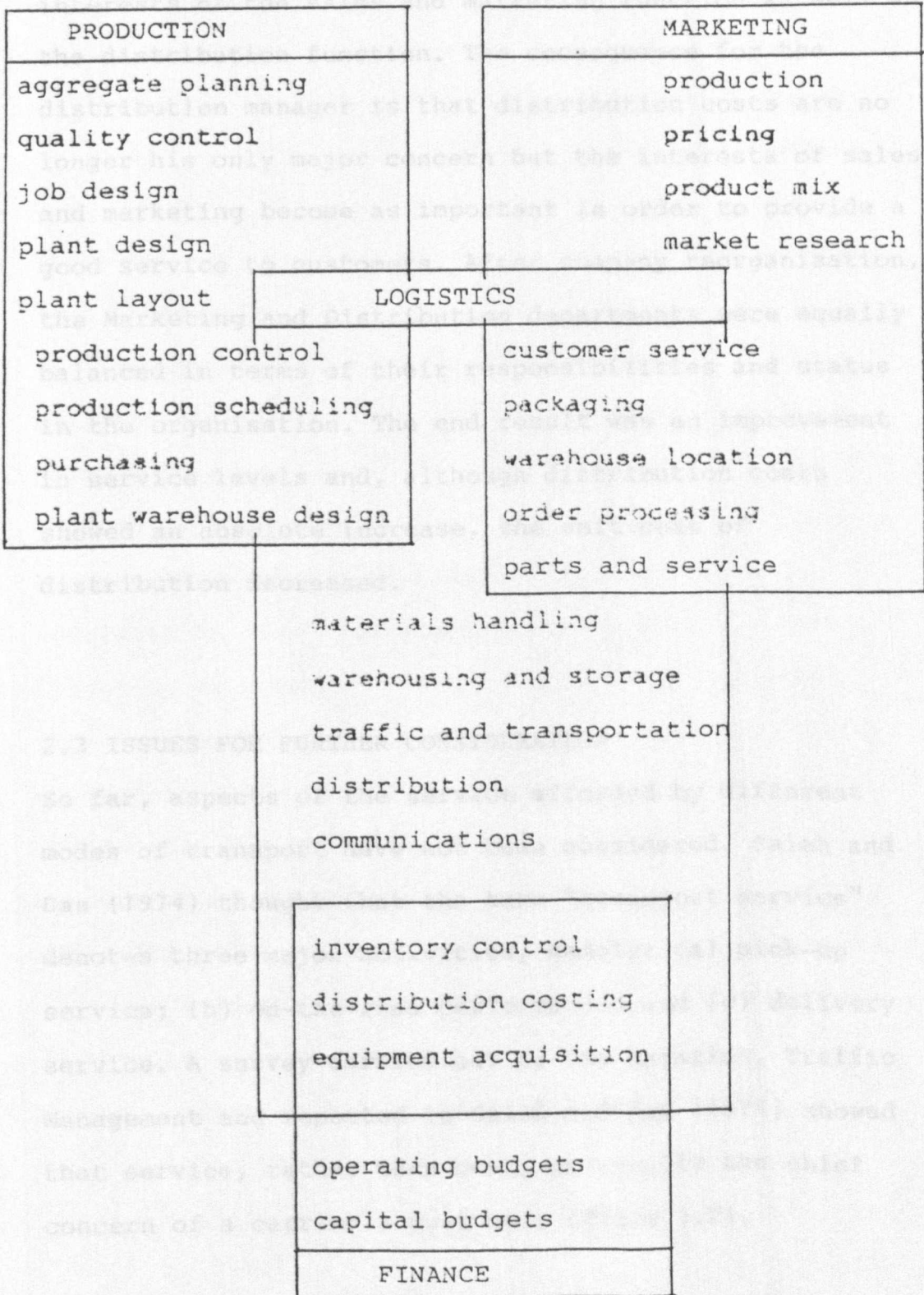
Whilst transport is seen as part of the spectrum of physical distribution, the total distribution concept itself is evolving into an even wider management system, namely that of logistics management. In this context, "logistics" means a total organisation and flow of materials from origin (input) to destination (output), the systems which carry them and consideration of the purpose for which they were organised. As such, a total flow is divided into an incoming part or "physical supply" and an outgoing part or "physical distribution" (Bartels, 1976).

The logistics concept suggests that all the various departments, such as marketing, production, distribution, finance and purchasing, of a company should work together rather than separately. In order for the whole logistics system to be most effective overall, it may be necessary for some (or even all) of the individual functional areas to operate sub-optimally within themselves. For example, the transport manager may be required to make more frequent deliveries if it benefits the overall logistical effectiveness of the system. The management of freight transport is no longer easy when the responsibility to deliver is poised between all kinds of other management responsibilities

even including, for example sales policy. Thus, one of the major problems in physical distribution is that the responsibility for it interacts with or is spread over many discrete functional areas within a company, as illustrated in Figure 2.6 (Christopher, Mole, Rushton and Wills, 1983).

Brouwer (1971) undertook a case-study, in which he traced the development of the total distribution concept, within one company. Some of the findings are reiterated here, as they serve to reinforce the more important issues raised so far. The catalyst for such an investigation, by the company, was the realisation that distribution costs were rising, while at the same time, delivery speed was falling (producing unacceptable levels of customer service). At this time, the different aspects of distribution were the responsibility of several departments and in consequence the information system within the company in the transport field was poor. Although the accounts department could give information on transport charges that were paid to common carriers, it was very difficult to obtain precise information about the costs of the own-account fleet. In order to improve the level of transport service to customers, better coordination of distributional activities is required, necessitating a change in the organisational structure.

Figure 2.6 Logistics System



Source: Christopher, Mole, Rushton and Wills, 1983

But further management coordination is required in the interests of the sales and marketing function as well as the distribution function. The consequence for the distribution manager is that distribution costs are no longer his only major concern but the interests of sales and marketing become as important in order to provide a good service to customers. After company reorganisation, the Marketing and Distribution departments were equally balanced in terms of their responsibilities and status in the organisation. The end result was an improvement in service levels and, although distribution costs showed an absolute increase, the unit cost of distribution decreased.

2.3 ISSUES FOR FURTHER CONSIDERATION

So far, aspects of the service afforded by different modes of transport have not been considered. Saleh and Das (1974) thought that the term "transport service" denotes three major activities, namely: (a) pick-up service; (b) on-the-road performance; and (c) delivery service. A survey carried out by the magazine, Traffic Management and reported in Saleh and Das (1974) showed that service, rather than cost, is usually the chief concern of a carrier's customers (Table 2.2).

Table 2.2 Survey in the magazine, Traffic Management

Factor Mentioned as of importance to "service"	Frequency	Proportion
	of Mentions (number)	of total Mentions (%)
Time in transit	326	77
On time performance	303	72
Shipment tracing	259	61
Freight charges	223	53
Door-to-door service	193	46
Promptness of claims settlement	189	45
Availability of standard equipment	158	37
Frequency of service	152	36
Loss and degree of damage	138	33
Availability of special equipment	114	27
Information services	113	27
Competence of solicitors	62	15

Note: The total number of mentions adds up to more than 100% because respondents were allowed to mention more than one factor.

Source: Survey of 448 distribution executives throughout the United States by the magazine Traffic Management, August 1966, in Saleh and Das(1974)

In the literature (for example, Stephenson and Willett, 1969; and Saleh and Das, 1974) consistency or reliability of service time appears as a very important attribute. Service time consistency refers to the degree of variation in delivery time of a shipment as measured against published or promised schedules.

Another survey, also carried out in the United States, into motor carrier selection was designed to look in more detail at this issue of service time consistency. The results of the survey are given in Table 2.3 and Table 2.4. This tended to reaffirm that consistent, on-time service is the most significant factor in the selection of a carrier. One possible reason for the importance of consistency is that erratic deliveries can affect adversely the customer's investment in inventory space and the frequency with which he runs out of stock. Erratic delivery can also affect the supplier's sales and it may even lead to the customer diverting his orders to alternative suppliers to achieve more consistency of delivery, even though the price may be higher.

Table 2.3 Criteria deemed important in selecting motor carriers

Evaluative Criteria	Proportion of total mentions (%)
1.Consistent, on time service	38
2.Reliable pick-up and special handling	8
3.Shipment tracing	6
4.Ability to handle distribution in a given area	7
5.Availability of standard equipment	7
6.Rates	5
7.Loss and degree of damage	5
8.One carrier service	4
9.Service frequency	4
10.Claims experience	3
11.Availability of special equipment	3
12.Information services	3
13.Financial status and operating rates	3
14.Willingness to negotiate rates	2
15.Other factors	2
Total = all criteria combined	100%

Source: Survey of 454 traffic executives conducted in Winter 1970 throughout the United States in Saleh and Das, 1974

Table 2.4 Shippers' Attitudes toward Carrier Service

STATEMENTS	LEVEL OF AGREEMENT [*]				
	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. Reliability or consistency of service is becoming more important to our own customers	43.7	51.5	0	0	0
2. Consistency of service is more important than speed of service	12.1	70.7	1.0	14.5	1.2

[*] Statements are significant at the 0.5 level

Source: Survey of 454 traffic executives conducted in Winter 1970 throughout the United States, in Saleh and Das, 1974

In Figure 2.7 and Table 2.5, the general effects of uncertainties in delivery time on the relationship between the supplier, carrier and customer are outlined.

The following is used to illustrate some of the perspectives and interactions between supplier, carrier and customer. It should be remembered that in order to produce its output of goods or services, a firm may require the transport of certain goods and hence become itself a consumer. For the most part, the discussion will be concerned with goods outward from a manufacturer (supplier) to a consumer (customer). From the customer's viewpoint, he requires an assured supply of the product in question. In this instance, the customer will want to specify in some detail, both the nature and timing of delivery. For a delay in arrival of a shipment to the customer can result in him running out of stock. The maintenance of a buffer stock to overcome this will tend to result in higher inventory costs. The supplier is concerned with ensuring that his product gets to the customer at the right time. So transit time is a highly relevant consideration when a supplier is considering selection of a transport mode.

Figure 2.7 General effects of delivery time on the customer - supplier - carrier relationship

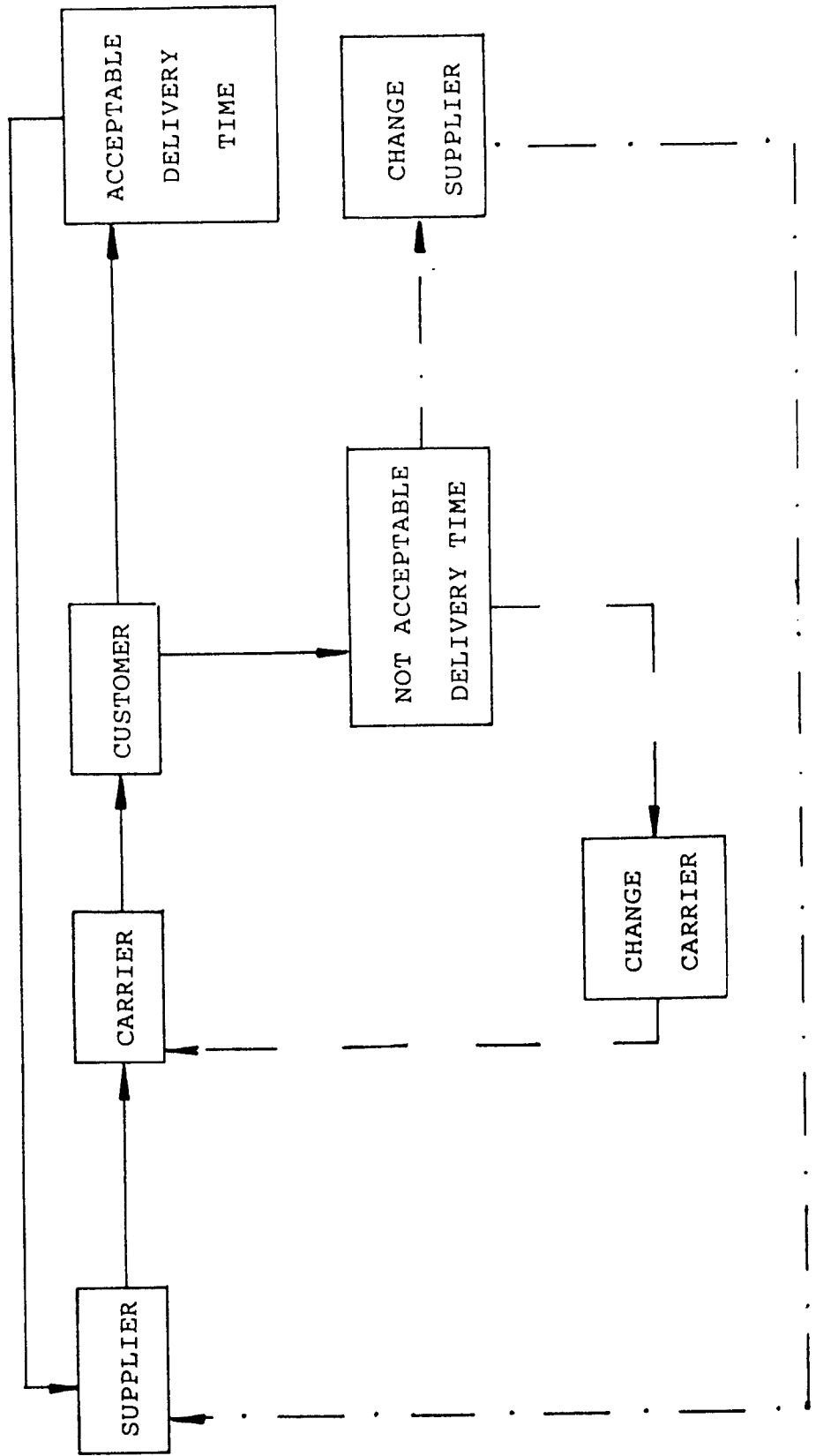


Table 2.5 Reasons for and reactions to uncertainties in delivery times on participants in a distribution channel

	REASONS	REACTIONS
SUPPLIER (MANUFACTURER)	1. Notice of changes in customer requirements	1. Increase inventory
	2. Required items not in stock	2. Charge customer a lower price
	3. Dependent on another supplier	
CARRIER	1. Scheduling difficulties	1. Pay compensation to the customer
	2. Traffic congestion	
	3. Mechanical breakdown	
CUSTOMER		1. Accept lower probability of goods arriving at a specified delivery time
		2. Increase inventory levels
		3. Search for replacement supplier &/or carrier

However, for a variety of reasons, a supplier may find it difficult to meet a customer's delivery requirements. The supplier may be dependent on another supplier himself and so he may not have the required items in stock. Thus, the supplier also has an inventory problem. Although, with respect to the Paper, Printing and Publishing industry, this is not usually a factor as goods tend not to be "stock-items". Instead, they are usually tailor-made to individual customer requirements. Also the supplier may have very little notice in changes in customer requirements and therefore this may lead to delivery difficulties. The carrier may find it difficult to deliver the goods at the time specified due to scheduling problems, traffic congestion and even mechanical breakdown. The supplier may not have the goods ready for the carrier and so time of departure will also affect the timing of delivery to the customer. Because of all this, promise of a specific delivery time may not always be possible in practice.

The customer can react to uncertainties in delivery time in a number of ways. The customer may be prepared to accept a lower probability of the goods arriving at a specified delivery time but he will wish to pay a lower price to reflect the poorer service standard.

Alternatively, if an erratic delivery time is not acceptable, then the customer will search for a

replacement supplier or carrier or both. Thus, the customer-supplier relationship can be considered as being fundamental to any distribution channel arrangement (Figure 2.2). Whereas the carrier can be thought of as an intervening institution, selected to facilitate the logistics functions of customer-supplier transactions. All things being equal, it is reasonable to suggest that a supplier will seek a carrier (or mode) which can guarantee to overcome conditions of erratic service. As Ballou and DeHayes (1967) found, greater variability in delivery time means higher inventory levels, even when average transit time remains constant.

In the literature, speed of delivery to a market or consumer is seen as an important criterion in selecting a transport carrier for certain products. Speed of delivery refers to the average time from door-to-door. Time taken in transit is a function of speed and distance. For example, a carrier will choose the minimum cost combination to achieve the overall transit time required and the choice may be between a trunk route, which is longer but quicker or an all-purpose road, which is shorter but slower. In a Canadian survey, speed of delivery was regarded as the most relevant service factor in the following industrial sectors: Food and Beverage; Office Equipment; and Textiles (Saleh and Das, 1974). In reality, it may be difficult for a carrier to

provide a high level of consistent service for the reasons already mentioned and therefore speed of delivery may become a more important service requirement. Consistency is rarely regarded as an absolute, rather it is the degree of variation in delivery times to a given customer.

It is reasonable to conclude that time of delivery to a customer is a function of time of departure and time taken in transit. But transit time relates to the performance characteristic of any transport facility. Thus, when a transport decision-maker is evaluating a transport service, it is likely to include consideration of transit time, both in terms of reliability and of speed.

A number of product-related features can influence the type of transport mode required and can be categorised either as direct or indirect (Table 2.6).

Table 2.6 Product-related features influencing transport selection

DIRECT

1. Shelf-life/perishability
2. Density
3. Value

INDIRECT

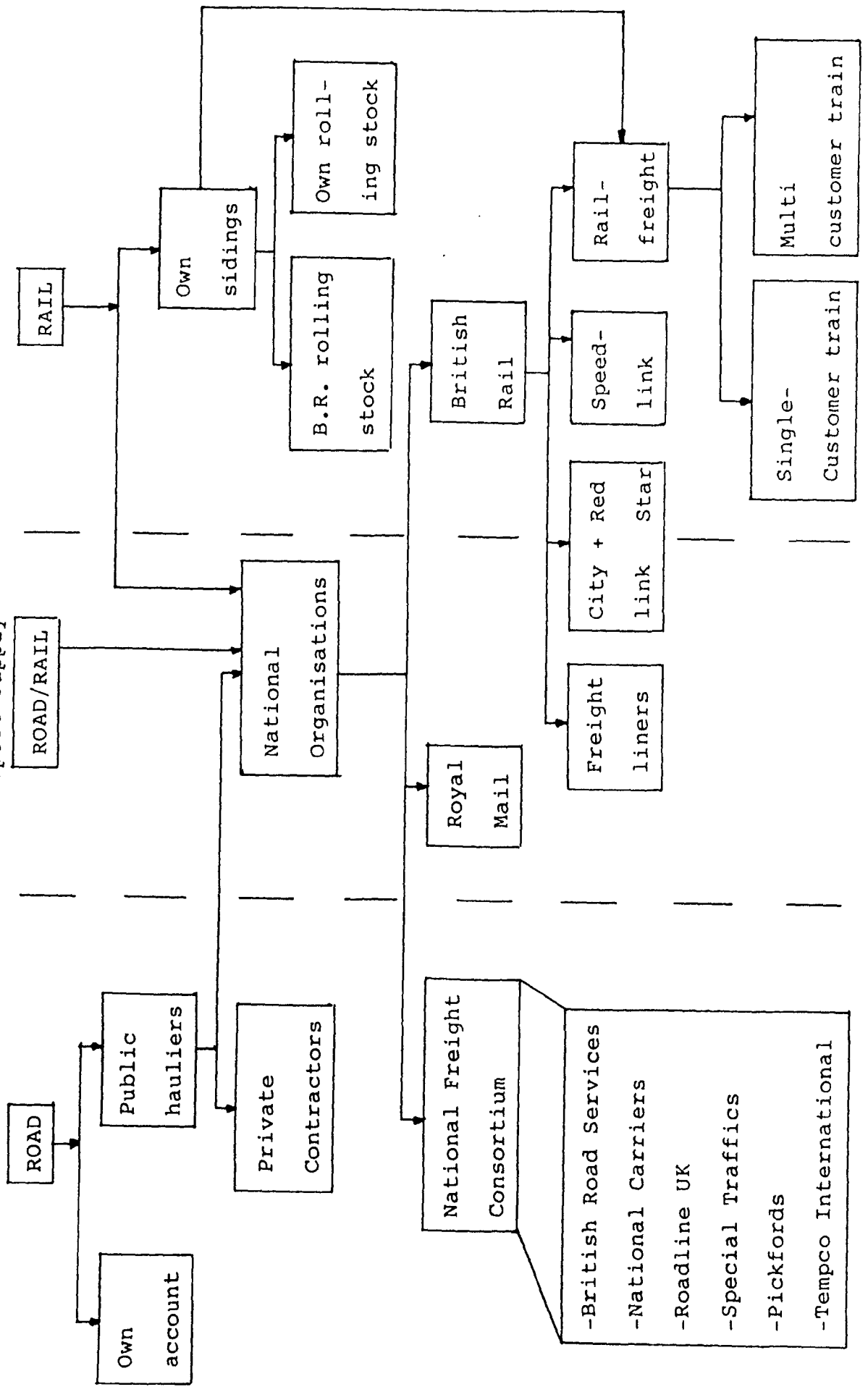
1. Rate of sale and sales volume
2. Seasonality
3. Consignment size
4. Market location
5. Market share/competitive status

For products with a short shelf-life and/or of a perishable nature, a quick and reliable method of transport is essential. Density, as expressed by weight to volume ratios, is an important factor in determining the requirements of a transport mode. If a product has a high value, then it is advantageous not to carry high levels of inventory and so rapid, reliable transport is necessary. Another effect of a high value product is its influence on security requirements during transit.

Ceteris paribus, the higher the value to weight coefficient of the product, the greater is the willingness to use a high-priced mode. If the rate of sale is high (for a given unit load size) then frequent deliveries are needed. So that a necessary modal attribute is the ability to meet stringent service requirements.

The relationship between customer size and location can produce some interesting effects. Customers who "consume" large quantities of goods and whose outlets are concentrated, make it possible to use large unit-loads with corresponding economies of scale. But when the customers become dispersed and/or the sales volumes are small, different delivery solutions are needed. For example, a manufacturer may seek to use the services of specialist distribution companies who, because of their own consolidation facilities, can offer relatively lower cost transport. It is reasonable to assume that a company whose product has a market monopoly can operate at lower service levels than those in highly competitive markets. If this is so, then it implies that transport considerations are related closely to the nature of market competition.

Figure 2.8 Overall Classification of Transport Supply



2.4 TRANSPORT SUPPLY INVESTIGATION

Figure 2.8 shows a simple classification of transport supply. The main division in the road freight industry, is between operators who carry for "hire or reward" (public hauliers) or those who carry on their own account, although the licensing distinction between these operators was removed in 1970. The Foster Report (Department of Transport, 1978) gives an excellent discussion on the background to the present licensing system (Appendix 1).

The organisation of the supply-side of road goods transport services is not easy to describe because of the diversity of circumstances within the industry. The own-account operator is concerned with carrying only his own firm's goods. Although he does have to consider whether to use his own vehicles or to contract it out to public road haulage or rail-freight, he has also to make investment decisions as to whether it is worthwhile replacing his fleet, adding to it or dispensing with it entirely. Even firms who operate their own fleets may use public road haulage regularly to supplement or occasionally to top up their fleets at times of peak demand.

The changeover from carriers' (A,B,C) licensing to operators (O) licensing has meant that even own-account

operators can now carry for hire or reward, if they so desire. Probably only a small percentage do so (Cooper, 1978).

The bulk of haulage is done either at periodically re-negotiated rates or on contracts which are exclusive to one customer. A profusion of sub-contracting also occurs in the road haulage industry, where one haulier quotes a price to a customer and then sub-contracts the job to another haulier (at another price).

Road goods transport is by no means a single homogeneous industry but rather a group of loosely-related trades. It is an industry with a very large number of operators - well over 100,000 licensed operators, as well as those using only small vehicles and therefore exempt from operators' licensing controls (Foster Report, Department of Transport, 1978). At present, only vehicles of 3.5 tonnes gross weight and above require an operators' licence.

Within the category of public road haulage there are a variety of national organisations, some of which employ other modes of transport as well. Sometimes, they may be wholly road-based, at other times rail-based, or a mixture of the two. Appendix 2 gives a brief outline of the main constituents of these national organisations.

CHAPTER THREE

APPROACHES TO FREIGHT TRANSPORT ANALYSIS

The intention of this chapter is to exemplify different approaches taken to the study of freight transport modal split rather than to produce a detailed exposition on every study to date - See Gray (1982) for an excellent review of the state of the art. For each example, the variables found to be important in explaining modal split are highlighted. The methodology used, data collection techniques, modes and industrial sectors surveyed are examined also.

In the literature (e.g. ECMT, 1973; Whiteing, 1978) three types of approach to the study of freight modal split are identified. These are:

- (1) Aggregate Flow Approach These methods use either nationally or regionally aggregated data. The former seek to establish relationships between total output of the economy or that of selected industries and demand for a particular mode of transport. In the latter case, modal split analysis is part of a global forecasting exercise and is aimed at

forecasting flows differentiated by mode on network links. The basis of the model is to calculate the overall cost, to either shipper or recipient, of transport operations.

(2) Consignment Approach In these methods actual choice of mode is observed by looking at individual consignments despatched by firms.

(3) Market Research Approach The aim of these methods is either to find out about the use of a particular mode, or to study the detailed requirements of the consignor with respect to the choice of mode.

Generally, all the studies reported here are British, apart from that by Mathematica (United States) and by Gilmour (Australia). This is not unrealistic, as the environment within which freight movement takes place varies considerably between countries. However, for a good review of the North American literature, it is suggested that Roberts (1977) is consulted.

3.1 AGGREGATE FLOW APPROACH

This approach is not concerned specifically with the issue of mode-choice per se but aims to establish reliable estimates of freight traffic flows for transportation planning purposes.

Mathematica (1967)

The model proposed by the consulting firm, Mathematica, for the North East Corridor Freight Project in the United States aimed to forecast freight flows (T_{ijkmt}). In other words, to provide forecasts of the tonnage shipped from i to j of commodity k by mode m at time t . An attempt was made to incorporate a mechanism for decision-making explicitly in the model structure, by employing the abstract mode technique; that is, a mode is not regarded just as road or rail but as a vector of values, which specify the relevant attributes which it offers the shipper. For example, a slower train service is considered to constitute a different mode to a more rapid train. An interesting feature of this model is the way in which new modes or new carriers with different service characteristics can be assimilated. In the abstract mode approach, demand estimation is based on attributes rather than on mode per se. Four variables were found to be of prime importance:

- (1) shipping cost per unit load (including freight rates, insurance cost and so forth);
- (2) mean shipping time;
- (3) variance in shipping time; and
- (4) carrying cost per unit of time in transit (to cover interest on capital, pilferage, deterioration)

One final element that they felt characterised a mode from the point of view of shipment of a particular commodity is the "usability" of the mode in question. For example, some commodities may require refrigeration while in transit and so they cannot use any mode which does not offer this attribute.

The model took the following form:

$$V[kij,m1]/(V[kij,m1]+V[kij,m2])= \\ 1/(1+(AVC[m2]/AVC[m1])[B1])$$

where $V[kijm]$ = volume of commodity k sent from i to j by mode m

The average variable cost (AVC) of using mode m to transport commodity k from origin i to destination j is defined as:

$$AVC[m] = rate[m]+B[2](time[m]*value)*B[3]/(V[kij])^{0.5}$$

where the term "rate" represents the out-of-pocket transport cost and "time" represents the in-transit carrying cost. The "value" term is used to reflect the inventory carrying cost.

An advantage of specifying the model in this way is that it includes within it a comparison of the logistic cost of the shipment alternatives. The Mathematica model was

estimated for train, truck and plane shipments for 15 commodity groups, using data from the 1963 Census of Transportation. Most of the coefficients in the set of estimates were significant. At the time, the results tended to support the Mathematica model as the appropriate approach to the estimation of freight demand. As Roberts (1977) points out, this model does allow variables such as rates, transit time and commodity value to be more precisely defined than previous aggregate mode-choice models. However, it still fails to provide an adequate basis for modal choice (and hence modal split) estimation. This failure is possibly due to the preoccupation with utilising only variables that are specified in cost terms. Indeed, the whole abstract mode approach is based on cost minimisation and so each variable has to be assigned as a cost.

Chisholm M. and O'Sullivan P.(1973)

In this study, the freight flow data was based on two surveys carried out by other bodies. The road freight data was obtained in 1962 by the (then) Ministry of Transport from a survey of the operations of the road haulage industry. While these data represented the work done by the transport sector, it did not replicate necessarily the flow from initial origin to final destination. For example, the goods may not go straight

to the consumer from the factory but go first to a warehouse. In this case, the same goods would appear as two separate movements. Information on rail freight movements in 1964 were obtained from British Rail. Problems were encountered in matching this to the 1962 road survey. Nevertheless, the 1962 volumes were grossed up to 1964 by applying a factor to each commodity flow matrix. The analysis was based on 13 separate commodity groups with Great Britain divided into 78 different origin destination zones.

The question of modal split was not a central theme to this study. In order to forecast freight flows, Chisholm and O'Sullivan thought it may be convenient to start by forecasting the aggregate movement of goods. They asserted that it is important to disaggregate the total by mode, so that estimates may be made of the traffic demands on the road and rail infrastructure systems, but they concluded that no simple relationship between distance and mode of transport could be postulated.

One problem that besets all aggregate models by their very nature is that aggregation of data always tends to reduce the explanatory power of the key variables.

3.2 CONSIGNMENT APPROACH

Bayliss B.T. and Edwards S.L.(1969)

In this investigation into the demand side of freight transport, information was obtained from 720 establishments in the manufacturing industry sector. Data collection was confined to specific Minimum List Headings within the five Orders of the Standard Industrial Classification (Central Statistical Office, 1968) given in Table 3.1.

Table 3.1 Parameters of sample frame

Foodstuffs	MLH 214, 218
Chemicals	MLH 271
Iron and Steel	MLH 311
Electronic Equipment	MLH 364
Paper	MLH 481 to 483

Source: Bayliss and Edwards(1969)

Data was collected in the survey on actual consignments. In the study, an attempt was made to assess the influence on distribution of traffic between modes of such factors as consignment type and weight; degree of containerisation; origin and destination; and price. Bayliss and Edwards considered that the subjective

assessment of the shipper is important for a demand study as it ultimately determines modal choice. However, they then went on to criticise studies (for example, Cook(1967)) that try to assess the determinants of demand by asking the firms themselves to rank a number of factors in order of importance. These rankings were then weighted by Cook to account for company size. They feel such a technique is open to criticism as there is no way of gauging independently the importance of a factor or of identifying interrelationships between factors or whether all factors have been taken into account. This criticism is less valid nowadays for two main reasons; first, due to increasing knowledge in the use and interpretation of behavioural techniques; and, secondly, any analytical model which ignores the subjective judgements inherent in the behavioural approach has so far not resulted in robust forecasts of freight transport modal split. Also, as Gray (1982) points out, Bayliss and Edwards adopted a more limited interpretation of market research than might normally be accepted.

The factors they regarded as contributing to modal choice were grouped together under three broad categories. The first included information relating to the consignment - for example, its size, destination, use of container and ancillary service performed. The

second contained factual information relating to the firm itself - such as its size and location. While the third included subjective assessments of the shipper, relating to such items as ready availability of transport, freedom from loss and damage and charges by alternative modes (Table 3.2).

The aim of the analysis that Bayliss and Edwards carried out was to establish the degrees of inter-dependence between explanatory variables and to determine the influence of the individual factors on the distribution of traffic in practice between the modes.

Table 3.2 Factors contributing to modal choice

FACTORS RELATING TO CONSIGNMENTS

1. Length of haul(miles)
2. Journey time(days)
3. Charge(pence)
4. Consignment weight(lbs)
5. Regularity of shipment
6. Container used
7. Special body requirement
8. Inter-establishment transfer
9. Consignment required more urgently than usual
10. Ancillary service performed
11. Type of commodity
12. Destination

FACTORS RELATING TO FIRM

1. Origin
2. Size of firm
3. Ownership of rail siding
4. Ownership of 'C' licence vehicles
5. Vehicles under 'A' licence contract-hire

SUBJECTIVE ASSESSMENTS

1. Knowledge of prices by alternative mode
2. Actual price by alternative mode
3. Speed required to meet customers' requirements
4. Speed required to ensure high utilisation of vehicles
5. Speed required to maintain low stock levels
6. Ready availability of vehicles
7. Freedom from loss
8. Freedom from damage

Source: Bayliss and Edwards(1969)

A probability model was developed as this could allow for the simultaneous interaction of a large variety of factors. Likewise, in order to handle the large number of observations and variables, the technique of multiple regression in a discriminant manner was used. In the case of obtaining the probability of a consignment going by own account, as opposed to public hauliers the model took the following form:

$$Y=f(X[1],X[2],\dots X[n]) \qquad \text{equation 3.1}$$

1 consignment went by
transport on own account

where:

Y=

0 consignment did not go
by transport on own account

X[1]-X[n]= explanatory variables

The value of Y, which can be calculated, represents the probability that a consignment will go by own account transport given particular values of X[1] to X[n]. The regressand is treated as a dummy variable.

The main explanatory variables were "length of haul", "consignment weight" and certain "service" features. Bayliss and Edwards suggested that type of commodity is important only in so far as certain commodity groups

were characterised by short hauls, (foodstuffs, for example) and that length of haul was the really important determinant. They found that in all branches of manufacturing industry the most important reasons for choice of main mode was either "ready availability when required" or "speed of delivery to meet customer's requirements". Freedom from damage and loss did not feature prominently in the subjective assessments. From the survey it was difficult to distinguish the ex post situation from the ex ante one, mainly because losses and damage occurred only infrequently.

3.3 MARKET RESEARCH APPROACH

Cook (1967) and Sharp (1970) provided early examples of the Market Research approach. Unfortunately, both studies suffer from a lack of statistical controls in their sampling procedures. This means that standard statistical tests cannot be applied to the numerical results.

Cook W.R.(1967)

Cook investigated the transport decisions of firms in the Black Country to identify the variables involved in such decisions. A direct interview technique was employed and by this method he obtained information covering 33 firms. The respondent in each case was the

transport manager of the firm. The firms covered a range of industrial sectors, although the dominant ones were in the metal-using and engineering categories. Inward transport, internal transport and outward transport were all considered, although not all the firms interviewed were concerned with inward transport, it being the suppliers' responsibility. Cook found that the most important aspect of transport is outward transport especially delivery to customers. Information on various aspects of outward transport were obtained and these are outlined in Table 3.3.

Table 3.3 Data collected for outward transport

1. Charging for delivery
2. Cost of transport relative to value of goods moved
3. Customer requirements for transport and their effects on the railways
4. Damage to goods
5. Relative importance of rail and various types of road transport

Source: Cook (1967)

The modes of transport that were considered are given in Table 3.4, with both the road and rail categories

further subdivided into their constituent elements, the importance of which is discussed later.

Table 3.4 Modes of transport

ROAD

Independent Haulier

Independent Haulier under contract

Own-account Haulier ("C" Licence)

RAIL

Goods:Sundries

Containers

Waggons

Passenger Train

PARCEL POST

MISCELLANEOUS

canal, air, etc.

Source: Cook (1967)

Cook assessed whether factors such as "number of employees" and "weight of goods moved" could be used as indicators of the nature and extent of a firm's transport problem. He concluded that both could be misleading. The reasons for this conclusion will be considered further in Chapter 6. One key to success of industry in the Black Country has been the flexibility

in its pattern of production to meet changing market demands. As product lines change, so may the transport requirements and thus adaptability of the transport mode is usually regarded highly. The aggregate output of a firm may be large but consignments can be small as customers are dispersed over a wide area. Low volume, multi-destination distribution is problematical for rail, or any fixed track system. Another important consideration is the practice by many customers of minimising stockholding which has implications for modal reliability. Thus Cook found that the respondents tended to view transport mainly in terms of "service to customer" rather than in terms of "cost". For example, if a customer specified a delivery time and date, only those transport operators that could meet the requirement would be considered and only at this stage would the cost component of the alternatives (if any) be evaluated. In fact, some of the transport managers interviewed did not consider that the "cost" component of transporting the product to the customer was within their area of concern. All this tends to reinforce road haulage as the dominant mode of freight transport. One of the main reasons put over by the firms for preferring road to rail revolved around "reliability of delivery times". It is difficult for firms to monitor the progress of their consignment(s) on the rail network and hence predict delivery times to their customers. This

reinforces again most firms' paramount concern with the concept of "service to customer". Choice of mode is subject to a certain degree of inertia and is constrained also by contracts, for example with British Rail or Road Hauliers, and the presence of own-account road vehicle fleets. The advantages of having their own road vehicle fleet were perceived as relating to this "service to customer" concept by the respondents.

The main findings of Cook's study emphasised the need to understand the decision-making process within the firm and to consider more fully the concept of "service to customer" as it relates to choice of mode.

Sharp C.(1970)

In 1970, Sharp carried out a detailed survey of 125 firms in the West Midlands in order to study the modal choice decision process. The survey included firms in all the SIC Orders in Manufacturing Industry, except Orders VII and XI. The survey was confined to road and rail transport but road was subdivided in a manner similar to that of Cook (Table 3.4).

The main determinants of modal choice centred around "Costs and Charges" and "Quality of Service" components (Table 3.5). Within the "Costs and Charges" component, a major problem was that not all of the variables were

independent and could in fact be interrelated in quite complex ways. For example, it can be argued that increasing consignment weight can lead to reduced costs per ton, especially if the consignment is of sufficient size to provide a good load factor for either a lorry or a rail-wagon. But the factor of consignment weight is partially dependent on route and regularity of shipment and so cost is not a straightforward function of weight.

Table 3.5 Variables considered important in modal choice

1. COSTS AND CHARGES COMPONENT

consignment weight

route

loadability

mileage

vulnerability

regularity

2. QUALITY OF SERVICE COMPONENT

reliability

low damage level

deliveries to all parts of the country

Source: Sharp (1970)

The difficulty encountered in measuring the "reliability" variable concerned the different interpretations by transport managers of the term. For example, some transport managers thought that the term meant keeping to delivery times while others thought it involved ensuring no loss or damage to consignments.

Another problem encountered concerned the respondent, for some firms did not have a "transport manager" as such but did have an individual performing the same function. Whereas, in other firms, there was no separate transport department and the transport function was just one aspect within an individual's wider work portfolio, for example the works manager or even the managing director. Sharp also found that the transport manager often performs a wide range of tasks in different firms. There appears to be no consensus concerning a job specification for the role of transport manager within a firm. Difficulty was also found in using "size of firm" as an indicator of the importance of the transport function to the firm. The nature of the product, such as perishability, seemed to Sharp a more meaningful indicator than size of firm.

General traffic characteristics, such as consignment size and geographical spread of destinations, may

suggest the use of one mode rather than another. In some instances, these traffic characteristics may be so dominant that the use of an alternative mode is very unlikely. However, for other firms, there is a choice element and therefore change between modal allocation is possible.

Sharp concluded that firms underestimated the importance of the transport function. Future studies he said should investigate more closely "quality of service" and attempt to express it in terms of money costs.

Gilmour P.(1976)

This study analyses the decision-making processes involved when transport managers make their modal choices for freight movements between Melbourne and Sydney.

Origin and destination data for freight movements in Australia generally, was felt to be inadequate. Two possibilities presented themselves in order to obtain information about the modal split of freight movements. The first involved the collection of data on movements of actual consignments. Alternatively, an investigation into the decision process of the users of freight services could be carried out. Gilmour chose the latter approach.

Information was obtained from a sample of business organisations and covered a wide product spectrum. One limitation imposed by Gilmour was that the organisations had to be large enough to have the use of their own vehicles for Melbourne to Sydney freight trips. From the surveys that were conducted, a large number of factors were found to be important in making the modal choice decision (Table 3.6).

Table 3.6 Main factors considered important for modal choice

Customers' terms of trade
Delivery time
Urgency
Reliability
Pilferage
Product characteristics
Cost
Regularity of service
Packaging requirements
Security
Product damage

Source: Gilmour(1976)

Price, as expressed by marginal cost to the company of providing its own transport or rate charged by a public carrier, is seen in many studies as the main criterion for modal choice. But if indirect costs are considered then road and rail are comparable, yet users' generally show a considerable preference for road transport.

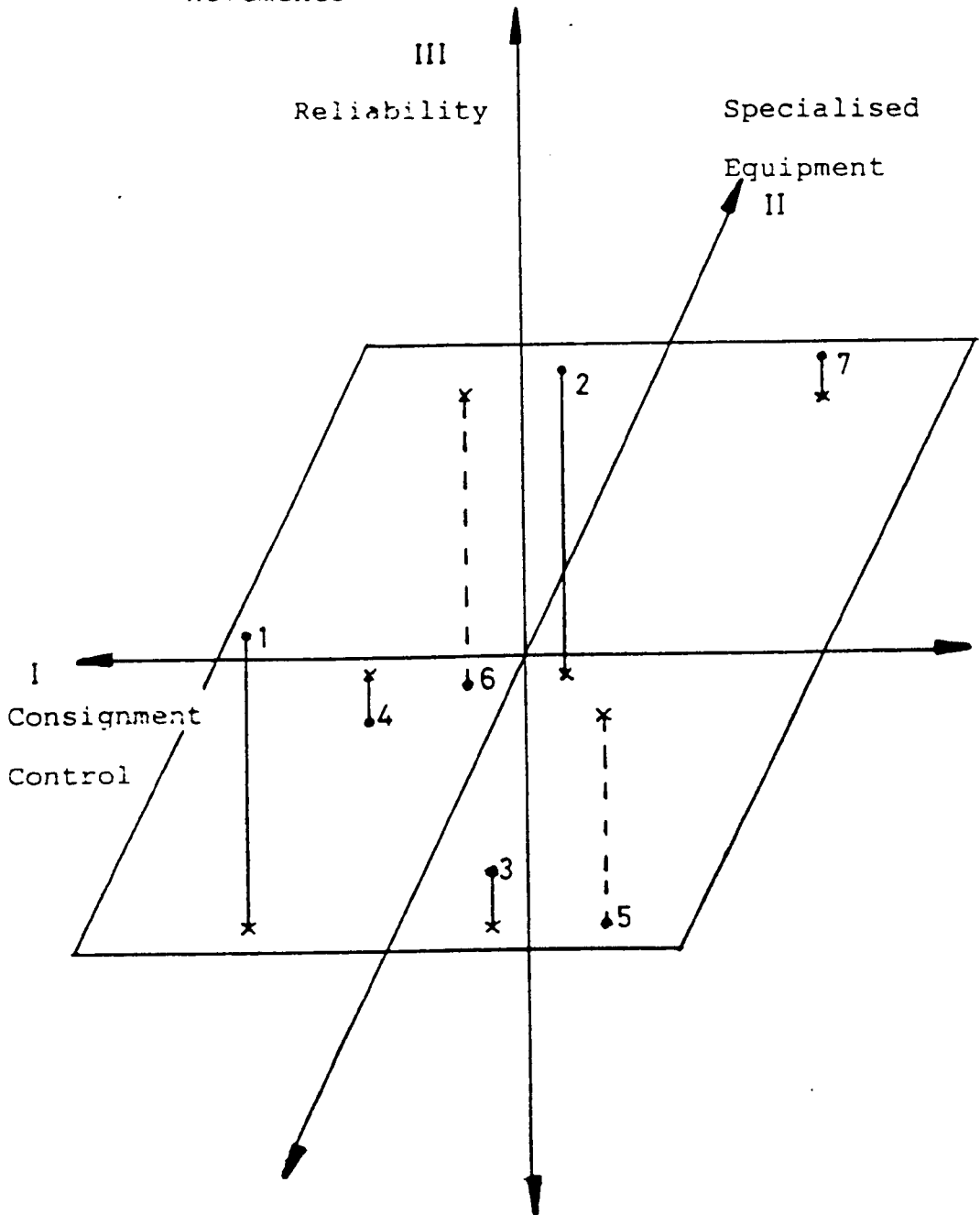
In his study, Gilmour found that indirect costs such as maintaining flexibility, immediate response and personal attention, were more important than direct costs. Within the direct costs category (that is, size of load, length of haul and long term contracts) the nature of the consignment was more important than the attributes of the transport mode. Finally, a high incidence of damage on rail and better delivery times by road tend to compound the advantage of road transport.

His method of analysis involved the use of multidimensional scaling. The respondents were divided into five product classes: grocery products; durable consumer goods; pharmaceuticals; industrial goods; and retailers. In order to select the number of dimensions to be used an examination of the stress generated by each dimension was carried out. Cluster analysis was employed to help identify the dimensions selected. This enabled perceptual spaces for each class and for the total to be developed. The perceptual space for the

group as a whole is shown in Figure 3.1.

From Figure 3.1, it can be seen that three main dimensions were identified. These were Consignment Control (the ability to control the individual parts of the consignment), Specialised Equipment (necessity to have specialised materials handling and transport) and Reliability (of the movement in relation to its expected duration). It is important to note that the direct cost of the transportation service is not among those recorded as an important determinant of modal choice for freight movement between Melbourne and Sydney.

Figure 3.1 Perceptual Space of Melbourne-Sydney Freight Movements



- | | |
|-------------------|----------------|
| Key: 1. Own road | 2. Normal road |
| 3. Overnight road | 4. Unit train |
| 5. Normal rail | 6. Sea |
| 7. Air | |

Source: Gilmour (1976)

3.4 AN EXAMINATION OF THE ALTERNATIVE APPROACHES

In examining the above three approaches it can be deduced that the transport decision-making processes by firms has been overlooked. The aggregate flow approach, developed at a macro scale, fails to study the behavioural patterns of the decision-makers and cannot incorporate changes that may occur in the variables which influence choice decisions in freight transport. It does not take into account the fact that modal split is the result of (at least, implied) choice by individual consignors. The information gained from such an approach is likely to be very misleading as no account is taken of modal choice determinants. Constraints also may be placed on the freedom of choice available to the consignor, such as a long-term binding contract with a particular mode operator or haulier.

In Chapter 1, it has been shown that a major problem involved in studying modal split is the lack of an adequate data base. For most countries, there is published data on origin to destination flows by commodity and mode, but analysing aggregate flow data has tended to ignore the complex logistics of freight distribution. The way in which freight transport statistics are collected tends to point analysts in the direction of the aggregate flow approach. Often these

statistics have as their basic sampling unit, the individual lorry journey. It is assumed that by plotting these journeys inter-zonally that a representative picture of the pattern of flow from production to consumption can be produced. But it has been shown in Chapter 2 that flows of goods from manufacturer direct to customer represent only one type of distribution channel. Although it is difficult to incorporate (for example) warehousing within the traditional framework of freight modelling, its exclusion is likely to undermine the validity of the analysis. Frequently, warehouses act as break - bulk points. At the warehouse, large consignments from manufacturers are broken down often into smaller loads for multi-drop delivery. Mathematica (1967) did attempt to take this into account in their average variable cost. Many advocate that freight flow analysis should be placed within the wider context of physical distribution (McKinnon, 1981; Whiteing, 1982). The only way to overcome such shortcomings is by engaging in empirical activity to provide the necessary data-base. It should be possible to achieve better results, if greater effort is devoted to understanding how shippers "behave" rather than attempting to develop more sophisticated mathematical models (Gray, 1982).

Other approaches (3.2) and (3.3), by contrast, are concerned with the micro-level, where the Consignment

Approach (3.2) observes the actual choice of mode at the most disaggregated level possible. The analysis is based on factors relating to the firm, to consignments and the subjective assessments of the shippers. The decision-process is analysed from the ex-post situation. This can lead to gross misinterpretation of results, as the respondent may answer in such a way that supports and justifies his past behaviour. The Market Research Approach (3.3) provides general insight into the transport requirements of firms, but it cannot discriminate between the use of different modes in different circumstances. If factor x is important but several modes offer a similar factor x then this factor cannot be used to distinguish between those various transport modes.

Analyses of modal split in freight transport using conventional techniques are not very accurate, suggesting that certain important parameters have not been considered or that no relationships exist. Before it is possible to develop modal split models, the modal choice decision-making process must be understood, together with consideration of the parameters which typically govern modal choice decisions in a firm.

A predictive model using qualitative data to produce quantitative decisions can be problematical but the

justification of using a detailed in-depth study of a phenomenon is that it can transform perception of the problem to the benefit of subsequent research.

With this in mind, the time is appropriate to develop further the Market Research approach, as modern techniques of behavioural analysis enable this method to be pursued more rigorously (Carrick, 1979). One of Cook's major findings was that the decision-making process did not conform closely with what might be expected by a student of the classical theory of the firm.

It is, therefore, important to understand how a consignor chooses a particular mode in order to develop freight transport demand models. Behavioural techniques may well provide the foundation on which to understand and explain more realistically consignors' choices of mode.

Methods that are based on classical economic theory are unrealistic in that there is no perfect market and decision-makers do not have perfect knowledge. In the imperfect market which exists, a shipper may have a wrong perception of alternatives or even no knowledge of them at all. The most up-to-date work of freight transport modal split is based on a generalised cost

model. In public sector planning, attempts are made to explain the observed distribution of goods in terms of generalised cost, based on resource values rather than behavioural values. This framework for the reasons given above is insufficient to explain modal choice reliably. Therefore, a new framework is required that will make it possible to achieve greater understanding of the forces involved.

In the UK, there is more road freight than would be expected just by doing a conventional modal split analysis. This implies that there are some important factors which are not being considered and used in modal split assessment. Deakin and Seward (1969) carried out a study (for 29 commodity groupings) of road and rail prices between 1962 and 1966. They found that, when 1962 road haulage prices per ton mile are compared with 1966 rail average receipts per ton mile, considerable price differentials still exist in favour of the railways for 18 of the 29 commodities. This finding does suggest that factors other than price may have a considerable impact on consumer choice of freight transport mode. Another major problem of using a generalised cost model formulation is the firm's estimation of these costs tends to be inaccurate anyway, even with own-account fleets (Bayliss and Edwards, 1969). The transport manager of a firm may not have full responsibility for

his own-vehicle fleet in accounting and managing the operation. If he only manages the operation and does not account for the fleet, then he is bound to prefer his own vehicles rather than an outside haulier as that shifts the cost to another department. But, if the transport manager is fully accountable, then he would look at the cost of using his own fleet compared to that of an outside road haulier or of a contract with British Rail.

The nature of the industry is such that arrangements are usually bilateral between consignor and haulier. Thus, the operator would not advertise the price of transport but he would negotiate individually with each customer. If bilateral arrangements are occurring widely then price-discrimination inevitably happens. Thus the same price will not prevail for all customers and this can undermine the assumption of overall competitiveness. Under normal circumstances, the theory of demand implies no price-discrimination. The theory can be adapted to account for price-discrimination but a very full set of information regarding every deal is required. This is perhaps why it is difficult to produce a realistic econometric model for freight transport.

Two alternative scalar approaches are available to analyse freight transport; again, at the macro and the

micro-level. But there is a current trend in transport research away from the macro-level forecasting models, based in the main on highly aggregated economic data, towards a more disaggregate consumer-oriented approach where demographic and broad psychological variables are used to explain, as opposed simply to predict, travel mode choice (Thomas, 1976). Behavioural analysis has been used in other investment decision contexts at a micro-level: for example, in the fields of passenger transport; residential location and industrial movement (Wachs, 1967; Green, 1974; and Carrick, 1979). This suggests that there are some useful concepts that could be applied to freight transport. Most of the freight modal split models constructed to date are based on the assumption of an "economic man" and as such are normative economic models. They are concerned with what should be, rather than what is, the case. There is no doubt that those kinds of model have been useful; but, clearly, decision-makers in the real world are far less consistent and, above all, less omniscient than these models assume. In order to develop a clearer understanding of freight modal split, it is necessary to look closer at the transport decision-making process. A theoretical review of decision-making in an industrial context is carried out in Chapter 4.

CHAPTER FOUR

REVIEW OF THEORETICAL PERSPECTIVES

It is apparent from Chapter 3 that the approach most appropriate to the study of freight modal choice is from the standpoint of the transport decision-maker within the firm. There has been much debate over the way in which business decisions made by firms and enterprises are explained by classical economic theory and how they appear to be made in reality. A full exposition of this debate can be found in the literature (for example, Cyert and March, 1963; Shubik, 1972; Simon, 1979; and Einhorn and Hogarth, 1981). Initially, a review of the theories of decision-making and consumer choice is undertaken. Usually, a paradigm, in this case for freight transport decision-making in an industrial context, is constructed prior to undertaking empirical studies of a particular firm or sector.

4.1 CLASSICAL AND NEOCLASSICAL PERSPECTIVES

The appeal of the theory of consumer choice in its classical formulation is its simplicity. Central to this theory are the concepts of rationality and optimality. The underlying principles behind the classical theory of

decision-making are as follows. First, a complete knowledge on all the alternatives is assumed. Secondly, it calls for the ability, on the part of the decision-maker, to predict perfectly the consequences of each of the alternatives. Another requirement is the need for certainty in the decision-makers present and future appraisal of these consequences and his assessment of them in terms of some consistent measure of utility. It may be feasible to use classical theory to predict human behaviour provided that behaviour is relatively stable and is operating close to some position of competitive equilibrium. But, in many instances, these provisos do not obtain; so it cannot provide an adequate base for the development of models capable of predicting demand (Shubik, 1972). In consequence, the behavioural theory of the firm has been advanced and this is discussed in 4.2. One reason for this weakness in classical theory is that few people act in a strictly utilitarian way. Another aspect is that in real life decisions are nearly always made under uncertainty. Although, to be fair, situations involving uncertainty and imperfect competition were never intended to be dealt with by classical economic theory (Simon, 1979).

The following example illustrates some of the problems involved. An individual may seek comfort as well as

cheapness and reliability in travel from an origin to any chosen destination, regardless of the transport mode used. In trying to accommodate this within the theory of consumer demand, a major problem of measurement exists. How can attributes such as comfort and reliability be measured? What are the underpinning dimensions of these attributes?

The firm is treated by classical economists as a primitive concept; where it is assumed that all decisions emanate from one decision unit, namely the entrepreneur. More recently, however (for example, Cyert and March 1963) the view is no longer taken that the firm is a primitive concept but instead as an organisation which contains different levels of decision-making.

"the gradual development of the modern corporation has made the entrepreneur of classical economic theory a somewhat unreal figure in a large part of the typical modern industrial economy."

Vickrey (1964)

The literature (Westaway, 1974) identifies four stages in the development of a business organisation. They are as follows:-

- (1) Small single function firms
- (2) National corporations with a single product line
- (3) Multidivisional corporations
- (4) Multinational corporations

The small firm is often controlled by a single entrepreneur or small family group. The consolidation of many small enterprises into national corporations has resulted in the evolution of a new administrative structure. This includes both horizontal and vertical systems of control. Horizontal control divides management into specialist departments such as Finance, Sales and Purchasing. While a vertical system of control was required to connect and coordinate the various departments and this, in turn heralded the beginning of the Head Office. The next stage saw the decentralisation of corporations into several divisions, based on a single product line, each with their own head office. The final stage resulted in the creation of a Group of firms or companies with a head office to coordinate the divisions and plan for the enterprise as a whole.

The revival of classical economic concepts in the 1950's attempted to cope with its traditional limitations of uncertainty and imperfect information. The first line of attack was to introduce "search and information transfer" explicitly as economic activities.

Search and information transfer with its associated costs and outputs could then be inserted into the classical formulation. This does not lead to the abandonment of the assumption of "utility maximisation" (Simon, 1979). Also the limits and costs that are introduced by this are based on the technological environment within which the decision-maker operates rather than on his psychological characteristics. The complexities that face the decision-maker in the real world and his ability to deal with them are still not taken fully into account in this conceptualisation (Simon, 1979). In order to incorporate uncertainty (or, at least, risk) into the classical decision-making models, statistical decision theory has been utilised. However, it has only served to increase the complexity faced by the decision-maker in the model because he now has to make assumptions about the probability distributions of the relevant variables.

4.2 BEHAVIOURAL PERSPECTIVES

Behavioural decision theory has two interrelated facets: normative and descriptive. The normative theory is concerned with prescribing courses of action that conform most closely to the decision-maker's beliefs and values. The aim of descriptive decision theory is to describe these beliefs and values and the manner in

which individuals incorporate them into their decisions (Slovic, Fischhoff and Lichtenstein, 1977).

Several procedures have been advanced which attempt to overcome some of the pitfalls inherent in classical solutions to decision problems in the real world (Simon, 1979). One such method is concerned with the idea of a satisfactory choice rather than optimal choice.

Alternatively, the decision-making task is broken down by examining the organisational structures in companies and departments of government, for example. These organisational structures have been devised in an attempt to cope with the limited ability of human beings to make decisions in the face of complexity and uncertainty.

Another theoretical perspective put forward in response to the deficiencies of classical theory is that of "bounded rationality". As Simon (1979) argues, there is a need for a more formal characterisation of the mechanisms of choice under conditions of bounded rationality. What then is meant by the term "bounded rationality"? In essence, rationality is bounded by the fact that the decision-maker does not have perfect knowledge of all the possible alternatives. It also takes into account the inability of the decision-maker to predict accurately the consequences of each

alternative and that uncertainty is a characteristic of real-life decision-making.

March (1978) shows that rational choice involves two guesses. One concerns the uncertainty of future consequences of current action. While the other considers the uncertainty of future preferences for those consequences. Theories of choice under uncertainty have been developed to emphasise the complications of guessing future consequences. For similar reasons, theories of choice under conflict or ambiguity have been developed for guessing future preferences. Theories of choice previously developed had assumed that future preferences are exogenous, stable and known with sufficient precision to make decisions unambiguous. But this assumption tends to break down when considering collective decision-making, where there is the problem of conflicting objectives which reflect the values of the different participants. Thus, there can be no "optimal" solution which is a requirement of classical theory. The best that is possible is a compromise between the goals that reflect the values of the different participants.

Central to the idea of bounded rationality are the concepts of "search" and "satisficing". A search process must be carried out by the decision-maker, if all the

alternatives for choice are not presented to him at the outset. Unlike classical theory, utility maximisation is not essential to the search scheme. Instead, the decision-maker has some idea of how good an alternative should be. This is termed the "level of aspiration". It has been postulated that as soon as the process of search of alternatives meets the aspiration level of the decision-maker then it is stopped and that alternative chosen. Simon (1979) called this method of selection "satisficing". Aspiration levels are not static. For example, under conditions of growth which provides many good alternatives, aspirations will probably rise. When conditions are in decline then aspirations tend to fall.

Information processing psychology is concerned with the processes that people use to make difficult decisions and solve complex problems. Figure 4.1 shows the processes involved in judgement and choice.

Figure 4.1 Processes of judgement and choice

Information acquisition
Evaluation
Action
Feedback/learning

Source: Einhorn and Hogarth, 1981

One process that is notable by its absence from Figure 4.1 is that of problem or issue identification. Problems are often presumed rather than identified. If this occurs then it can lead to the collection of data, which by its very nature, is incapable of revealing the root causes of the problem. The first step, prior to any data collection and analysis, is problem identification. Theories of information processing consider that the search for a solution to a given problem is very selective. Even for a "simple" problem, the decision-maker decides in which areas he will look for solutions. Therefore, search is a constrained process and this again emphasises the fact that the decision-maker does not look for a uniquely determined optimum as would be required by classical economic theory.

"In a modern market society, economic decisions on price, output, product lines, product mix, resource allocation are made not by individual entrepreneurs but by a complex of private and public institutions. Many of these decisions are made within the large, multifunctional and complicated organisations called firms."

Cyert and March (1963)

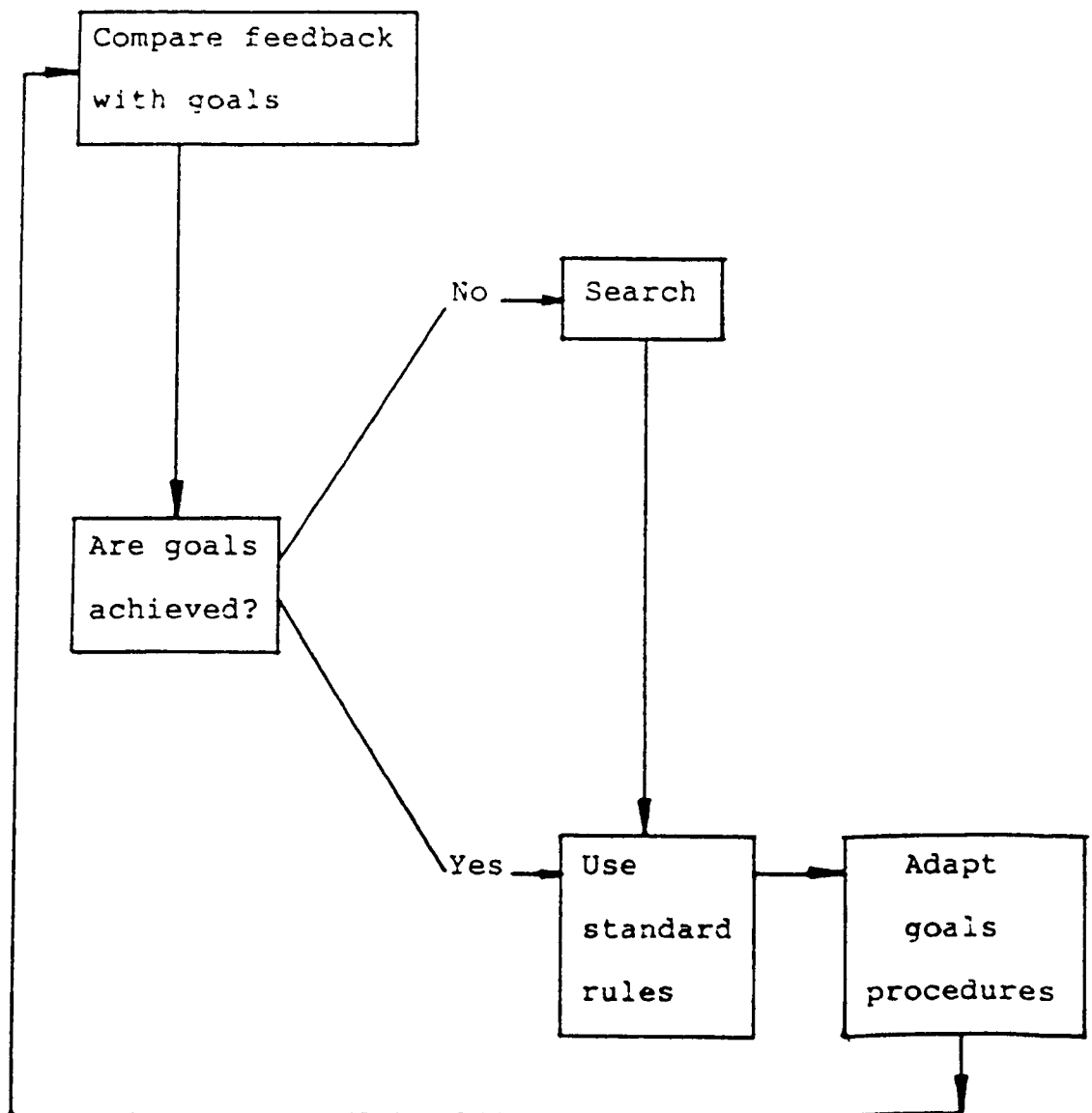
General features of decision-making such as selective search and satisficing have been used to build theories of the firm based on behavioural assumptions. Cyert and March (1963) considered the relationships in the business decision-making system to comprise:

- (1) quasi-resolution of conflict between decision-makers
- (2) uncertainty avoidance
- (3) a simple, problem-oriented search process
- (4) organisational learning from experience

It can be argued that it is impossible to avoid uncertainty whereas it is feasible to minimise risk. Uncertainty avoidance, therefore, should be replaced by risk minimisation as this refers to uncertainties which are capable of being quantified in probabilistic terms. With this rider, these relationships form the core of the framework within which the variables involved in the decision-making process can be analysed. Conflicts within the internal environment, such as between different departments (transport, marketing, finance) may affect decisions or choices between options. Resolution of such conflicts may, on the one hand, curtail search and, on the other, stimulate it. It may result also in biased informational feedback. If an existing policy is deemed satisfactory then there is little or no need to search for alternatives. Search is

usually intensified when failures of policy occur. As Pred (1976) has pointed out large corporations are known to reduce uncertainty by choosing alternatives that resemble most closely those taken in the past. Organisational decision-making occurs in response to problems or perceived potential problems. Figure 4.2 indicates, in a very general manner, the decision process for a department in an enterprise.

Figure 4.2 Schematic representation of departmental decision-making



Source: Cyert and March, 1963

Cyert and March (1963) argue that the goals of an enterprise result from a continuous bargaining and

learning process and that this does not necessarily produce consistent goals. Thus, the goals of a Production department may vary from those of the Marketing department. Conceptually, then, an organisational decision is seen as a choice made in terms of objectives from among a set of alternatives on the basis of available information. Another important element, which introduces complexity in the firm's behaviour, at least in the short run, is (in Cyert and March's (1963) terminology) "organisational slack". This is one of the methods by which firms reduce conflict between the differing goals by accumulating surplus internal resources. Others include the decentralisation of information and attending to crises sequentially. Organisational slack acts as a buffer between the environment and the firm's decisions. Even with identical environmental conditions, different decision mechanisms can produce different behaviours as between firms. This must have a profound effect on policy implications for, if different assumptions about the decision mechanisms can produce different conclusions, then the process is an important aspect of analysis at the micro level. In other words, a central concern should be with the ways in which decisions are reached as well as with the outcomes themselves.

Another aspect of decision-making that may be of

relevance is the frequency of decision-making. If a certain decision is made frequently then the decision-maker is likely to have a good idea which alternatives are viable. And of those, which one is likely to produce the most successful outcome. The opposite is likely to apply for infrequent decision-making.

To date, there is no single, widely accepted, behavioural theory of choice. Instead attempts have been made to identify the major aspects of key processes that appear to be reflected in decision-making. As Shubik (1972) points out, if detail appears to be important then a simulation should be attempted rather than relying on the construction of an analytical model.

Various salient issues must clearly be addressed when investigating decision-making in a business environment and these should be incorporated in any paradigm for freight transport modal choice. Thus, transport as one function of a business, even though it is of central importance to this study, should rely on the firm as the relevant unit for analysis. In Chapter 2, it has been shown that a transport policy for any enterprise is part of an overall logistics policy. This covers aspects such as Production and Marketing and these may significantly

affect modal choice and this reinforces the firm as the starting point. The nature of its organisational structure is also an important consideration, especially in terms of its impact on the particular decision process studied. How a firm seeks to reduce uncertainty is another relevant consideration. In an attempt to minimise risk, is the status quo position an attractive proposition to the decision-maker? As regards the procedure of searching for alternatives, it is important to realise that not only are organisations looking for alternatives but alternatives are also looking for organisations!

4.3 PARADIGM FOR FREIGHT TRANSPORT DECISION-MAKING IN AN INDUSTRIAL CONTEXT

Frequently, two alternative decisions face a firm concerning transport. The first decision would involve the firm in major investment with commitment to a certain mode of transport, either in terms of acquiring their own fleet of lorries or their own private sidings and rail-wagons. In these instances, the firm by making that investment decision constrains its transport choice to that particular mode. However, this may not hold true for all consignments but will certainly relate to base-load requirements. Firms may use other freight modes for "topping up" in times of peak demand.

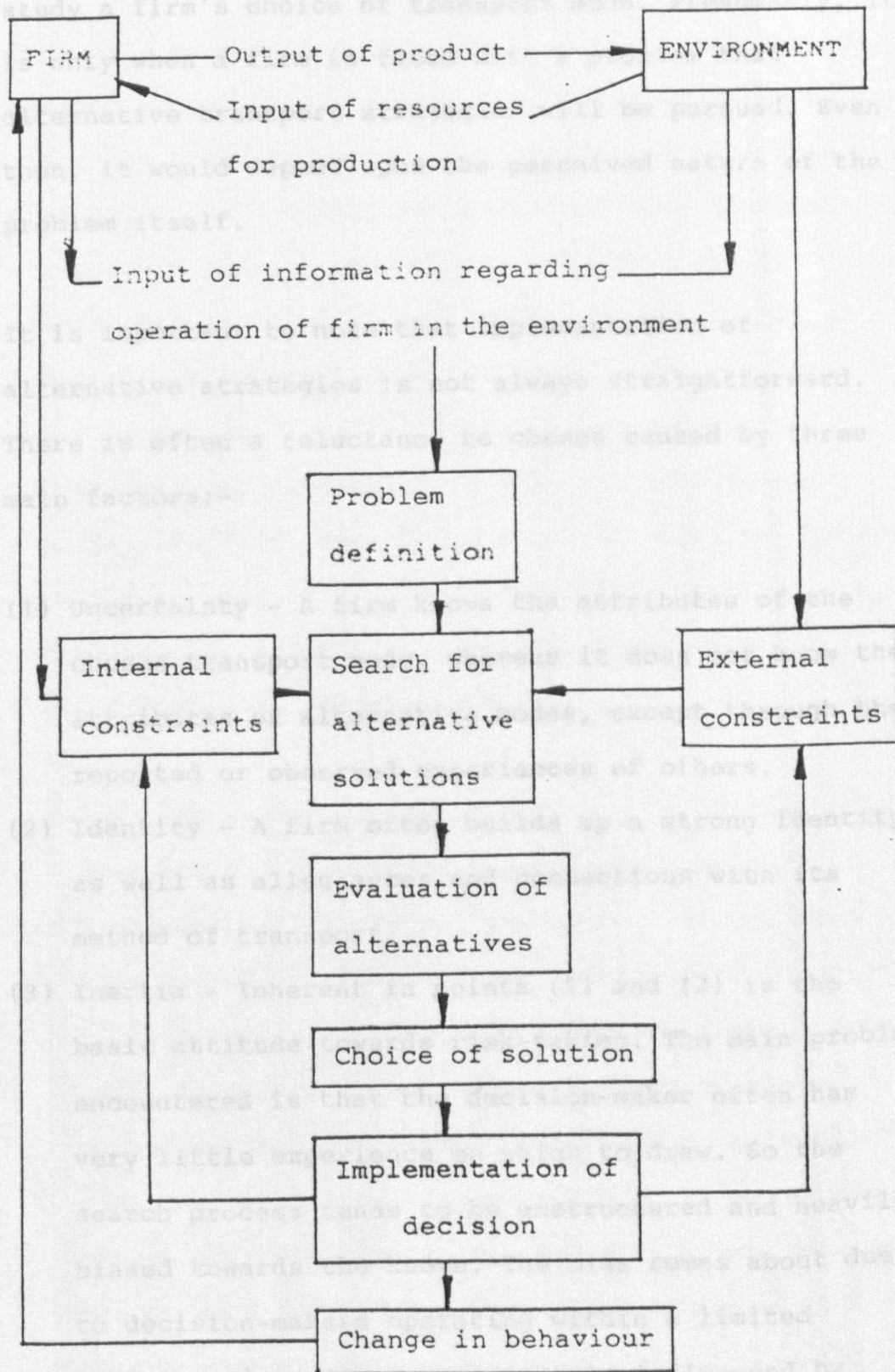
Otherwise, to a large extent, these firms are then captive to the mode in which they have invested. Although "captivity" to the mode will only hold true during the useful life of the investment. The second decision is where the firm chooses to go to public freight contractors for its transport. In this case, the freedom of choice is preserved even though the recurrent costs may be greater.

Methodologically, decision-making can be simplified into three basic stages, although an individual making a decision may not be aware of each stage in this process. The stages are:-

- (1) stimulus to make a decision and identification and definition of the nature of the problem;
- (2) search for alternative solutions; and
- (3) evaluation of the consequences of each alternative leading to an ultimate choice of solution.

Figure 4.3 shows a simplified model of the decision-making process. Basically, the diagram is a search-based decision-model which has an inherent circularity and also is, in consequence, a simple learning model. A stimulus is identified, a search is carried out and an appropriate response is chosen which changes the system's behaviour.

Figure 4.3 A Simplified model of the decision-making process



With suitable modification, this model can be used to study a firm's choice of transport mode. Presumably, it is only when a firm is faced with a problem that alternative transport strategies will be pursued. Even then, it would depend upon the perceived nature of the problem itself.

It is important to note that implementation of alternative strategies is not always straightforward. There is often a reluctance to change caused by three main factors:-

- (1) Uncertainty - A firm knows the attributes of the chosen transport mode, whereas it does not know the attributes of alternative modes, except through the reported or observed experiences of others.
- (2) Identity - A firm often builds up a strong identity, as well as allegiances and connections with its method of transport.
- (3) Inertia - Inherent in points (1) and (2) is the basic attitude towards risk-taking. The main problem encountered is that the decision-maker often has very little experience on which to draw. So the search process tends to be unstructured and heavily biased towards the known. The bias comes about due to decision-makers operating within a limited behavioural environment (strongly influenced by

their position both geographically and socially).

Each will have preferences for some modes and prejudices against others. These derive from opinions which in most cases are based not upon a systematic and objective evaluation of the relative merits but upon a collection of sporadic impressions. Whether or not such subjective assessments are true in any absolute sense is not at issue; it is enough that modes are believed to vary in their qualities. In addition to this, certain constraints may operate which rule out some modes a priori. Finally, the attribute of identity or "source loyalty" is seen as a strong motivating force in maintaining allegiance to a particular mode within freight transport decision-making:

"The concept of source loyalty can be defined as a preference, inferred from a buyer's observed behaviour, to purchase a product or service from the same source from which it was obtained previously. It is essentially a matter of degree, ranging from perfect loyalty at one end of the scale, where purchases continue without interruption from the same source of supply, through split loyalty, where orders are consistently divided up between the same two or more sources, to complete disloyalty at the other extreme, where a product is never purchased

more than once from the same source."

Cunningham and Kettlewood (1976)

In freight transport, it is possible to identify two distinct types of loyalty: mode and source loyalty. Mode loyalty refers to the tendency to remain loyal to a particular mode of transport, while source loyalty relates to the particular transport supplier. It is possible for mode loyalty to be equivalent to source loyalty where suppliers are few in number. This is more likely for rail than for road haulage. The transport decision-maker may exhibit a strong allegiance to road haulage but may change his actual choice of haulier quite frequently and so have a low degree of source loyalty. This is discussed further in 6.3.

For both conscious and, possibly, subconscious reasons, the decision-maker's search for a suitable alternative is both biased and limited in scope. Search, other than of a simple nature, can be costly in terms of both time and money and, at some stage, a cut-off point is reached (Pred, 1976). The fact that businessmen possess neither sufficient ability nor sufficient information to act as "perfectly rational" economic men adds a great deal of complexity to the analysis. It is important therefore to build a healthy body of decision-making in freight transport theory on the basis of behavioural principles.

Because, in the final analysis, freight transport modal split is the cumulative expression of numerous decisions made by large numbers of people at different points in time and under a variety of conditions. This kind of approach has been applied to other decision areas within a firm and has been found to improve considerably our understanding and to overcome many of the limitations of classical economic theory (for example, Industrial Location, see Collins and Walker, 1975).

It is important, therefore, to discover what attributes govern the mode-choices that a firm makes. In the literature, it has been pointed out that choice relies upon perception (Hills and King, 1979). In other words, for a particular firm, there may well be several mode-options, but these are only valid as choices when the decision-maker is aware of them.

Upto this point the firm has been considered as representing a single organisational structure. However in 4.1, four separate stages in the development of a business organisation have been identified.

Chandler and Redlich (1961) have devised three levels of decision-making which correspond, in part, to the process of corporate development. Level One consists of the top management whose functions are to determine

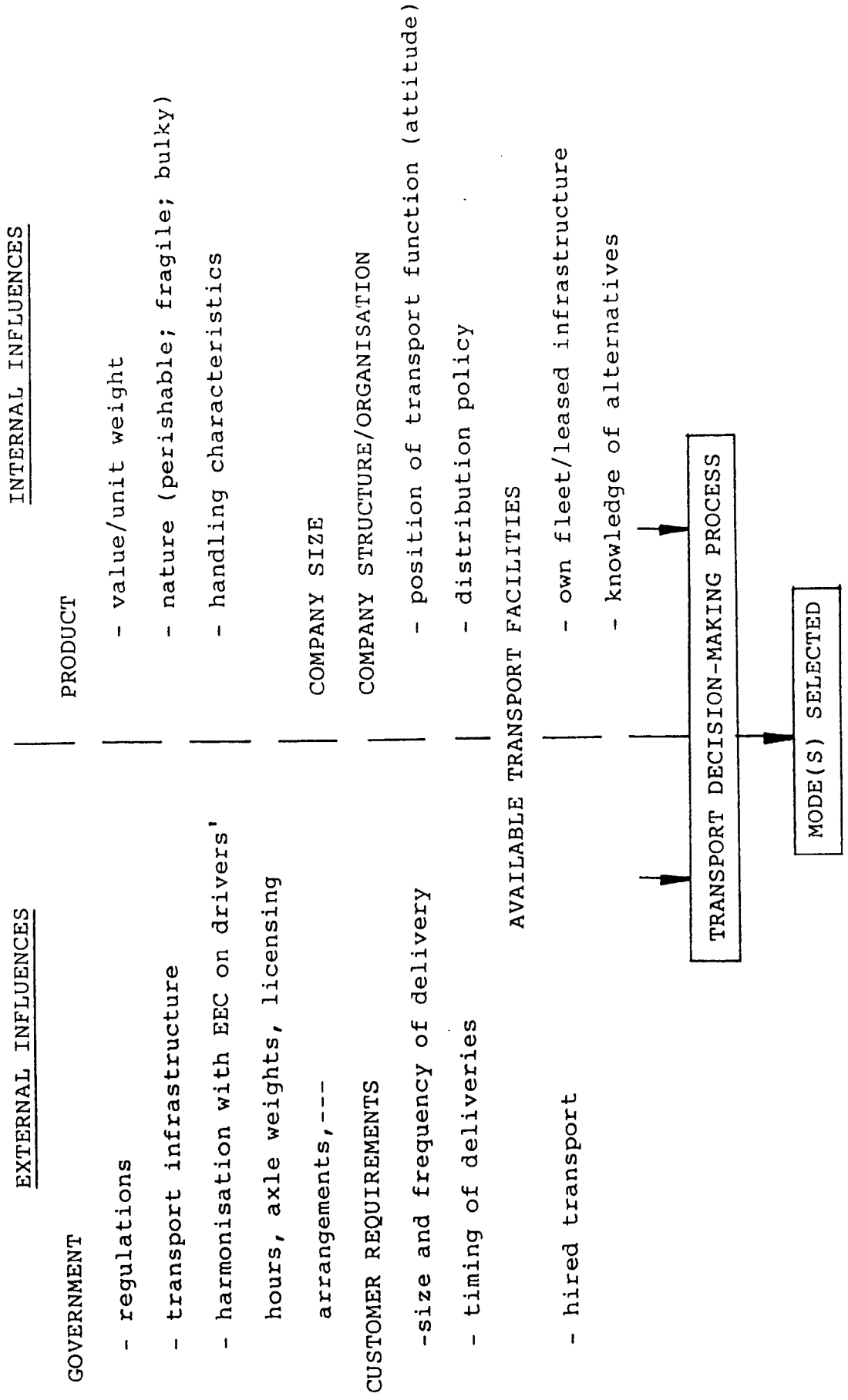
goals and planning objectives for the enterprise as a whole. For a multidivisional corporation, Level One decision-making is separated from Level Two and takes place in a Group head office. Level Two is formed when there is a head office which means it can be separated from activities connected with production. The main responsibility of management at this stage is to coordinate line managers at Level Three. Thus, in a typical national corporation, the top two levels become separated from Level Three, which is concerned with the day to day operational management of the enterprise. In the early stages of the development of a corporation, all three levels tend to be incorporated within the single entrepreneur.

At any particular location, therefore, an establishment may be an independent firm or an externally controlled company in a group. It can be argued that the externally-controlled establishment might have several important advantages over the independent one (Watts, 1981). For example, an externally-controlled establishment would have access to the financial resources of the parent firm without sacrifice in terms of their autonomy in decision-making. Although its investment policies may be controlled from the parent company, it might enjoy autonomy (say) in its purchasing policy. In this context, it will be interesting to see

how far firms in reality reflect the above conceptualisations and whether type of firm influences transport decision-making significantly. This proposition will be tested in Chapter 6.

A number of parameters can now be put forward that may determine freight modal split (Figure 4.4). From this, a number of relationships can be derived and these are set up as hypotheses for testing in Chapter 5.

Figure 4.4 Parameters determining Freight Modal Split



CHAPTER FIVE

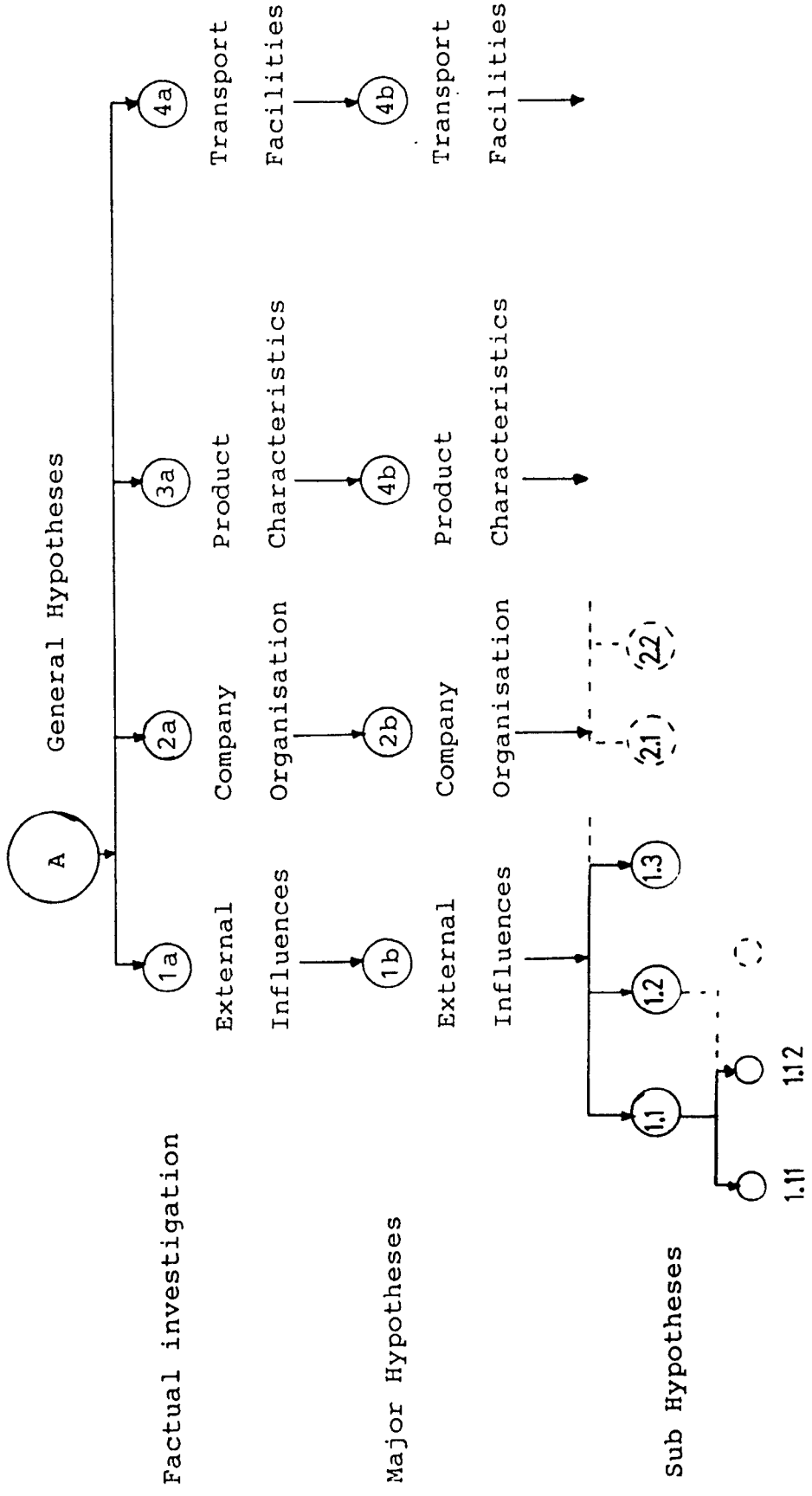
RESEARCH DESIGN

5.1 DEVELOPMENT OF HYPOTHESES

This chapter outlines the approach taken to investigate modal choices in freight transport within the Paper, Printing and Publishing sector in West Yorkshire. The choice of this sector is discussed in section 5.2. To determine the more important parameters governing freight modal split, four hypotheses have been developed. These are:

- (1) there is a significant relationship between external influences (e.g. price and rate levels) and transport mode selected;
- (2) there is a significant relationship between the internal organisation of a company and the mode it selects for its goods movement;
- (3) there is a significant relationship between characteristics of the company's product and the mode selected; and
- (4) there is a significant relationship between the transport facilities available to a firm and the mode selected.

Figure 5.1 A Hierarchy of Hypotheses



To enable more detailed analysis, a hierarchy of these hypotheses and further sub-hypotheses can be established. Figure 5.1, gives an indication of the form this process takes. Taking each of the main hypotheses in turn, it was possible to list a number of specific relationships that could be tested and these formed the sub-hypotheses. For example, the relationship between customer requirements and the transport mode selected was a sub-hypothesis of Hypothesis 1. If a situation arises where a particular relationship can be tested using more than one indicator then further sub-hypotheses were developed.

Hypothesis 1: "There is a significant relationship between external influences and the transport mode selected"

There is a significant relationship between.....and the transport mode selected.

- 1.1 ...customer requirements (as measured by specification of the required mode by the customer; the need of the customer to have the product delivered urgently).
- 1.2 ...long-term contracts (as measured by formal agreements with public hauliers to use their transport to deliver the product).
- 1.3 ...and so on.

Hypothesis 2: "There is a significant relationship between company organisation and the mode selected"

There is a significant relationship between.....and the mode selected.

- 2.1 ...the management characteristics of the establishment (as measured by the number of organisational levels present).
- 2.2 ...the employment characteristics of the establishment (as measured by the total number of employees and the number of employees solely concerned with transport/distribution within the establishment).
- 2.3 ...the nature of the establishment (as measured by the structure of the company and type of business undertaken).
- 2.4 ...position of transport function in company structure (as measured by its place in the organisational hierarchy; its relationship to other management areas).
- 2.5 ...the independence of the establishment (as measured by degree of management autonomy; its role within a group of companies; whether it runs other establishments).
- 2.6 ...the size of the establishment (as measured by

the value of output; number of employees).

- 2.7 ...the level of responsibility of the transport manager (as measured by whether he manages or manages and accounts for the operations).

Hypothesis 3: "There is a significant relationship between product characteristics and the mode selected"

There is a significant relationship between.....and the mode selected.

- 3.1 ...destination of product (as measured by the establishment's sphere of operations, both geographically and in terms of market outlets).
- 3.2 ...nature of product (as measured by its type, production process and operation).
- 3.3 ...handling characteristics (as measured by the need for special facilities).
- 3.4 ...and so on.

Hypothesis 4: "There is a significant relationship between the available transport facilities and the mode selected"

There is a significant relationship between.....and the mode selected.

- 4.1 ..."base load" requirements (as measured by the

need to use different modes or carriers to meet upward fluctuations in demand).

- 4.2 ...knowledge of alternatives (as measured by the use of different transport modes; option appraisal).
- 4.3 ...perception of alternatives (as measured by respondents' attitude towards risk taking).
- 4.4 ...presence of own transport facilities (as measured by type and number of vehicles or railway wagons owned).
- 4.5 ...perceived transport service characteristics (as measured by an attitudinal rating scale).
- 4.6 ...and so on.

To test this set of related hypotheses, a questionnaire was devised (Appendix 4). Before detailing the design and content of the questionnaire, the sample frame and sampling procedure are outlined. It is necessary to draw a clear distinction between sampling procedure and survey method, since the two are often confused. The sampling procedure is concerned with the process of generating a representative (or other) sample of a population, while the survey method is concerned with the technique used to administer the survey itself to the selected sample.

5.2 SAMPLE FRAME; SAMPLING PROCEDURE

Sources of Information

It can be argued that more than one source should be used when trying to create a listing of all establishments in a single industry. Foley (1981) for example, carried out a comparison of four industrial data-sources. He suggested that the two most efficient and informative data-sources are the Market Location Limited (MLL) directory and the Annual Census of Employment (ACE) records, although the latter are not commonly available for research studies. He concluded that, where time or financial constraints preclude the examination of other sources, these two data-sources are both adequate to form a sample frame.

Unfortunately, data examined in this case from these two sources were not collected at the same time. The Annual Census of Employment records derived from Inland Revenue data and the files on West Yorkshire both relate to early 1977, whereas the latest data for the Market Location Limited Directory was collected mid 1978. The number of firms recorded by both MLL and ACE was less than 50% of the total number generated by each source. It was decided, therefore, to use only the Market Location Limited Directory as the basis of the sample frame for two main reasons. First, the MLL directory

does not rely on other data-sources for its listing of establishments. Reference to other sources introduces a further stage at which inaccuracies can develop: for example, the Annual Census of Employment records rely on the accuracy of data supplied to the Inland Revenue. Secondly, as regards ACE records, delays in processing the information mean that most local authorities have only recently received the census for June 1978 and may still be using information from the 1977 Census. Consequently, the information collected in the 1979 and 1980 censuses is not being processed and the next available information is from the 1981 Census.

Information Collected

Market Location Limited state, in the introduction to their directory, that they provide the only maps and indexes compiled by researchers in the field. Their data is collected by observers walking all the streets shown on maps provided to them and listing the location of each individual premise.

When all these industrial premises have been identified, interviewers visit the managements of each. If an interview is not possible, estimates are made of employment size and other information about the company is collected from other sources such as Companies House.

The categories of interview data collected are, as listed below:

- (1) company name;
- (2) address with postcode;
- (3) telephone number (and telex);
- (4) where possible, the name and title of the person in charge at each location;
- (5) brief description of the company's precise business/activity;
- (6) SIC code;
- (7) total number of employees (with a breakdown by sex, where known);
- (8) map page and grid reference; and
- (9) an indication of the status of each factory.

If an interview is possible, the employment numbers are those obtaining when the data is collected. These are then stratified into the groupings shown in Table 5.1. Where estimates have to be made, they are allocated the letters S, M and L (Table 5.1) according to the range of firm size concerned.

Table 5.1 Employment Stratification Groups for
the Market Location Directory

Code	Category size (No. of Employees)	
	Actual	Estimates
A	unknown	
B	0-10	
C	11-25	
D	26-50	
E	51-100	
F	101-250	
G	251-500	
H	501-1000	
I	over 1000	
S		0-25
M		26-100
L		over 100

An example of how the information is presented by Market Location Limited is shown by the annotated diagram in Figure 5.2. The status of each factory refers to the level of independence at each location. The status code referred to in Figure 5.2 is derived from the letters and numbers shown in Table 5.2.

Figure 5.2 An annotated diagram to show the information presented by the Market Location Directory

Name of company	Address and Postcode	Telephone number and exchange	Activity code based on SIC	Status code
A.N. Other Ltd.	Main Street Collingham LS22 5AJ	Collingham 71221	(R) BBB A2 P	1H
GMD Mrs S Johnson		Colour Printers and Lithographers		
Job title and name of location manager		Activity description	Employees (male, female, total)	Grid reference letter on map

Table 5.2 Control Stratification Groups for the Market
Location Limited Directory

Status Code Letter	Status of Unit
1	An independent company operating at only one address.
2	An independent company operating at more than one address.
3	A subsidiary company operating at only one address.
4	A subsidiary company operating at more than one address.
H	Head Office
B	Branch

Samples taken from two directories are required to study West Yorkshire. The directory for the eastern part of the county was compiled in June 1978 and the directory for the western part was compiled in July 1978.

The information collected from the MLL directories was put on an "establishment information" record card, as shown in Figure 5.3.

Figure 5.3 An Establishment Information Record Card

A. N. Other Ltd.

Main Street,

Collingham,

LS22 5AJ.

Tel:Collingham 71221

Employment - M

Business Type - Printers

Other information - GMD Mrs S Johnson

Page 220,1.

Sampling Procedure

Methods of modelling freight movement to date are based on:

- (1) commodity. Even within one commodity, freight movement is not necessarily homogeneous.
- (2) vehicles. They are reasonably simple, although they cannot take account fully of changes in modal split. (Eastman, 1981).

In passenger transport planning, it is assumed that the household is the basic unit of trip-making. It seems appropriate therefore for freight transport to take the firm as the corresponding basic unit for analysis. Data from a paper by Edwards (1970) has been used to

ascertain the SIC order to be used to obtain the sample frame.

From the literature, cost of transport (whether operating cost of an own-account fleet or contract price to consignor for haulage) does not appear to be the main determinant of modal choice. Therefore, the firms selected for study should have neither high nor low transport costs in relation to the value of the commodities hauled. Total transport cost as percentage of the value of net output has been taken as the unit for comparison between SIC orders. This unit was chosen because transport cost may be important in an industry where transport, though cheap in comparison with other cost-components (value of sales less items such as purchases of materials) is still not cheap in relation to the low value of the industries' product.

Table 5.3 has been used as the data-base. The observations of total transport cost as a percentage of the value of net output of the SIC orders have been placed in rank order and the median obtained. The median is SIC order XV, which is the Paper, Printing and Publishing sector.

Table 5.3 Industrial sector sample frame

M.L.H. (Minimum List Headings)	Industry or group of commodities	Total transport cost as a proportion of the value of net output(%)
(All manufacturing industries excluding Order VII Shipbuilding and marine engineering)		
Order III	Food, Drink, Tobacco	13.94
Order IV	Chemicals/Allied Industries	7.03
Order V	Metal Manufacture	6.64
Order VI	Engineering and electrical goods	2.68
Order VIII	Vehicles	2.16
Order IX	Metal goods not elsewhere specified	4.97
Order X	Textiles	3.34
Order XI	Leather, leather goods and fur	4.23
Order XII	Clothing and footwear	2.24
Order XIII	Brick, pottery, glass, cement etc	15.40
Order XIV	Timber, furniture etc	8.77
Order XV	Paper, Printing, Publishing	5.73
Order XVI	Other Manufacturing	4.46
Industries		

Source: Edwards, S.L. (1970)

The total number of establishments in the Paper, Printing and Publishing sector in West Yorkshire generated by the MLL directory was 367. Table 5.4 shows the breakdown of these establishments in terms of number of employees. The unknown category included those establishments with estimated employment numbers.

Table 5.4 Establishment size (based on number of employees)

Number of employees	Number of establishments	% of total
1-25	213	58
26-100	76	21
101-250	20	5
Over 250	15	4
Unknown (S,M,L)	43	12
Total	367	100%

Bearing in mind the resource constraints on the research study, a 20% sample has been used with direct interviews at about 100 of these establishments. It is important to note that the sample-frame consisted of establishments not firms. Thus, the establishment location may only

register a small number of employees but the firm could still be large.

The use of quasi-random sampling can be usually justified, provided that the list is arranged more or less at random (in other words, any order in the arrangement of the frame can be ignored). And so, selection, at regular intervals from a list, is often reasonably acceptable as equivalent to random sampling (Moser, 1969). The establishment record cards were sorted into alphabetical order. They were then checked for alphabetical bias but none was found and the record cards were then assumed to be arranged in a random manner. Due to the small numbers of establishments registering over 100 employees it was decided to include all of them in the sample. Establishments with up to 100 employees were sampled on a 20% basis. To start the sampling procedure, a random number between 0 and 4 was obtained. In the event, the random number selected was 3. So the third establishment was placed on the sample list and after that every fifth one, consistent with obtaining overall a 20% sample.

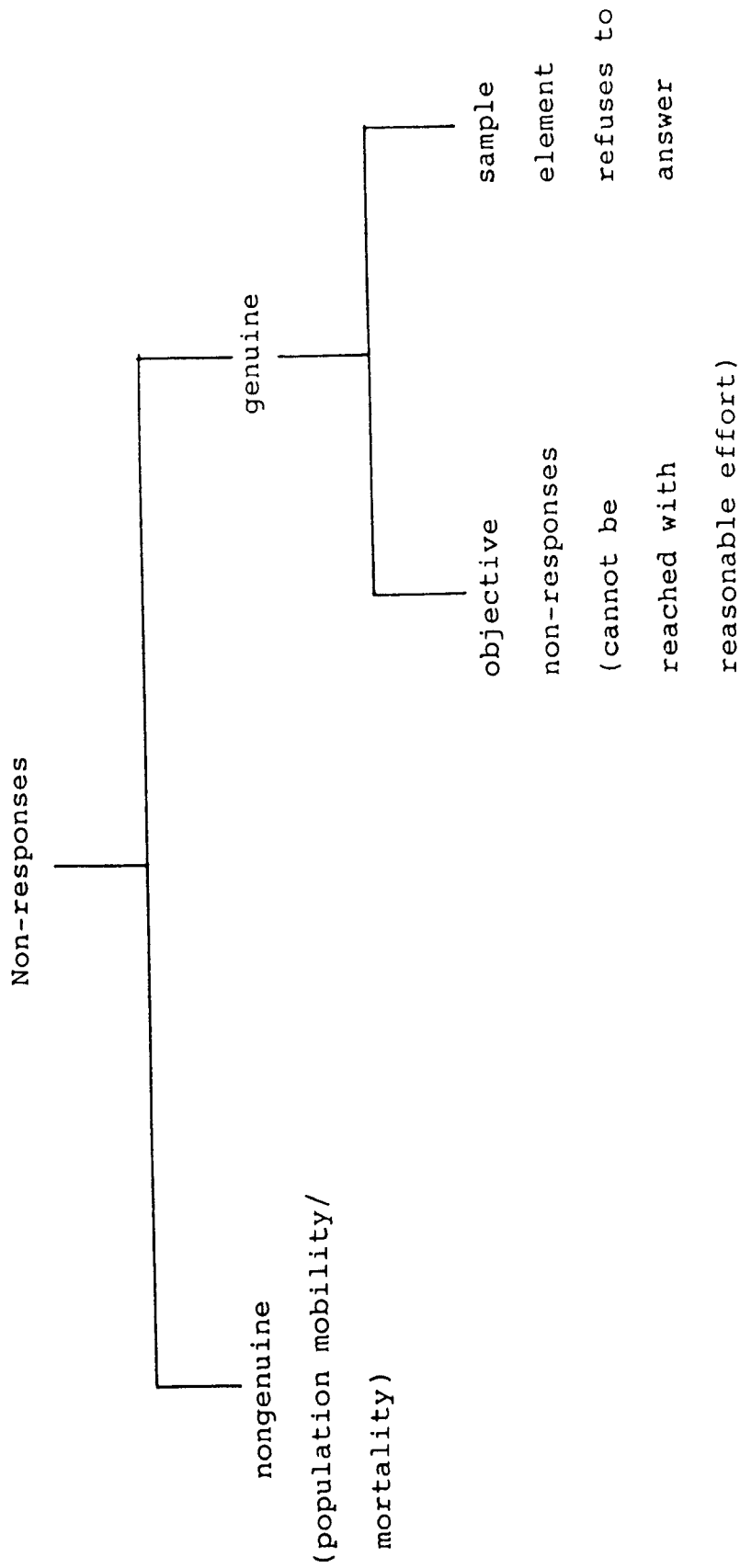
The Problem of Non-Response

In order to achieve a total sample of 100 firms, it was necessary to contact more than this, due to problems of

non-response. Non-response can take two main forms, as shown in Figure 5.4:

- (1) misclassification - this includes companies which have transferred their business or ceased trading since inclusion in the MLL directory as well as those which were wrongly classified as being in the Paper, Printing and Publishing sector.
- (2) genuine non-response - this includes companies which refuse to answer the questionnaire due to lack of time, concern about confidentiality and other such reasons.

Figure 5.4 Classification of Non-responses



5.3 QUESTIONNAIRE DESIGN

To test the hypotheses, interviews with firms in the Paper, Printing and Publishing sector within West Yorkshire were undertaken. To give these interviews structure and therefore enable them to form a valid part of the research, a questionnaire was developed. This questionnaire was designed to examine thoroughly the following factors:

- (1) company organisation;
- (2) nature of the product;
- (3) usage of transport modes; and
- (4) individual profiles of the transport decision-makers.

General Principles of Design

This questionnaire has been designed to try and attain the three conditions necessary for a successful interview (Cannell and Kahn, in Lindzey and Aronson, 1968). These are described below:

- (1) Cognition: the understanding by the respondent of what is required of him or her. For this reason, each firm was contacted by telephone. The appropriate person within the firm was identified

and told about the nature of the research and the type of information required. They were then asked if they would take part in the investigation. The questions had been worded as simply as possible to allow immediate understanding of what was required. Where details were required in "open" questions, areas to probe for further details had been written after each question.

- (2) Accessibility: the interviewer must be sure the respondent has the required information to answer his or her questions.
- (3) Motivation: the desire of the respondent to answer accurately the questions asked of him or her. It is the interviewer's job to try to reduce those factors tending to decrease interviewees' motivation and to build on those tending to increase it. It is hoped that the respondents' desire to get on with other activities was generally overcome by increasing curiosity and the mobilising of politeness and keenness to help the interviewer.

Questionnaire Content

The questionnaire (Appendix 4) was divided into six sections. These are:

- (1) current status of the firm;
- (2) employment and organisation of the firm;

- (3) transport usage;
- (4) linkage patterns and product characteristics;
- (5) attitudes; and
- (6) details of the person responsible for transport decisions/operations.

A variety of indicators relevant to any one hypothesis were sometimes pursued in more than one section of the questionnaire.

For example, as far as the current status of the firm was concerned, Questions 1, 2 and 3 were included to ascertain whether the establishment was independent or not (hypothesis 2.3 and 2.5). This theme was then developed further in the following sections: employment and organisation of the firm; transport usage and person responsible for transport decisions/operations. It was assumed that the product may have had certain characteristics that led to modal choice constraints and questions 4 - 7 inclusive were designed to assess this (hypothesis 3.2). Question 8 related to the possibly sensitive subject of company finance. The use of scaling methods to a large degree overcame respondents' refusal to answer such questions in detail.

Questions 1 and 2 in the employment and organisation of the firm section gave one indication of establishment

size, namely number of employees (hypothesis 2.2). Another indicator of size that was used was that of overall value of output and this question was asked in the section on current status of the firm (hypothesis 2.6). It was felt to be useful to find out how the firm viewed the transport function. It was reasonable to assume that a firm which considered transport to be important would accord it relative prominence in its management structure. Also that different approaches to transport were feasible, depending on whether the Transport Department was seen as a profit-centre in its own right or not (hypotheses 2.1, 2.2, 2.4).

In the transport usage section, Question 2 was asked in order to ascertain whether an establishment was connected to the rail system and whether the link was used or not. Questions 3 to 12 inclusively, pertained to establishments with "own account" fleets (hypotheses 4.2, 4.4). Own account operation was sub-divided into those establishments which required an 'O' licence and those which did not. Question 5, enabled the analysis of goods vehicles which required 'O' licences, in terms of size and type, to be carried out. Question 8 was included so that the reasons for the respondents' establishments having an own account fleet could be discovered. Questions 10 and 11 were devised to shed some light on the calibre of the transport

decision-maker, in terms of his knowledge about vehicle suitability for the distribution task. In question 12, the respondent was asked to rank reasons for buying a particular vehicle. The use of public road haulage was examined in questions 13 to 18 inclusively. Questions 19 to 24 were devised to ascertain usage of British Rail and similarly, questions 25 and 26 pertained to the use of the Royal Mail (hypothesis 4.1). Questions 28 and 29 were designed in order to ascertain whether firms had changed their modes of transport over the last few years and the reasons for doing so.... also whether the establishment was intending to change transport modes in the future and the likely reasons for this (hypothesis 4.3). Questions 30 and 31 related to the financial commitment by the establishments to transport. Questions 32 to 34 were concerned with establishing whether the firm had a specific management strategy towards transport and distribution.

Question 1 in the linkage patterns and product characteristics section attempted to find the type of linkage patterns between the manufacturer and consignee, in terms of percentage value, percentage weight and consignment size. Question 4 followed this point up in relation to the "customer direct" category (hypotheses 1.1, 3.1). Question 3 was used to find out who bore the costs of transporting the product. In questions 5 and 6,

the establishment's sphere of operation and its relationship to the transport mode selected was considered (hypothesis 3.1).

The next section in the questionnaire was entitled Attitudes. From the literature review, certain features were considered to be important when a firm transports its product. The areas of concern that were identified, are:

- (1) reliability of transport mode;
- (2) level of control over the despatch of its product;
- (3) cost of transporting the product in relation to its value;
- (4) level of inventory;
- (5) degree of company's control over delivery time;
- (6) avoidance of damage to goods when in transit;
- (7) security of goods in transit;
- (8) service level to customer required;
- (9) length of haul;
- (10) size of consignment;
- (11) time that goods spend in transit;
- (12) ready availability of transport when required; and
- (13) regularity of shipment required.

To yield attributes rather than objective assessments a Likert rating-scale format was used to test hypothesis

4.5. To each of the 13 concepts, five alternative judgements were attached and the respondents were asked to assign one of the judgements to each of the concepts as it affected them. The judgements were as follows:

- (1) very unimportant
- (2) somewhat unimportant
- (3) neither important nor unimportant
- (4) somewhat important
- (5) very important

Each was given a box into which the respondent was expected to tick the one corresponding most closely with his perception of the concept. An odd number of steps was and is favoured in a rating scale so that there exists a central category which can be viewed as a midpoint or neutral station. Experience of other researchers, suggested that a five-point scale was the most suitable (Dobson, 1977). Beyond the five points, it has been found that respondents encounter a certain degree of difficulty in differentiating the strength of their feelings. This has been partly attributed to a phenomenon called "the error of central tendency" in which respondents are often reluctant to express an extreme view. Another problem is that people usually pay more attention to the early part of a list. In order to counteract this possible tendency, the order of the

items in the rating scale were altered and two versions were administered (Appendix 4). Half the sample answered one version and the rest answered the other.

In the person responsible for transport decisions/operations section, questions 3, 4, 5, 6 were asked in order to explore the company's attitude towards the transport function (hypothesis 2.4). Question 7 was aimed at determining the level of responsibility that the transport decision-maker has for transport within the firm (hypothesis 2.7). Question 8 was posed in an attempt to gain an insight into the decision-makers attitude towards risk-taking (hypotheses 4.3, 4.1). A probe was used to see if the firm was prepared just to accept the status quo; when it last looked at other options; and the attributes on which it based its knowledge of alternatives. The last aspect was very important, as it is central to the theme of the research, namely the perception of options available to the transport decision-maker. It could be difficult to ascertain respondent's perceptions without coming up against the problem of cognitive dissonance. By the use of this question in relation to the transport usage and attitude sections, this problem was overcome.

The questionnaire, as given in Appendix 4, was designed so that data for computer analysis could be transferred straight to "key-to-disc". The questionnaire was designed to proceed in a logical manner by moving from the general to the specific and from topic to topic in a way that indicated to the respondent the relationship between questions and question areas (Moser and Kalton, 1971).

5.4 SURVEY METHOD

Data obtained by means of interviews and questionnaires should always be regarded as confidential, in the sense that no findings should be published which could be traced back to particular individuals or companies (Steele, 1974). In enlisting cooperation for the survey, respondents were given an assurance to this effect and a guarantee of anonymity. This was often crucial in obtaining frank and revealing responses. The method of data collection that was chosen for this research was the direct interview. Other techniques that could have been utilised were postal and self-administered questionnaires. The advantages and disadvantages of each of these approaches, together with reasons for the chosen method, are set out below.

(1) Postal questionnaire

The chief advantage of the postal questionnaire is cheapness. The processing and analysis are usually also simpler and cheaper than in the case of interviews. However there are a number of drawbacks. First of all, eliminating the interviewer means that the questionnaire has to be much simpler since no additional explanations can be given and no probes initiated. It also lacks the personal introduction of the research by the interviewer, though a good covering letter can be of great help. In an interview, the interviewer has strict control over the order and sequence of the questions, and the respondent does not know what is coming; postal questionnaires usually are perused before being answered, so that respondents often skip questions or come back to them later, all of which may bias the responses. By far the biggest disadvantage of postal questionnaires, however, is the fact that they usually produce very poor response rates. The important point about these poor response rates is not the reduced size of the sample, which could easily be overcome by sending out more questionnaires, but the possibility of bias. This is because invariably the returns are not representative of the original sample drawn; non response is not a random process and has its own determinants which vary from survey to survey.

(2) Self-administered questionnaire

These are usually presented to the respondents by an interviewer. The purpose of the inquiry is explained and then the respondent is left alone to complete the questionnaire, which may be collected later by the interviewer. This method of data collection ensures a higher response rate, accurate sampling, and a minimum of interviewer bias, while permitting interviewer assessments, providing necessary explanations (but not the interpretation of questions). A higher response rate results because some personal contact is given to the respondent initially and then he is left to answer the questions. He therefore does not feel overawed by the interviewer's presence.

(3) Direct interview

The direct interview consists of three interacting variables; the respondent; the interviewer, and the interview schedule or questionnaire. Each of these, as well as the interview situation, can have an important influence on the results. The greatest advantage of the interview in the hands of a skilled interviewer is its flexibility. The interview situation is fraught with possibilities of bias. For example, the interviewer may give an inkling of his own opinion or expectations by his tone of voice. An interviewer may misunderstand or

fail to obey instructions; he may show surprise or boredom or in other ways unconsciously communicate his own attitudes and his expectations of the respondent's attitudes. Some of these biases can be largely eliminated by suitable selection and training and by careful checks and supervision. However there remains the undisputed advantage that the quality of information collected is higher than with the other two methods.

The method of data collection which appeared to be the most viable in this case was that of the direct interview undertaken solely by the researcher. It was hoped that a full set of data would result as the possibilities of misinterpretation and non-response were minimised.

The survey was carried out between October 1982 and August 1983. 100 questionnaires were successfully completed. Initial contact with the establishment was by telephone. In all, 150 companies were contacted. There were 50 non-responses and the reasons are given in Table 5.5.

Table 5.5 Reasons for Non-response

Reason	Number of Establishments
Interview not realised due to small company (<4 employees) or all customer collections	12
Wrongly classified	6
Ceased to manufacture	4
Refusal/Too busy to answer/ Against company policy	5
Non-contact/Ceased to trade/ Cannot be located	23
Total	50

5.5 STATISTICAL CONSIDERATIONS

The analysis is concerned with the Paper, Printing and Publishing sector in West Yorkshire. A sample was taken between October 1982 and August 1983 according to the Scheme set out in detail earlier in this chapter. This sample is considered a random sample in time of the hypothetical infinite population of all such establishments that could exist. Of course, the number of establishments in an industrial sector varies through time due to births, deaths, in moves, out moves, expansions and contractions (Storey, 1980). So the assumption made above assumes that the underlying random process is stationary.

When estimating population proportions, frequencies relating to the small establishments (sampled at the 20% level) are weighted with respect to the large establishments (sampled at the 100% level). Small establishments include those which registered up to 100 employees.

In order to determine whether there is a significant association between pairs of attributes, the chi-square test is used. When testing for association, the data should be analysed directly and without weighting. The fact that the small establishments are under-represented with respect to the large ones does not affect the distribution of the test statistic and hence the validity of the test.

CHAPTER SIX

ANALYSIS OF QUESTIONNAIRE

The principal purpose of this chapter is to analyse the results of the questionnaire, answered by 100 firms in the Paper, Printing and Publishing industry of West Yorkshire. The discussion is divided into the same six sections which formed the questionnaire - current status of the firm; employment and organisation of the firm; transport usage; linkage patterns and product characteristics; attitudes; and profiles of the persons responsible for transport decisions/operations.

6.1 CURRENT STATUS OF THE FIRM

A number of characteristics of the current status of the firm are considered. These include product category, establishment type, value of output and transport costs.

The majority of establishments are concerned with manufacturing a final product (Table 6.1).

Table 6.1 Type of Business

Type of Business	Percentage of Establishments		
	Small	Large	Total
Final Product	87.4	92.4	87.7
Component	1.5	0.0	1.4
Processing	4.1	3.8	4.1
Other	2.6	3.8	2.7
Final+processing	2.9	0.0	2.7
Final+other	1.5	0.0	1.4
Totals	100.0	100.0	100.0

The product is subdivided into six categories based on Minimum List Headings. The majority (66%) of establishments are within the general printing category. Table 6.2 shows the breakdown of establishments into the product categories.

Table 6.2 Product Category

Category of Product	Percentage of Establishments		
	Small	Large	Total
Paper and Board	2.6	3.8	2.7
Packaging Products	19.1	26.9	19.6
General Printing	67.2	50.0	66.0
Manufactured Stationery	9.6	11.7	9.8
Miscellaneous Paper-board	0.0	3.8	0.3
Newspapers, Journals	1.5	3.8	1.6
Totals	100.0	100.0	100.0

The nature of the firm may have a considerable impact on the mode(s) of transport used. Some establishments which form a group may be allowed complete autonomy in decision-making, whereas others are constrained to a greater or lesser degree by head office. Thus, decisions may arise that do not represent the choice of any specific individual but are compromises moulded by internal discussion and consultation (Gold, 1980). For these reasons, it is important to ascertain whether the establishment is independent or not. Approximately 74% of establishments are independent and 26% are at least partially dependent

(Table 6.3). By stratifying into the two sub-populations of small and large establishments, it can be seen that the majority (78%) of small establishments are independent whereas the majority (73%) of large establishments are dependent. This is explored more fully in 6.2 Employment and Organisation of the firm.

Table 6.3 Establishment Type

Type of Establishments	Percentage of Establishments		
	Small	Large	Total
Independent single address	67.2	11.5	63.2
Independent multi-address	10.9	15.4	11.2
Partially or totally dependent	21.9	73.1	25.6
Totals	100.0	100.0	100.0

The subject of company finance is very sensitive but only 15% of respondents refused to divulge information or did not have any. Over 36% of establishments had an annual value of output greater than £750,000; only 9% had less than £100,000 per year. Table 6.4 shows the overall picture of value of output for the population.

Table 6.4 Value of Output

Range of value of output (£ per year)	Percentage of Establishments		
	Small	Large	Total
0-100,000	9.7	0.0	9.0
100,001-200,000	15.9	0.0	14.8
200,001-300,000	6.6	0.0	6.1
300,001-500,000	17.6	0.0	16.4
500,001-750,000	17.9	4.6	17.0
750,001-1,000,000	11.2	0.0	10.3
1,000,001-1,500,000	9.7	13.6	10.0
Over 1,500,000	11.4	81.8	16.4
Totals	100.0	100.0	100.0

A breakdown of transport expenditure categories is given in Table 6.5

Table 6.5 Transport Expenditure

Range of annual expenditures on transport (£ per year)	Percentage of Establishments		
	Small	Large	Total
0-5,000	31.5	0.0	29.2
5,001-10,000	15.9	0.0	14.8
10,001-25,000	20.7	0.0	19.2
25,001-50,000	14.3	26.1	15.1
50,001-75,000	12.5	17.4	12.9
75,001-100,000	3.4	4.3	3.5
Over 100,000	1.7	52.2	5.3
Totals	100.0	100.0	100.0

On its own, transport expenditure is not very meaningful and it is usual to relate it to the value of output produced by the company. Total transport cost, as a percentage value of net output, is shown in Table 6.6. The data indicates that transport costs, overall, are not of a high order in the Paper, Printing and Publishing sector.

Table 6.6 Proportion of Overall Value of Output
Attributable to the Costs of Transport

Transport expenditures as a proportion of annual value of output	Percentage of Establishments		
	Small	Large	Total
< 1%	3.4	10.0	3.8
1-1.5%	11.3	15.0	11.6
2-2.5%	25.8	15.0	25.1
3-3.5%	24.1	15.0	23.5
4-4.5%	3.1	10.0	3.2
5%	19.2	20.0	19.3
6-9%	11.4	15.0	11.6
10% and over	1.7	5.0	1.9
Totals	100.0	100.0	100.0

6.2 EMPLOYMENT AND ORGANISATION OF THE FIRM

The basic and most competitive role for British Rail is the movement of large amounts of bulk materials over long distances. However, there is a good prima facie case that extensive use of containerised services such as Freightliner offers considerable returns to scale.

Therefore, for large firms moving sufficiently large volumes, a service like Freightliner is ideal in many ways; for the small operator, much more thought is required. It must be remembered that the overall concentration of British industry is low, that is to say, firms typically are small (Murphy, 1978).

Typical indicators of establishment size are number of employees and overall value of output.

Table 6.7 Establishment Size (based on number of employees)

Number of employees	Percentage of Establishments
1-10	13.6
11-25	20.5
26-50	38.3
51-75	11.5
76-100	9.0
101-250	4.9
251-1000	1.9
Over 1000	0.3
Total	100.0

More than half of the establishments employ less than 50 people. But, if an establishment is part of a group, then these figures may under-represent the actual size of the firm.

In Chapter 4, it has been argued that an externally-controlled establishment may exhibit different characteristics in respect of its transport decision-making than a wholly independent establishment. It is useful to find out whether there is any association between independent and non-independent establishments. Table 6.8 forms the basis of testing for a significant association between size of establishment, as measured by number of its employees, and independence of establishment. A Chi-square value of 27.3 with 4 degrees of freedom suggests there is an association between size of establishment and independence of establishment, significant at the 99% level. From the nature of the data in Table 6.8 (and Table 6.3), it is generally the smaller establishments that comprise independent firms.

The position that is held by the transport decision-maker within the firm is indicative of the weight that the organisation accords that function within its overall business strategy (Table 6.9).

Table 6.8 Crosstabulation of Number of Employees and Independence of Establishment

Range of employment size	Independent?	
	no	yes
1-25	4	22
26-50	5	25
51-100	7	9
101-250	12	6
251+	7	1
Totals	35	63

Table 6.9 Organisational Level of the Transport Function

Level of transport decision-making	Percentage of Establishments		
	Small	Large	Total
1 (highest)	49.3	3.9	46.1
2	36.9	11.5	35.2
3	9.7	34.6	11.4
4	4.1	38.5	6.5
5 (lowest)	0.0	11.5	0.8
Totals	100.0	100.0	100.0

Table 6.9 shows that the majority of transport decision-makers are contained within the two highest levels of the establishment's organisational framework. One respondent even went as far as to say that the transport function within his firm is considered to be the most important one! There is an association between the position of the transport function in the organisational structure and the independence of the establishment, significant at the 99% level (Chi-square value = 32.03 with 4 degrees of freedom). This may be explained by the transport function within independent firms often being carried out by the owner or managing director. Whereas in non-independent establishments, the transport function is performed usually at a medium to low level within the organisational hierarchy.

As expected, there is an association between number of organisational levels and independence of establishment, significant at the 99% level (Chi-square value = 19.56 with 3 degrees of freedom).

Small establishments in terms of employment size tend to be independent. It is not surprising, therefore, that they have fewer organisational levels. There is

no significant association between independence of the establishment and whether the transport decisions require board approval or not.

Table 6.10 shows that 54.8% of establishments did require board approval. Board approval is normally required only when the transport decision involves capital expenditure.

The majority (75%) of establishments viewed the transport function as an integral part of the firm's operations. While 21% of the establishments considered transport to be a defined task and only 3% considered transport to be a profit centre in its own right.

Table 6.10 Transport Decisions - Board Approval

Approval required	Percentage of Establishments		
	Small	Large	Total
Yes	52.1	80.0	54.8
No	47.9	20.0	45.2
Totals	100.0	100.0	100.0

6.3 TRANSPORT USAGE

This section is concerned with the modes of transport that establishments use to transport their product to the customer. There has been a tendency for firms to undergo a locational change since World War II, away from rail connections to areas with good accessibility by road. This is reinforced by the survey findings, since there is now not one establishment connected by a rail siding to the British Rail system.

Table 6.11 shows current usage of transport modes by establishments.

A limitation imposed on this research at its inception was that the transport decision studied is concerned only between road and rail modes. This still resulted in nine distinct modal categories. The British Rail service is not subdivided further because, for the Paper, Printing and Publishing sector, the Red Star service is the only one that is used. But it should be borne in mind that if any other industrial sector were being studied then it would be necessary to break down further the rail mode.

Table 6.11 Transport Mode Usage

Mode of transport used	Number of establishments after weighting		% Modal share
	Small	Large	
Own account vehicle fleet	186	18	18.1
Own account-0 licence	80	17	8.6
Public road haulage	312	26	30.0
British Rail	153	15	14.9
Post Office	204	11	19.1
Company cars	84	0	7.4
Customer collects	15	0	1.3
Group transport	0	1	0.1
Other	5	1	0.5
Totals	1039	89	100.0

Companies very rarely use just one method of transporting their product to the customer. This is due to a variety of reasons. For example, market conditions may determine that different transport means are suited to different sections of the business. Even when an establishment relies upon a single mode for its base load, it often uses alternatives to meet peak demand or when goods are

requested urgently by the customer. Of those firms which have their own road fleet, only 34% have sufficient capacity to meet upward fluctuations in demand. Table 6.12 shows that only 5% of establishments use one mode only and the majority (76%) use 3 or more methods of transport.

Table 6.12 Number of Modes Employed

Number of modes used	Percentage of Establishments		
	Small	Large	Total
1	5.6	0.0	5.2
2	17.9	26.9	18.5
3	38.1	11.5	36.2
4	36.9	34.6	36.8
5	1.5	26.9	3.3
Totals	100.0	100.0	100.0

Tables 6.13 to 6.17 cover those establishments with "own account" fleets, subdivided into those requiring 'O' licences and those which do not.

The majority have less than two non 'O' licence vehicles. The reason for one establishment having a very high number of non 'O' licence vehicles is the

fact that they belong to the Newspaper/Journals product category, with daily multi-drop, low volume consignments.

Table 6.13 Vehicle Fleet Size - Non 'O' Licence

Number of vehicles	Number of sampled establishments	% after weighting
1	34	59.7
2	17	25.0
3	6	9.7
4	1	2.3
5	1	2.3
6	1	0.5
43	1	0.5
Totals	61	100.0

Table 6.14 shows the analysis of goods vehicles requiring 'O' licences, by size and type.

It is important to note that the driver of a vehicle up to 7.5 tonnes GVW does not require a heavy goods vehicle licence and this category covers 28% of the

total number of vehicles surveyed. Thus, the establishment does not have to employ a specialist driver where, for example, a storeman could double up as the delivery driver. 3% of establishments had access (when required) to a pool of heavy goods vehicles owned by the firm but operated from another establishment.

Table 6.14 'O' Licence Vehicles Surveyed - Size and Type

Vehicle type	Gross vehicle weight (tonnes)					Total
	up to 7.5	up to 13	up to 16	30 to 32	above 32	
Flat or sided	-	3	6	-	-	9
Boxbody with special fittings	9	1	15	-	-	25
Boxbody without special fittings	24	16	12	-	-	52
Articulated	-	-	-	24	1	25
Drawbar trailer	-	-	-	7	-	7
Total	33	20	33	31	1	118

To ascertain the reasons for having an own-account fleet and yet not bias the response, an open-ended question has been set deliberately. After analysing all the answers in the survey, seven categories have been devised

and these are given in Table 6.15. The following gives some more detailed indication of the reasons respondents' preferred having their own vehicles to call upon at any time. One respondent said "that most of the consignments are small and that anything up to thirty drops per day is fairly typical". For these reasons, the mode employed had to be flexible in its usage and he felt that his own vehicles gave this flexibility. Another attitude prevalent in the survey is that of "total" control.

Table 6.15 Advantages of Own-Account Fleets

Advantages	Percentage of Establishments		
	Small	Large	Total
Total control	14.2	27.4	15.3
Flexibility	27.9	22.7	27.5
Customer service	18.0	31.8	19.2
Cost	9.9	4.5	9.4
Local deliveries	15.9	13.6	15.7
Convenience	9.9	0.0	9.0
Other	4.2	0.0	3.9
Totals	100.0	100.0	100.0

As one respondent remarked "once you pass your product to another party, it is out of your hands". Control over delivery of the product to the customer has been

found to be an important consideration in running an "own fleet" and one respondent regarded it as the main factor. This reinforces the findings of Cook (in 3.3). The attribute of customer service subsumes flexibility and control to quite a degree; but service to customer in this context also incorporates other aspects. One respondent classed his drivers as "ambassadors for the company" creating confidence in the customer for the firm's product. Others considered that two business functions could be undertaken at once, namely delivery and sales promotion. In only 9% of the cases was cost-effectiveness given as a reason for owning your own fleet. This could be due to the fact that "own fleets" are not really any cheaper than other modes. Alternatively and perhaps nearer the mark, is that the attribute of cost is not a very important determinant of modal choice.

A person who fully understands the nature of the product and its relationship with transport is more likely to know which vehicles suit his distribution purpose best. The organisational level within the firm responsible for own vehicle purchase is given in Table 6.16.

For the majority of establishments, it is at a high level in the organisational chain that responsibility is borne for vehicle purchase. Where the decision takes

place at lower organisational levels in the hierarchy, it is normally ratified at a higher level due to the involvement of capital expenditure: This division is clearly reflected when stratifying the population into small and large establishments.

Table 6.16 Organisational Level Responsible for "Own-Vehicle" Purchase

Level	Percentage of Establishments		
	Small	Large	Total
1 (highest)	62.5	9.2	57.7
2	31.3	31.8	31.3
3	4.0	22.7	5.7
4	0.0	22.7	2.0
Group	2.2	13.6	3.3
Totals	100.0	100.0	100.0

Table 6.17 is concerned with vehicle purchase and whether or not the transport decision-maker selects the vehicles to a pre-determined specification or not.

Only 18% of establishments neither based their vehicle purchase on dealer recommendation nor on their own

specification. And of these, 85% relate to purchase of vehicles of less than 3.5 tonnes (GVW) and an "off-the-shelf" choice is more likely in this situation as the cost of purchasing such vehicles is not very great. Each respondent who was involved in vehicle purchase was asked to rank six factors, in order to gauge the reasons for them buying a particular vehicle. Reliability of the vehicle is the most important and residual price of the vehicle is the least. In order of importance, the reasons for buying a particular vehicle are given as: reliability; purchase price of vehicle; fuel consumption; cost of ownership; model availability and residual price. This is based on 2.1 in Appendix 3.

Table 6.17 Vehicle Purchase

Specification of vehicle	Percentage of Establishments					
	Small		Large		Total	
	Yes	No	Yes	No	Yes	No
Vehicle recommended by truck dealer	12.8	87.2	5.6	94.4	12.2	87.8
Vehicle designed to own specification	57.5	42.5	77.8	22.2	59.1	40.9

Even in terms of vehicle purchase, it reinforces the transport decision-makers predilection with reliability

as an important factor in modal choice.

Tables 6.18 to 6.20 reveal the use of public road haulage by establishments. Only 8% of establishments make no use of public road haulage at all (Table 6.11). Table 6.18 shows the "source loyalty" by the respondents to public road hauliers.

Table 6.18 Employment of the Same Public Road Hauliers

Loyalty to one public haulier	Percentage of Establishments		
	Small	Large	Total
Yes	65.7	80.8	66.8
No	34.3	19.2	33.2
Totals	100.0	100.0	100.0

Table 6.18 suggests that there is a fairly strong source loyalty in the road haulage market. This may be due to the high level of service proffered by the public road haulier giving no reason to seek a change. On the other hand, it may be due to inertia. Table 6.19 shows the reasons given by respondents for changing their public road haulier.

Table 6.19 Reasons for Changing Public Road Hauliers

Reason	Percentage of Establishments		
	Small	Large	Total
Price	21.3	60.0	23.0
Service	12.9	0.0	12.4
Service/price	43.5	20.0	42.5
Availability	17.6	20.0	17.7
Destination	4.6	0.0	4.4
Totals	100.0	100.0	100.0

The "service" aspect that most respondents considered to be a major deficiency in road haulage was unreliability of delivery. Often the delivery of the product to the customer was late and, in some instances, was not even delivered on the stated day. This resulted in a feeling expressed by many respondents of loss of control over the product. Also, "customer service" cannot be emphasised enough and delivery on time is an important aspect of this. Although in theory the haulier is accountable at all times to the consignor, in reality this is not the case. Thus, when a product is damaged or wrongly delivered then many found it very difficult to unearth the facts. One point worth mentioning is that certain parts of the country are served relatively

badly by public road haulage. Of the 33% that did not employ the same public road haulier, some did work on a year to year basis and changed the haulier if they felt another one could provide them with a high level of service at a reasonable cost. Around 30% of transport decision-makers felt that there are deficiencies in the road haulage service offered in the public sector.

Interestingly, there is no significant association between the use made of the same public road haulier and the perception of deficiencies in public road haulage. A tentative conclusion may be that, as regards public road haulage, inertia plays a large part in the decision to use a particular road haulier. The nature of the arrangements between the haulier and the consignor may reinforce this also (Table 6.20).

Table 6.20 Nature of Arrangement Between Haulier and Consignor

Types of arrangements	Percentage of Establishments					
	Small		Large		Total	
	Yes	No	Yes	No	Yes	No
Formal contract	13.5	86.5	26.9	73.1	14.5	85.5
Informal	53.8	46.2	65.4	34.6	54.7	45.3

The informal arrangement is in terms of a "gentleman's agreement", which in many instances provides the haulier with a certain volume of trade in return for a fixed price and guaranteed availability. One respondent felt he could treat the haulier's vehicles as his own, as he had built up such a good relationship with the haulier over the years. As Table 6.20 shows, only 14.5% had any formal contact with a haulier. This is not particularly surprising, as the road haulage sector is a highly competitive industry, made up of many companies.

Of those establishments which use rail, all use the British Rail Red Star service (Table 6.11). Approximately 30% of establishments using rail felt that there are deficiencies in this service offered by British Rail. These are mainly concerned with the service not being "door to door" and therefore requiring more product-handling than with road modes of transport. The more handling that is involved the greater is the potential for theft and damage. Customer collection at the destination is seen also as a negative aspect of this form of rail transport. Only 4% of establishments have any formal contract with British Rail to ship their product.

Of those establishments (Table 6.11) which use the postal mode, 20% have a formal contract with the Post Office. For the distribution of small parcels over a wide geographical area, the post is a very useful method of transport. To the manufacturer, the postal mode ensures that he pays a fixed rate regardless of the distance travelled by the consignment.

As far as the weight of consignments is concerned, the survey revealed that this is very variable and initially it presented a difficult coding problem. However, by breaking them down into weight band restrictions as given by the Post Office, British Rail, Securicor and Roadline the coding problem has been overcome. As will be shown, some modes of transport are more constrained in this respect than others. Table 6.21 shows the break-down into weight bands for each of the modes; Public Road Haulage, British Rail and Post Office.

The postal mode is weight-constrained to a maximum of 27.5 Kg. But parcel consignments by public road haulage and post are also volume-constrained. The postal mode up to a consignment weight of 27.5 Kg is far more important than rail and public road haulage

Table 6.21 Consignment Weight Bands

Weight band (Kg)	Percentage
(a) Public road haulage	
Up to 22.5	16.8
22.6 - 25	3.0
25.1 - 27.5	1.7
27.6 - 50	4.0
50.1 - 100	12.5
100.1 - 200	0.7
Over 200	56.7
Parcel dimensions	4.6
(b) British Rail	
Up to 10	37.7
10.1 - 22.5	25.8
22.6 - 25	3.3
25.1 - 27.5	10.0
27.6 - 50	12.6
50.1 - 100	3.3
100.1 - 200	3.3
Over 200	4.0
(c) Post Office	
Up to 1	12.9
1.1 - 5	29.4
5.1 - 10	24.4
10.1 - 22.5	14.9
25.1 - 27.5	13.9
Max. parcel size	4.5

together, as it retains 57.7% of the market. The heavier consignments are generally the prerogative of public road haulage (and own-account operation) as 94% of consignments weighing over 100 Kg are sent by road. This is not surprising as it is preferable for heavier consignments to be handled as little as possible. Even within the British Rail network, consignments over 100 Kg are destination-constrained as well.

It is important to find out whether firms have changed their transport modes over the last few years and what may have prompted the change. 18.5% of establishments had made changes of mode within the last five years. The changes ranged from type of vehicle used in own-account operation to the use of a motorbike courier. However, nearly one-third had changed from own-account operation to public road haulage, mainly due to increased costs of vehicle replacement and maintenance. One method by which a company can overcome cash-flow problems is by hiring assets instead of purchasing them. Thus, to overcome this negative aspect of own-account operation some establishments had moved to lease or contract-hire systems. Hiring is also a useful hedge against future uncertainty. One respondent for example,

had been forced by British Rail (who no longer provide a parcel collection and delivery service) to change mode. He now uses the Post Office. 12% of establishments were intending to change their present mode of transport in the near future. The majority are seeking to increase their own road fleet.

32% of establishments, which use public road haulage at the present time, are intending to increase its use in future and only 5% intend to decrease their usage of this mode. However, a slightly different picture emerges for rail, as 10% intend to decrease future use and for the majority (88%) usage will remain the same. The main reason given for decreasing usage of the rail mode is the necessity of having another mode to transport the product between the factory and the railway station. A major reason given for increasing the use of public road haulage is the broadening of the existing customer base and many customers requiring goods in smaller quantities.

It is reasonable to expect a company that considers transport to be an important management function to have worked out some kind of strategy for it. In fact, 20% of establishments do have a transport strategy and only 14% never carry out a review of it (Table 6.22).

Table 6.22 Review of Transport Strategy

Frequency of review	Percentage of Establishments		
	Small	Large	Total
Continually	24.2	50.0	28.6
Monthly	15.5	0.0	12.9
Quarterly	0.0	8.3	1.4
Half yearly	8.6	8.3	8.6
Annually	25.9	25.1	25.7
Irregularly	0.0	8.3	1.4
As required	8.6	0.0	7.1
Never	17.2	0.0	14.3
Totals	100.0	100.0	100.0

Of those companies that do develop some type of transport strategy, many use the twin criteria of size of consignment and delivery distance to select their preferred mode of transport, provided that reliability and service characteristics are acceptable. One example of such a strategy is where all small parcels are sent by post; consignments up to a radius of 70 miles are sent by own-account vehicles and public road hauliers are used for trips to the rest of the

United Kingdom. For another company, there is close liaison between the transport and despatch departments and the planning and production side. So, the daily production meeting can be influenced by the transport manager in terms of the ordering of job runs to fit (better) the transport schedules. But the majority (80%) did not have a transport strategy as such. Some felt that it is impossible to have one, in the sense that the industry as a whole is totally customer-orientated and, thus, it is the customer who dictates the transport requirements. Some respondents said that the cost of transport is insignificant as regards the turnover and so savings in transport are not worth pursuing especially if it increases the possibility of disappointing the customer. Another regarded transport as a necessary evil and that the only reason for having an own-account fleet is to be able to get the product to the customer as and when required - even though it resulted often in a very poor load factor as it is impossible usually to wait to combine loads.

It is useful to distinguish between those establishments which actively seek information about alternative transport modes and those who do not. 45% of establishments do seek information rather than just receive

circulars sent to them by transport companies. Of these, only 2% found any difficulty in obtaining the necessary information. In all cases, this is due to the transport decision-maker finding it difficult to contact the "right" person in the transport organisation.

As many as 26% of establishments used the services of a Freight Forwarder and in all cases it is due to the product being exported.

6.4 LINKAGE PATTERNS AND PRODUCT CHARACTERISTICS

Linkage patterns, between the production site and where the product is transported to, may pose constraints on mode usage. For the Paper, Printing and Publishing sector, the product is, on the whole, transported directly to the customer. Only 6.5% of establishments regularly transported some products to a warehouse and 7% of establishments to a wholesaler. Thus, the pattern of linkage is mainly just between the manufacturer and the customer (see Figure 2.2). As this is the case, it is not unreasonable to propose that it is just as likely for the customer to dictate the transport mode as the consignor. In the event, 41% of establishments did, for some consignments, use the mode of transport specified by the customer. The reasons for modal specification are given in Table 6.23.

Table 6.23 Transport Mode Specification by the Customer

Reasons for mode specification	Percentage of Establishments		
	Small	Large	Total
Customer preference	35.8	21.4	34.6
Speed of delivery	17.6	21.4	17.9
Security	3.8	14.5	4.8
Specify vehicle type	10.7	7.1	10.3
Red Star	14.5	7.1	13.8
Customer collects	3.8	0.0	3.4
Manufacturer's own fleet	6.9	7.1	6.9
Customer's transport arrangements	6.9	21.4	8.3
Totals	100.0	100.0	100.0

If a customer has had a bad experience - for example, in terms of late delivery, loss or damage - then he may specify either the mode or even the particular public road haulier to be used. However, some customers such as Banks and Her Majesty's Stationery Office require a mode which offers the best possible security arrangements. This usually means that the product is transported by road. A customer may even specify the actual vehicle type to be used, especially the use of enclosed vehicles

when handling packaging for food.

Many studies assume that the transport manager will seek to minimise transport costs but, up to a point, this depends on who it is who actually bears the costs of transport (Table 6.24). In one sense, a company must bear all of its costs, otherwise it will go out of business. But many of the true costs of distribution are hidden away in the accounts of many companies, disguised under other cost-headings (Benson and Whitehead, 1975). When a delivery is required urgently by a customer, the cost may be borne either by the establishment or the customer. Sometimes the transport cost is not billed as a separate item, but instead as a percentage of the purchase price, supposedly to cover it. In some instances, it is billed separately and so a direct charge and a direct entry for it can be made. This aspect is considered further in 6.6.

Table 6.24 Bearer of Cost of Transport

Responsibility for paying transport costs	Percentage of Establishments		
	Small	Large	Total
This establishment	27.4	34.6	27.9
Customer	43.8	38.5	43.4
Establishment + customer jointly	28.8	26.9	28.7
Totals	100.0	100.0	100.0

The establishment's sphere of operation may affect the usage of certain transport modes. To assist analysis, Great Britain has been divided up into 9 regions (see Figure 6.1) and an Overseas category has been included as well. The proportion of sales by geographic area are given in Table 6.25, which shows that, 10% of establishments operate totally within the home region of Yorkshire and Humberside and 3.3% of establishments operate totally outside it. Although, superficially, the latter may appear rather surprising, it should be realised that West Yorkshire is one of the major centres for the Paper, Printing and Publishing sector in the country.

Table 6.25 Sales Proportion by Region

Region	Proportion of total sales in each region (%)								
	None	1-10	11-25	26-50	51-99	100	Minor	Major	Unknown
Yorkshire & Humberside	3.3	7.1	11.4	12.3	32.1	10.1	4.1	5.2	14.4
South East	29.6	18.5	8.4	13.1	3.0	-	3.8	6.0	17.7
East Anglia	55.3	15.8	1.6	-	-	-	8.2	-	19.1
West Midlands	37.9	24.5	9.0	0.3	-	-	9.0	1.9	17.4
East Midlands	35.7	29.4	7.1	1.6	-	-	10.1	0.3	15.8
North West	31.5	20.2	18.3	6.3	1.4	-	5.4	2.5	14.4
North	37.2	22.1	12.0	1.4	-	-	9.0	3.0	15.3
South West	61.0	14.2	-	-	-	-	6.3	0.3	18.2
Wales	55.3	16.9	2.7	-	0.3	-	9.3	0.5	15.0
Scotland	53.7	20.4	1.6	0.6	-	-	7.9	2.2	13.6
Overseas	71.9	2.7	-	1.4	0.3	-	0.3	-	23.4

Note: The 'Minor', 'Major' and 'Unknown' categories are used when a respondent could not specify in any greater detail the proportion of total sales to a region

Figure 6.1 Map of Great Britain showing the regional breakdown used in the survey



Table 6.26 shows (in a condensed form) the geographical distribution of product sales.

Table 6.26 Regional Distribution of Product Sales

Region	Proportion of Establishments with sales in region	
	Yes (%)	No (%)
Yorkshire & Humberside	96.7	3.3
South East	70.5	29.5
East Anglia	44.7	55.3
West Midlands	62.1	37.9
East Midlands	64.3	35.7
North West	68.5	31.5
North	62.8	37.2
South West	39.0	61.0
Wales	44.7	55.3
Scotland	46.3	53.7
Overseas	28.1	71.9

It can be hypothesised that establishments which are part of a group are more likely to have a greater geographical extent of sales than single, independent establishments. Significant variations in the spheres of operation have been found to exist between those

establishments which are non-independent and those which are independent. For instance, it is far more likely for non-independent establishments to operate totally outside of the Yorkshire and Humberside region than an independent one and this has been found to be the case, significant at the 95% level. (Chi-square value = 4.42 with 1 degree of freedom.) Similarly, it is fair to hypothesise that independent establishments are less likely to go to an area outside West Yorkshire than a non-independent one. As expected, independent establishments are less likely to go to the following market areas:- East Anglia (Chi-square value = 10.49 with 1 degree of freedom, significant at the 99% level); West Midlands (Chi-square value = 6.79 with 1 degree of freedom, significant at the 99% level); East Midlands (Chi-square value = 4.08 with 1 degree of freedom, significant at the 95% level); South West (Chi-square value = 9.03 with 1 degree of freedom, significant at the 99% level); Wales (Chi-square value = 7.66 with 1 degree of freedom, significant at the 99% level); Scotland (Chi-square value = 4.22 with 1 degree of freedom, significant at the 95% level); and Overseas (Chi-square value = 8.31 with 1 degree of freedom, significant at the 99% level). Thus establishments which are part of groups are more likely than independent establishments to have sales areas at a greater

geographical distance from the establishment's location in West Yorkshire.

Product destination may affect the usage of certain modes of transport. In 66% of the cases, destination did affect the choice of mode. It has been shown already (in 6.3) that some companies operate a transport strategy which is based on mileage zones. Some companies may use their own transport up to a certain distance, for example, within a 100 mile radius of the establishment. However, consignment weight may necessitate the use of another mode, even within the normal operating radius of an own-account fleet. One company mentioned the tachograph as a constraint on own-vehicle usage and so they operate their vehicles in terms of distances that can be covered within one working day. It is reasonable to conclude that distance does affect choice of mode but the relationship is not necessarily a straightforward one.

Another attribute that may affect choice of transport mode is the urgency with which the consignment is required by the customer. For 64% of establishments, the urgency of the consignment did affect the mode used and the breakdown into modal categories is given in Table 6.27.

Table 6.27 Mode of Transport Used when the Consignment is Urgent

Mode used	Percentage of Establishments		
	Small	Large	Total
Own vehicle	6.4	11.8	6.8
Guaranteed road	29.6	29.4	29.7
Own/guaranteed road	19.2	17.6	19.1
Guaranteed road/rail	12.8	17.6	13.1
Own vehicle/rail	2.3	0.0	2.1
Own/guaranteed road/rail	6.4	11.8	6.8
Own vehicle/company car	2.3	5.9	2.5
Post	4.1	0.0	3.8
Rail	16.9	5.9	16.1
Totals	100.0	100.0	100.0

A guaranteed service is one where delivery is guaranteed within a certain time-period and failure to do so involves the carrier in heavy financial penalties. Naturally, such a service is expensive and tends under normal circumstances to be used only when a specified delivery time is required by the customer. This reinforces the findings in 2.3 that a consistent, "on-time" transport service is highly regarded by consignors as it promotes

positive feelings between customer and supplier. Own-account vehicles feature prominently when a consignment is required urgently. For many firms, there is still a tendency not to wish to lose control over their consignment, especially when timing of delivery is all important.

6.5 ATTITUDES

A theme that runs throughout this research is the importance of the perceived nature of transport characteristics. In order to assess the respondents' perceptions on the importance of certain attributes, an attitudinal rating-scale test has been administered.

The frequency of the attitudinal responses obtained are given in Table 3, Appendix 3. All subsequent analysis involves 11 out of the 13 attributes. Level of inventory and shipment regularity are not considered any further, as most respondents found the two categories not applicable to the Paper, Printing and Publishing sector. The attributes are given in descending order of importance, based on Table 4, Appendix 3 (the most important first):

- (1) service level to customer;
- (2) reliability of transport mode;

- (3) ready availability of transport when required;
- (4) avoidance of damage to goods when in transit;
- (5) control over delivery time;
- (6) control over despatch;
- (7) security of goods in transit;
- (8) transit time;
- (9) minimum transport cost;
- (10) length of haul; and
- (11) size of consignment.

Further analyses of these attributes have been undertaken and the findings discussed in Chapter 7.

6.6 PERSON RESPONSIBLE FOR TRANSPORT DECISIONS/OPERATIONS

It has been argued that there will be wide variations in the capabilities of transport managers or persons responsible for running the transport department of a firm. Also, that the calibre of the people involved may not reflect always the size, complexity and importance of the firm's transport problems (Jeffs, 1981). In this section, an attempt is made to gain insight into this. It is assumed that a company with a positive attitude towards the transport function is more likely to employ staff with some formal education or previous experience in transport/distribution.

In fact, 32% of transport decision-makers have had no post-school education and 86% have had no formal educational training in transport. But 26% did have previous job experience in transport. Of the remainder, 21% were in their first job. Table 6.28 shows the number of years that the transport decision-maker had spent with the company.

Table 6.28 Number of Year with the Company

Years' service	%
0 - 4.9	10.9
5 - 9.9	29.7
10 - 19.9	25.3
20 - 29.9	15.3
30 - 39.9	7.1
40 and over	11.7
Total	100.0

However, it is possible that different emphases are placed on years spent with the company, post-school education and previous job experience in transport (Table 6.29 and Table 6.30).

Table 6.29 Number of Years with the Company by
Post-School Education

Years' service	College	University/ Polytechnic	None
0 - 4.9	6	4	1
5 - 9.9	12	8	8
10 and over	27	6	28
Totals	45	18	37

A person's known ability in the company may be more important than his level of post-school education. There is a relationship between years with the company and post-school education, significant at the 95% level (Chi-square value = 10.47 with 4 degrees of freedom). But, from inspection of Table 6.29, there appears to be less likelihood of the respondent having had post-school education, the longer he has been in employment.

If the relationship between years served with the company and post-school education is controlled for those with and without previous job experience in

transport, an interesting picture emerges. There is no significant relationship between years with the company and post-school education for those with previous job experience in transport (Chi-square value = 3.17 with 2 degrees of freedom). This perhaps implies that previous job experience in transport is considered by companies to be as important, if not more so, than post-school education. Whereas for those with no previous job experience in transport, a significant relationship exists between years' service with the company and post-school education, at the 99% level (Chi-square value = 7.53 with 1 degree of freedom).

Table 6.30 Number of Years with the Company by Post-School Education by Previous Job Experience in Transport

(1) Previous job experience in transport

Length of service (years)	Post-school education?	
	Yes	No
0 - 5	3	1
5.1 - 10	11	4
Over 10	5	7

(2) No previous job experience in transport

Length of service (years)	Post-school education?	
	Yes	No
Up to 10	16	3
Over 10	15	18

It is important to determine the level of responsibility that the transport decision-maker has. For example, the transport manager of an establishment may have full responsibility for his own-vehicle fleet, both in accounting and managing the operation. If he only manages the operation, then he may prefer to use his own vehicles so that he can "shift" the cost to another department. But, if the transport manager is fully accountable, then he is more likely to look at the cost of using his own fleet compared to that of an outside road haulier or a contract with, say, British Rail. In fact, 72% of transport decision-makers are responsible for both managing and accounting for the transport operation, while the rest are in a managing role only.

Remarkably, 51.4% of transport decision-makers did have knowledge of alternative modes other than the ones they utilise at present (for number of modes used, see Table 6.12). The remaining 48.6% are prepared then just to accept the status quo position, without question. For those who look at other transport options, it is useful to ascertain what are the attributes on which they base their evaluation of alternatives (Table 6.31).

Table 6.31 Evaluative Attributes of Alternative
Transport Options

Attribute	%
Transport service	29.1
Service and charges	21.2
Charges	28.6
Usage (multi-modes)	18.5
Other	2.6
Total	100.0

As Table 6.31 shows, transport service is a feature which is valued highly even when transport decision-makers are concerned only with obtaining information on alternative transport options. Although 51.4% do look at different options, in the end, most of them maintain the status quo, in terms of mode. Again, this reinforces a strong mode-loyalty by transport decision-makers. However, source-loyalty within the public road haulage sector may not be quite as strong. So that, although some transport decision-makers feel that there is no alternative to public road haulage, evaluation of alternatives within the road haulage

sector is still undertaken. Availability to the manufacturer's operation is an important aspect of this evaluation - that is to say, transport service is more important than cost. Thus transport service tends to be the main focus of concern.

The transport decision-maker may have constraints placed on his choice of transport mode. 11% did not feel they had a free choice. Table 6.32 outlines the reasons for constraints being imposed upon the transport decision-maker.

Table 6.32 Reasons for Modal Choice Constraints

Reason	%
Production level	2.5
Company policy	7.3
Customer requirements	21.9
Price	21.9
Urgent deliveries	12.2
Transport infrastructure	12.2
Group	22.0
Total	100.0

Some transport decision-makers felt that the decision in the company is controlled by accountants who are only interested in the charges rather than service aspects. About 11% of transport decision-makers felt that the coarseness of the rail network restricts the use of this mode. Some company accountants prefer to have transport as a billed item each month and may therefore encourage the use of public carriers rather than investing in "own transport" facilities involving as it does capital, maintenance and running cost expenditures. Some transport managers felt that such a strategy often resulted in a reduced transport service to the customer and even a less cost-effective solution overall.

It may be useful to conclude this chapter with a few brief comments on some of the more salient findings. For many transport decision-makers, the level of control that they can exercise over transporting the product from factory departure to arrival at the customer's premises appears to be of crucial importance. Control over delivery for many companies appears to be of paramount concern in enabling them to promote positive customer relations. It has been shown that this aspect, especially control over delivery, is a major reason for

a company running an own-account fleet and prompting a change in the public haulier used, if the previous one is found to be erratic in this respect. Reliability is another feature which dominates many establishments' modal choice decisions and even extends to decisions concerning the type of vehicles purchased by them. When a company has a transport strategy (or possibly only an implicit one), the length of haul and consignment size are important variables in determining choice of mode. However, the relationship between choice of mode and length of haul is often modified by the geographical location of the product destination. Many transport decision-makers prefer to minimise the risk of potential damage to the product by choosing transport modes which require the least handling of the product. This is a major cause for failure to select the rail mode, as more product-handling is required since it is not a door-to-door service. Company structure and organisation have been found to be important internal influences on modal choice. These and other considerations will be analysed and discussed further in Chapter 7.

CHAPTER SEVEN

TESTS OF INITIAL HYPOTHESES

As set out in Chapter 5, there are four main hypotheses to be tested. Each will be considered in turn and trends (if any) will be detected. Finally, the attitude section of the questionnaire will be analysed further in order to throw light on the determinants of modal choice.

In this chapter, own-account refers to own vehicle fleets which require an operators licence. Those fleets which do not require such a licence are referred to as "non 'O' licence own-account" vehicles.

Hypothesis 1: "There is a significant relationship between external influences and transport mode selected."

The first type of external influence to be considered is that of customers' requirements. This can be further subdivided into specification of the transport mode by the customer and the need of the customer to have urgent delivery of the product.

No significant relationship is apparent between specification of mode by the customer and transport mode selected. This is a rather surprising result for it is highly unlikely that an establishment will not use the mode specified by the customer. However, this apparent contradiction can be explained by the fact that the majority of establishments use a variety of modes of transport and so they can accommodate the customer's request for a particular mode for a particular consignment without drastically altering the establishment's overall selection and use of transport modes for all consignments. However, when the customer requires the product in a hurry, then this does affect the selection of the transport mode. When urgent delivery of the product is required, selection of the postal mode is significant at the 95% level, and selection of the rail mode is significant at the 99% level (Chi-square value = 6.29 with 1 degree of freedom for post and 11.24 with 1 degree of freedom for rail).

The second type of external influence considered is where a formal agreement between an establishment and a carrier exists. No significant relationship has been found between an establishment which has a formal agreement with a carrier and selection of the transport mode. Notwithstanding a formal agreement between

consignor and carrier, other modes of transport are also used and this accounts, in a statistical sense, for no direct relationship being found. In Chapter 6, it has been shown that the majority of establishments use 3 or more modes of transport (Table 6.12).

Hypothesis 2: "There is a significant relationship between the internal organisation of a company and mode selected."

The suggestion here is that the type and size of internal organisation may well tend towards selection of certain modes rather than others.

The management characteristics of the organisation as measured by the number of organisational levels were considered initially. There is a relationship between number of organisational levels and use of own-account vehicles, significant at the 99% level. The larger the firm, the more likely it is that they will have their own fleet of 'O' licence vehicles. This is not an unrealistic conclusion, as presumably the larger the firm, the greater will be their assets. Otherwise, no relationships between the number of organisational levels within a company and mode selected have been found. This is also not surprising, however, as most firms have access to public hauliers, to the railways, to the post and even (if desired) to non 'O' licence

own-account vehicles.

The employment characteristics of an establishment have been considered in terms of the number of employees solely concerned with transport/distribution. The public road haulage sector cannot be tested, as the method of testing is invalid due to the nature of the data. The use of the rail and postal modes is not (it seems) determined by the number of employees solely concerned with transport/distribution within the establishment. However, there is a relationship between number of employees solely concerned with transport and selection of own-account transport, significant at the 99% level (Chi-square value = 15.41 with 3 degrees of freedom) and selection of non 'O' licence own-account, significant at the 95% level (Chi-square value = 8.39 with 3 degrees of freedom).

It has not been possible to test whether there is any relationship between the nature of the establishment, as measured by the type of business undertaken, and the mode selected. It had been hoped to see if any pattern emerged when the SIC order had been broken down into its constituent MLH's, but data-limitations precluded further examination of this.

No significant relationship has been found between the

position of the transport function in the organisational hierarchy and selection of public road haulage, non 'O' licence own-account, postal and rail transport, but there is a relationship between the transport manager's place in the organisational hierarchy and selection of own-account, significant at the 99% level (Chi-square value = 23.03 with 4 degrees of freedom).

Considerable importance has been attached to the independence of an establishment and the effect this can have on its decision-making. Two measures of independence have been used and, in each case, it is quite feasible that independence of the establishment may affect the mode selected. It may especially affect the ownership of own-account fleets. A non-independent firm may, on the one hand, be constrained in modal choice by group decisions. On the other hand, the non-independent firm may have greater choice due to the availability of greater resources within the organisation as a whole.

No significant relationships between transport decisions at the level of an individual establishment and mode selected have been found however.

The size of establishments has been measured in terms of both value of output and number of employees. There is

no relationship between value of output and selection of rail, postal, non 'O' licence own-account and public road haulage; but there is a relationship between value of output and selection of own-account fleet, significant at the 99% level (Chi-square value = 24.50 with 4 degrees of freedom). This conclusion is to be expected, since the modes of rail, postal and public road haulage do not involve investment decisions and all establishments, regardless of size, have access to them. Whereas, the decision to have an own-account fleet does require a substantial financial commitment by the firm.

A significant relationship exists between the number of employees and selection of both own-account fleets at the 99% level (Chi-square value = 29.62 with 4 degrees of freedom) and non 'O' licence own-account fleets at the 95% level (Chi-square value = 11.89 with 4 degrees of freedom).

Rather surprisingly, however, no significant relationship was found between level of responsibility of the transport decision-maker and mode selected, as measured by whether he manages or manages and accounts for the transport operations. One possible explanation is that operational decisions are often taken at a low level in the organisational hierarchy but endorsed at a higher level. But when transport decisions have to be

approved by the Board, then two significant relationships were found. Thus, there is a relationship between transport decisions which require Board approval and selection of own-account (Chi-square value = 7.09 with 1 degree of freedom) and selection of non 'O' licence own-account fleets (Chi-square value = 4.46 with 1 degree of freedom), both significant at the 95% level. This is not unexpected as, presumably, any decision within a company requiring capital expenditure will need approval of the Board.

Hypothesis 3: "There is a significant relationship between characteristics of a company's product and mode selected."

There is no significant relationship between destination of the product and selection of own-account fleets, postal and public road haulage. However, there is a relationship between destination of product and selection of rail, significant at the 99% level (Chi-square value = 19.66 with 1 degree of freedom). This is to be expected as the rail network is very much destination-constrained, unlike the other modes. A particular public road haulier may specialise within certain regions of the country but the mode, taken as a whole, will usually provide a complete geographical

coverage. The number of customers to be served may also affect mode-selection. There is a relationship between number of customers and selection of non 'O' licence own-account, significant at the 95% level (Chi-square value = 9.66 with 3 degrees of freedom).

Initially, when the SIC Order was broken down into MLH's to distinguish between the different product categories, it was not possible to test the significance of the relationships (even if there were any to test). However, by inspecting the data and considering only the three product categories of Packaging Products, General Printing and Manufactured Stationery, which represents 94% of the sample, the Chi-square test can be utilised. From this, two significant relationships emerge: (a) there is a relationship between type of product and selection of own-account transport, significant at the 99% level (Chi-square value = 21.4 with 2 degrees of freedom); and (b) there is a relationship between type of product and selection of the postal mode, significant at the 99% level (Chi-square value = 14.86 with 2 degrees of freedom).

Lastly, there seems to be a relationship between the need for special handling facilities and selection of own-account transport, significant at the 99% level (Chi-square value = 9.98 with 1 degree of freedom).

Hypothesis 4: "There is a significant relationship between the transport facilities available and mode selected."

No significant relationship was found between the need to use different modes or carriers to meet upward fluctuations in demand and mode selected.

There is, however, a relationship between knowledge of alternative modes and selection of own-account transport, significant at the 95% level (Chi-square value = 4.59 with 1 degree of freedom).

How does the presence of a firm's own transport facilities affect mode selection? There is a significant association between ownership of an own-account fleet and the use of the postal mode, significant at the 95% level (Chi-square value = 4.34 with 1 degree of freedom). In particular, those establishments with own-account fleets are less likely to use the postal mode than others. Otherwise, the presence of "own transport" facilities does not seem to make any difference to the selection of rail and non 'O' licence own-account vehicles.

As far as it is possible to generalise, certain trends can be detected. The selection of the own-account mode

is very much orientated towards establishment type. Company size, structure and organisation seemingly play an important role in determining the presence of an own-account fleet in the establishment and its subsequent use. The nature of the product also results in a significant relationship with the selection of the postal mode. The reason for this is not too difficult to discover. The postal mode is utilised very much by establishments in this sector sending samples to customers for final approval, prior to the commencement of the printing run. The important point to emphasise in all this is that selection of the own-account mode (if available) overwhelms significantly the others as first choice in the transport decision-makers judgement.

User's Perceptions of the Modal Attributes of Freight Transport

To examine the attitudes of transport decision-makers in the sample to various characteristics of a freight transport mode, factor analysis has been utilised. The scope of the application of factor analysis was limited to the unweighted sample values and, therefore, any attempt to extend inferences to the population would depend on an assumption that the correlations

within the sub-populations of small and large establishments are identical. The foregoing results suggest that such an assumption is not tenable. This analysis should enable any underlying pattern of relationships to be detected (if such a pattern exists) for the set of variables in question. One of the goals of factor analysis is to reduce the data-matrix to a smaller number of meaningful dimensions. A description of the salient aspects of factor analytic techniques is given in 1.1 (Appendix 3).

Figure 7.1 represents, in flow-diagram form, the factor analysis procedure used. The correlation matrix is based on Spearman Correlation Coefficients (Table 7.1). The initial factor matrix (Table 7.2) has been produced using the principal-axis solution, with the main diagonal elements of the correlation matrix replaced by communality estimates.

Figure 7.1 Flow-diagram of the factor analysis procedure

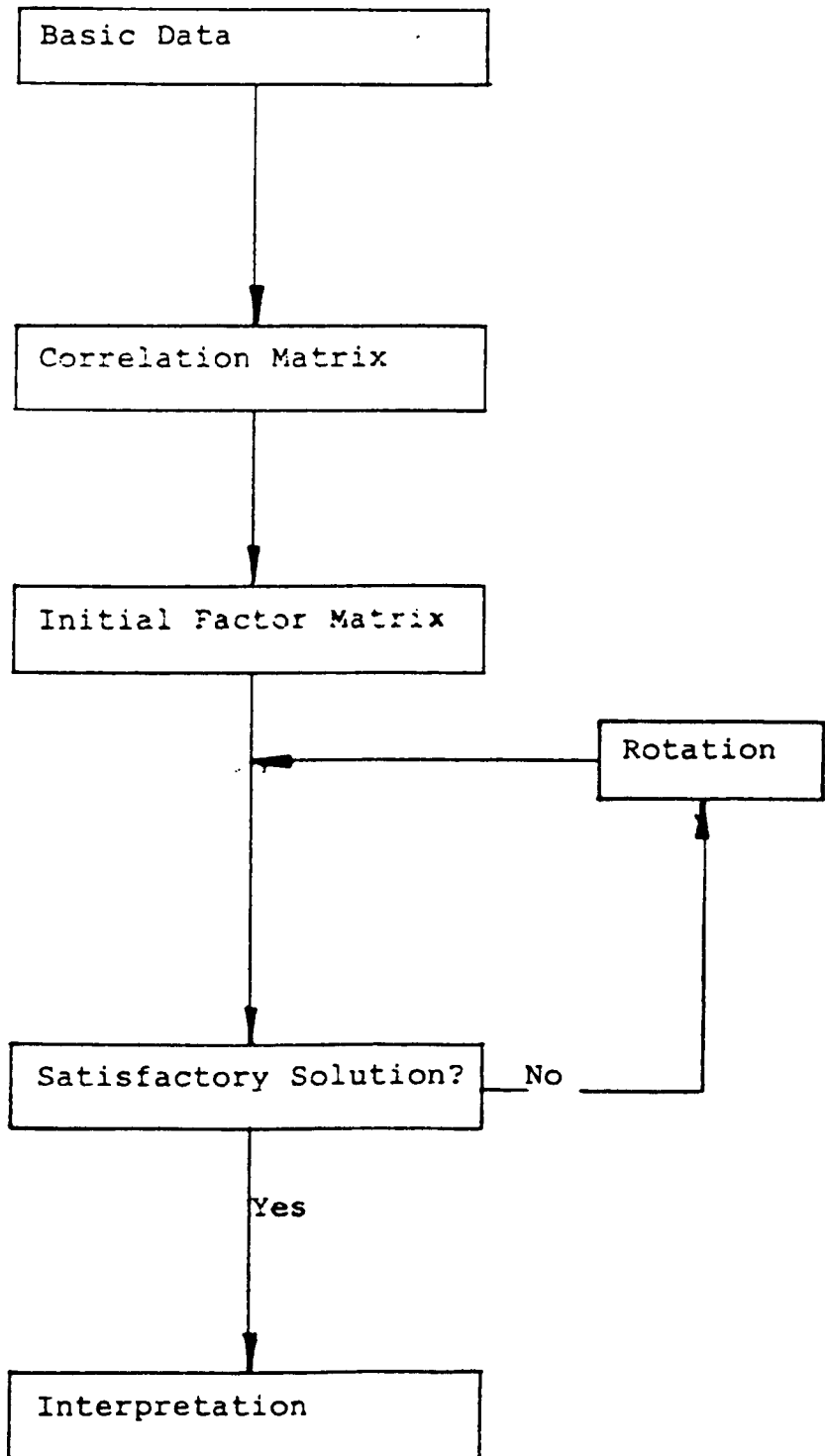


Table 7.1 Correlation Matrix (unweighted)

AT1	AT2	AT3	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	
AT1	1.00	0.30	0.08	0.26	0.22	0.17	-0.02	0.05	0.02	0.07	0.38
AT2	0.30	1.00	0.07	0.25	0.14	0.26	0.13	0.06	0.10	0.23	0.22
AT3	0.08	0.07	1.00	-0.03	0.11	0.20	-0.11	0.22	0.16	0.19	0.05
AT5	0.26	0.25	-0.03	1.00	0.15	0.35	-0.07	-0.17	-0.10	0.16	0.12
AT6	0.22	0.14	0.11	0.15	1.00	0.40	-0.05	0.06	0.14	0.03	0.05
AT7	0.17	0.26	0.20	0.35	0.40	1.00	-0.08	-0.09	0.16	0.18	0.16
AT8	-0.02	0.13	-0.11	-0.07	-0.05	-0.08	1.00	-0.15	-0.07	-0.09	-0.05
AT9	0.05	0.06	0.22	-0.17	0.06	-0.09	-0.15	1.00	0.41	0.18	0.01
AT10	0.02	0.10	0.16	-0.10	0.14	0.16	-0.07	0.41	1.00	0.05	-0.12
AT11	0.07	0.23	0.19	0.16	0.03	0.18	-0.09	0.18	0.05	1.00	0.27
AT12	0.38	0.22	0.05	0.12	0.05	0.16	-0.05	0.01	-0.12	0.27	1.00

NOTE: based on Spearman Correlation Coefficients

KEY:

- AT1-reliability;
- AT3-minimum transport cost;
- AT6-avoidance of damage to goods when in transit;
- AT8-service level to customer;
- AT10-size of consignment;
- AT12-ready availability of transport
- AT2-control over despatch;
- AT5-control over delivery time;
- AT7-security of goods in transit;
- AT9-length of haul;
- AT11-transit time;

Table 7.2 Factor Structure Matrix of Principal-axis solution

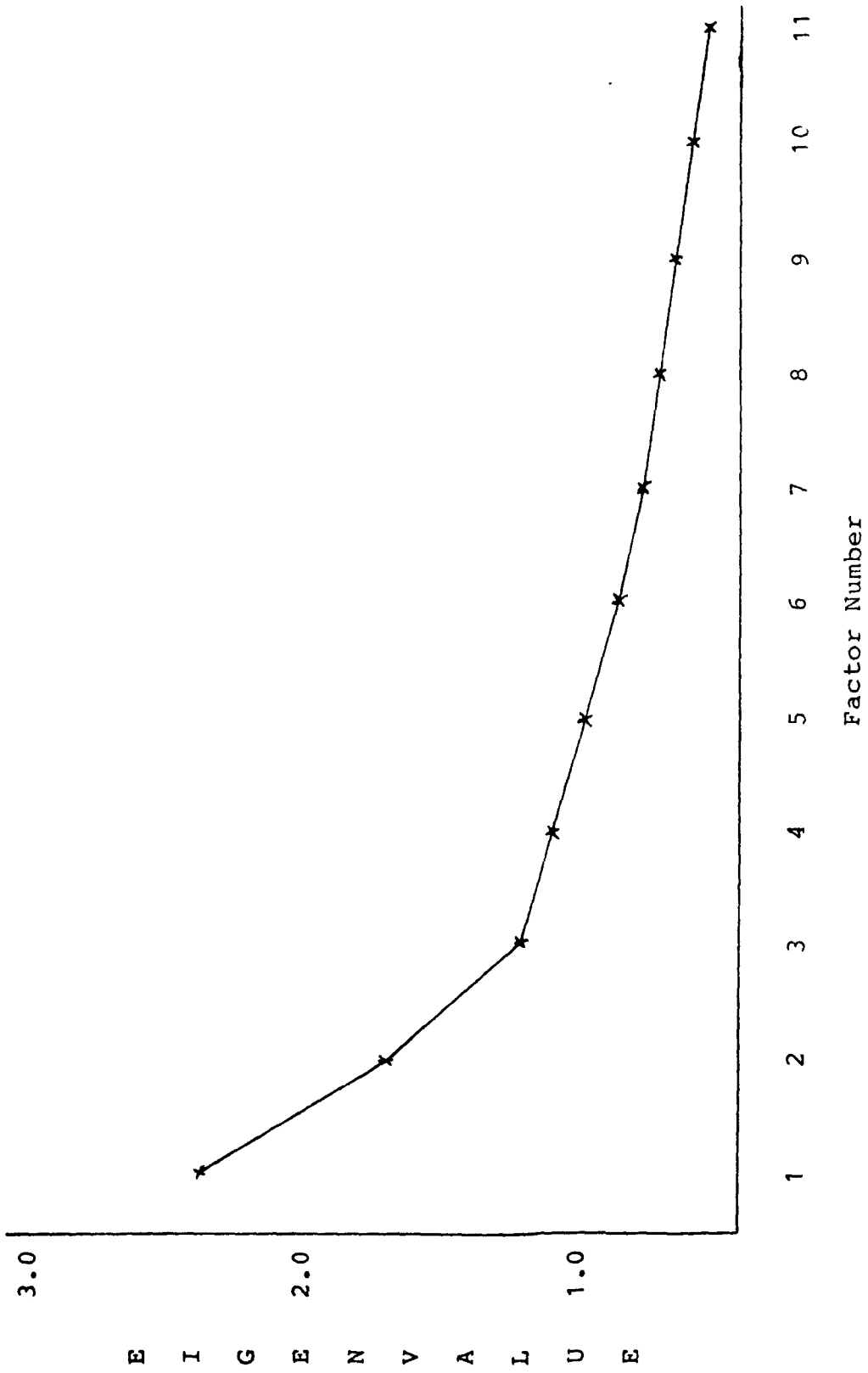
	Factor 1	Factor 2	Factor 3	Factor 4	h[2]
AT1	-0.63	0.20	0.53	-0.37	0.85
AT2	-0.45	0.04	0.09	0.04	0.21
AT3	-0.24	-0.28	-0.05	0.03	0.14
AT5	-0.40	0.28	-0.07	0.07	0.25
AT6	-0.39	-0.03	-0.19	-0.20	0.23
AT7	-0.73	0.10	-0.59	-0.03	0.89
AT8	0.10	0.15	0.03	-0.04	0.04
AT9	-0.13	-0.75	0.18	-0.08	0.62
AT10	-0.17	-0.53	-0.14	-0.22	0.38
AT11	-0.43	-0.21	0.13	0.61	0.62
AT12	-0.39	0.13	0.29	0.16	0.28
Eigenvalue:	1.90	1.13	0.83	0.64	---
% of variance explained	42.2	25.1	18.5	14.1	---

KEY: h[2] is the communality value

According to the common factor model, a variable consists of common, specific and error variance (Figure 1, Appendix 3). However, the proportion of common variance in a set of variables is not known prior to the factor analysis. Consequently, most methods of factor extraction which analyse only common variance require an initial estimate of common variance to be made and this is referred to as the "communality estimate". Initial estimates of the communalities are given by the squared multiple correlation between a given variable and the rest of the variables in the matrix. The SPSS package employs an iteration procedure for improving the estimates of communality. The communalities (h^2) given in Table 7.2 are the result of convergence after 72 iterations.

The reason for this procedure being preferred to the principal component solution is that, in transportation research, very few variables can be thought of as "error-free". Kaiser's criterion of extracting factors with Eigenvalues greater than or equal to 1.0 (Table 7.2) and Cattell's scree test (Figure 7.2) suggest that the number of factors to be retained is two. Cattell (1965) suggests retaining the number of factors immediately above the break. The next stage in the procedure is to select the criterion for choosing the significant loadings in each factor. Loadings greater

Figure 7.2 Scree Test (Cattell, 1965)



NOTE: The number of factors to be retained are those immediately above the point of inflection

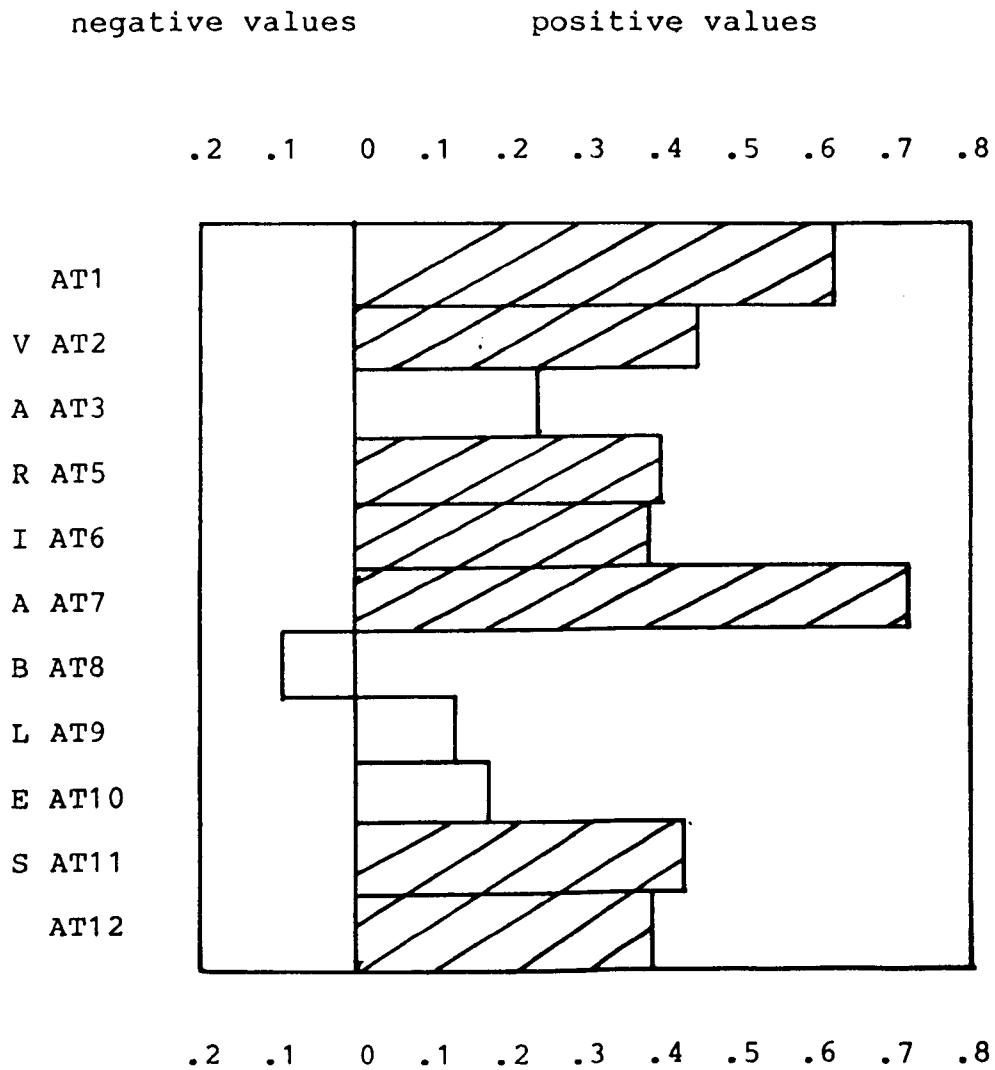
than or equal to 0.30 are considered to be significant (Child, 1970; Kass and Tinsley, 1979).

The profile of Factor 1 is shown in Figure 7.3 and, similarly, Factor 2 in Figure 7.4. The signs are reversed in these figures but nothing is violated by reversing all the signs in any one factor, if it is so desired (Child, 1970). It is usual, however, to arrange for the highest loadings to be positive.

Factors 1 and 2 represent 67.3% of the variance among the observed variables. Rotation to the initial factor matrix did not aid interpretation and, thus, all ensuing discussion is based on this initial solution. It is felt that the initial solution satisfies "best" the theoretical and practical needs of the research into the determinants of freight transport modal choice.

The most obvious point to emerge from the factor analysis is that freight transport evaluation is a much more complex issue than conventional methodology assumes. Furthermore, minimum cost, the most widely used criterion of choice is, in this particular case, of secondary importance (it does not feature as a significant loading in either Factor).

Figure 7.3 Loadings of Attitudinal Variables on Factor 1



KEY:

low loadings

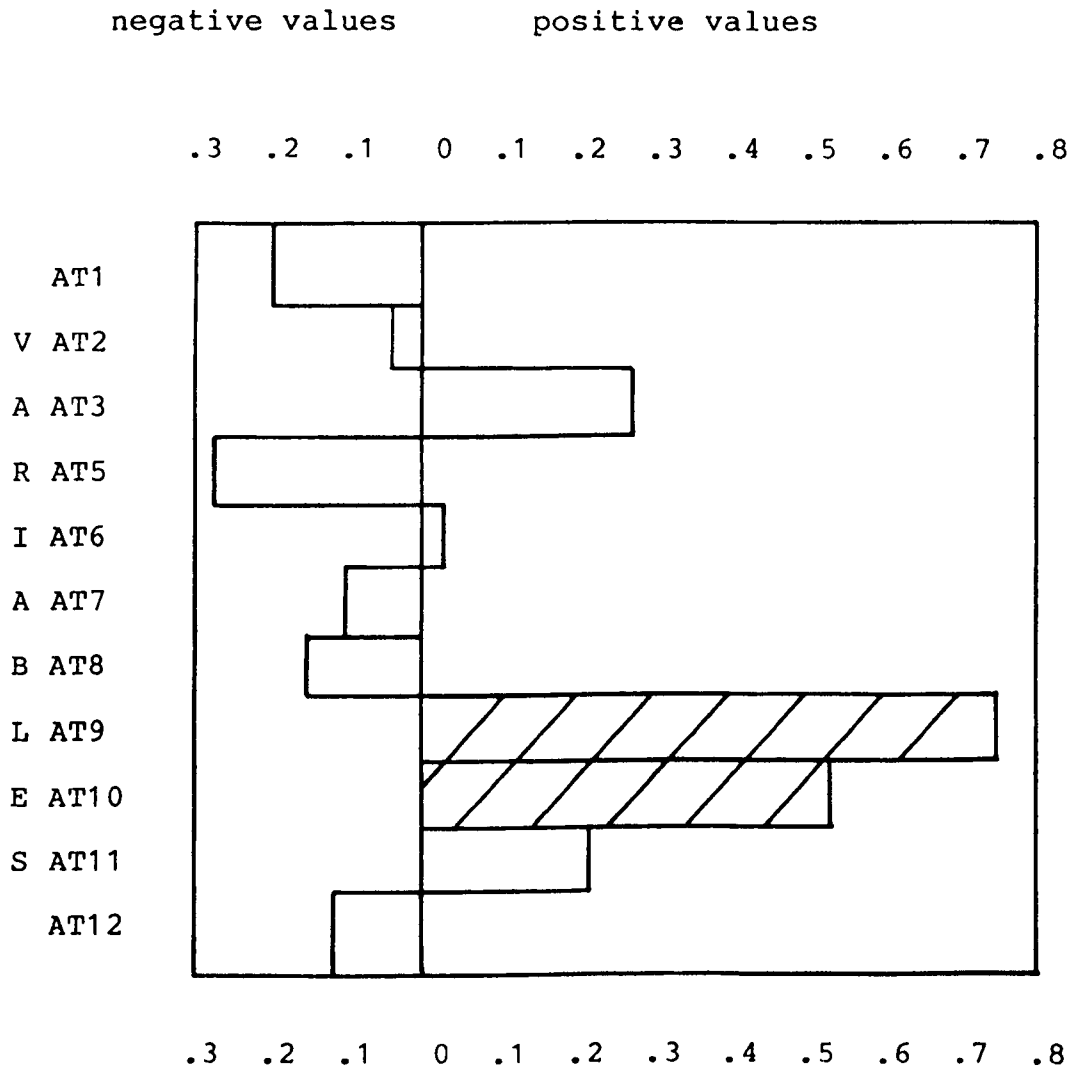


significant loadings (over 0.30)



all signs reversed

Figure 7.4 Loadings of Attitudinal Variables on Factor 2

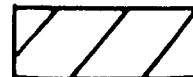


KEY:

low loadings



significant loadings (over 0.30)



all signs reversed

The significant loadings of Factor 1 reinforce the sampled transport decision-makers' need to be able to exercise "control" over the product from leaving the factory to its arrival with the customer. The nature of the Paper, Printing and Publishing industry is such that the product is tailor-made to meet individual customer requirements. Thus, it is necessary for the consignor to be able to guarantee a reliable delivery to the customer. Hence, an important determinant of modal choice is the level of control that can be exercised over the mode of transport. It is felt that the label "control" best sums up the significant loadings for Factor 1. (It should be remembered that the choice of labels for factors is always entirely subjective). As can be seen from Table 7.2 and Figure 7.3, the significant loadings are - reliability of transport mode; control over despatch; control over delivery time; avoidance of damage to product when in transit; security of product in transit; transit time and ready availability of transport when required.

These have been reinforced not only in this study (Tables 6.15 and 6.19, for example) but confirm some earlier findings by Cook. The significant loadings of Factor 2 are the variables - length of haul and size of consignment (Table 7.2 and Figure 7.4). This so-called

doublet factor reinforces also earlier findings by Bayliss and Edwards. From Chapter 6, it is not surprising that these variables are determinants of modal choice, as the main-stay of companies' transport strategy is often geared to length of haul and consignment size with the proviso that the transport mode is reliable. The major determinants of modal choice in freight transport in the Paper, Printing and Publishing sector of West Yorkshire based on unweighted sample values are summarized in Table 7.3.

It is useful, at this point, to summarize the significant relationships that have been found in terms of the main hypotheses, as set out in Chapter 5.

Hypothesis 1 : "There is a significant relationship between external influences and the transport mode selected"

The major external influence that has been found to affect selection of the transport mode is the need of the customer to have the product delivered urgently (non 'O' licence own-account [95%] and rail [99%]).

Table 7.3 Major determinants of modal choice derived from the factor analysis[*]

Reliability of transport mode

Control over despatch

Control over delivery time

Avoidance of damage to goods when in transit

Security of product in transit

Transit time

Ready availability of transport when required

Length of haul

Size of consignment

[*] Note: this list contains only those variables for which the factor loadings exceeded 0.30.

: based on unweighted sample values

Hypothesis 2: "There is a significant relationship between company organisation and the mode selected"

It has been shown that company organisation exerts a considerable influence over the transport decision-making process. Significant aspects of company organisation which affect transport mode selection are: the number of organisational levels (own-account [95%]); number of employees in transport within the establishment (non 'O' licence own-account [95%] and own-account [99%]); number of employees (non 'O' licence own-account [95%] and own-account [99%]); and value of output (own-account [99%]). It has already been shown in this chapter that, as the dimensions of these variables increase, so does the selection by a firm of its own road transport.

Both the organisational position of the transport function within the establishment (own-account [99%]) and the need to have Boardapproval (own-account and non 'O' licence own-account [95%]) affect transport mode selection. It is highly likely, that as a company increases in size, so will the importance of these two variables.

Hypothesis 3: "There is a significant relationship between product characteristics and the mode selected"

The characteristics of the product which affect selection of the transport mode are product type (own-account [99%] and Post Office [99%]) and handling characteristics (own-account [99%]). Other product related characteristics which have been found to be significant are destination of product (British Rail [99%]) and number of customers (non 'O' licence own-account [95%]).

Hypothesis 4: "There is a significant relationship between the available transport facilities and the mode selected"

A significant relationship has been found to exist between the presence of an own-account fleet and the use of the postal mode [95%]. The use of the postal mode is less likely if an establishment has an own-account fleet at its disposal. There is a relationship between knowledge of alternative transport modes and selection of own-account [95%]. A very important conclusion that has been drawn is that the own-account mode is the transport decision-makers' preferred option, with the

rider that it is available when required.

Some other relationships have been found to be significant and these are given in Chapter 6. Finally, a summary of those relationships which have been investigated and found not to be statistically significant in the Paper, Printing and Publishing sector are contained in Table 7.4. However, these relationships may be found to be significant in other industrial sectors.

Table 7.4 Relationships found not to be significant in
the Paper, Printing and Publishing sector

NO SIGNIFICANT RELATIONSHIP BETWEEN:

- (A) transport mode selected and ..
 - .. specification of mode by customer
 - .. formal agreement with carrier
 - .. transport decisions taken within establishment
 - .. level of responsibility
 - .. production process
 - .. upward fluctuations in demand

- (B) selection of own-account transport and ..
 - .. need of customer to have product delivered urgently
 - .. number of organisational levels
 - .. organisational position of transport function
 - .. destination of product
 - .. number of customers

- (C) selection of non 'O' licence own-account transport and ..
 - .. need of customer to have product delivered urgently
 - .. number of organisational levels
 - .. organisational position of transport function
 - .. value of output
 - .. destination of product
 - .. product type
 - .. handling characteristics

- (D) selection of public road haulage and ..
 - .. need of customer to have product delivered urgently
 - .. number of organisational levels
 - .. organisational position of transport function
 - .. value of output
 - .. number of employees
 - .. need to have Board approval
 - .. destination of product
 - .. number of customers
 - .. product type
 - .. handling characteristics

- (E) selection of rail transport and ..
 - .. number of organisational levels
 - .. number of employees in transport
 - .. organisational position of transport function
 - .. value of output
 - .. number of employees
 - .. need to have Board approval

Table 7.4 (continued)

NO SIGNIFICANT RELATIONSHIP BETWEEN:

- (E) selection of rail transport and ..
 - .. number of customers
 - .. product type
 - .. handling characteristics

- (F) selection of postal mode and ..
 - .. organisational position of transport function
 - .. number of employees in transport
 - .. value of output
 - .. number of employees
 - .. need to have Board approval
 - .. destination of product
 - .. number of customers
 - .. handling characteristics

- transport decisions requiring board approval and independence of establishment
- use of same public road haulier and perceived deficiencies in public road haulage
- years' service with company and post-school education, for those with previous job experience in transport

CHAPTER EIGHT

CONCLUSIONS

This research has been concerned with investigating the processes of decision-making in a firm regarding transport, with the intention of providing a better explanation of modal choice. After consideration of the various approaches which could be used to study modal choice, it was argued that the behavioural approach offered the most fruitful avenue for analysis. It is necessary now to draw together the various strands of the research and a useful starting point is to summarize the main conclusions that have emerged from the empirical work. This is followed by an examination of the relevance of the findings for the basic conceptual and methodological problems inherent in estimating freight modal split. Then, it is important to discuss the implications of these findings for the art and practice of transport demand-modelling and transport policy and finally, how future inquiry into modal choice in freight transport (and hence modal split) should best be directed?

As the empirical work has shown, many variables appear to exert an influence on the modal choice decision-making process. However, it is possible to categorise them into six main groups. It is the inter-actions and inter-relationships between these which ultimately determine freight modal split. The major parameters which determine modal split in freight transport are shown in Table 8.1.

It has been shown, albeit in one industrial sector only, that various parameters affect transport choice but that, for some freight movements, choice between modes does not really exist. Policy-makers, in developing and implementing transportation policy, must be aware of the complex nature of transport decision-making within firms. A major conclusion arising, therefore, from this research is that the firm is the relevant unit of analysis to study modal split in freight transport.

Some factors may have a greater influence on certain types of decision than others. It has been noted, for example, that linkage patterns have been found to be fairly straightforward in the Paper, Printing and Publishing sector. But it must be realised that these patterns may be more complex in other industrial sectors, thereby affecting to a greater extent the way

in which individuals and firms behave and hence exert a greater effect on transport decisions. As a consequence of the present economic climate, stock-holding patterns are changing. There is an increasing tendency for customers to minimise stock-holding and so they require the manufacturer to deliver the products more frequently and more quickly, as and when required. In such a situation, transport is becoming more important and reliability of the mode employed even more critical. The nature of a company in terms of its structure and organisation has been found to be important in influencing the decision-making process. Similarly, any change in patterns of industrial consumption affect the decision-maker's perception of his transport needs. One of the main reasons given by respondents for use of public road haulage was the broadening of the existing customer base and the requirement of many customers to have goods more frequently and in smaller quantities. If similar changes are taking place in other industrial sectors, then the effect that these exert on the decision-making process is increasingly important. However, it is clear that this effect cuts across industrial sector boundaries and is therefore not specific to any one type of industry.

Table 8.1 Parameters which have been found to determine
freight modal split

(1) CUSTOMER REQUIREMENTS

- size and frequency of delivery
- timing of delivery
- urgency of delivery
- specification of mode by customer

(2) PRODUCT CHARACTERISTICS

- value
- volume to weight quotient
- product type
- handling characteristics
- perishability

(3) COMPANY STRUCTURE/ORGANISATION

- independence of establishment
- number of organisational levels
- number of employees engaged in transport function
- position of transport function in hierarchy
- sphere of operation

(4) GOVERNMENT

- transport infrastructure
- regulations (e.g. drivers' hours)

(5) AVAILABLE TRANSPORT FACILITIES

- own fleet
- availability of public modes for delivery operation

(6) DECISION-MAKER

- knowledge of alternatives
- level of responsibility in company

For those establishments which have a positive transport strategy, the strategy appeared to be based on the twin criteria of size of consignment and length of haul (delivery distance), provided that reliability and service characteristics of the transport mode were adequate. Although delivery distance does affect choice of mode, it cannot simply be measured in kilometres but it must be related to the geographical location of the customer. The geographical location of the customer may rule out some modes depending, for example, on: (a) how well served an area is by public carriers; (b) the interaction between the spatial component and drivers' hours for own-account operation; and (c) the quantity of goods to be sent.

In this research, transport service has been shown to be a major focus of concern to the transport decision-maker. Quality of service is not a single variable but rather a set of elements such as reliability of delivery and freedom from anxiety, loss and damage. Generally speaking, speed of freight transport is less important than the prompt despatch of goods at the required time and the predictability of the transit time. To ensure a good transport service to the customer, the degree of control has been found to be a crucial parameter, especially over delivery. Control

over delivery is often the overriding criterion for usage of a particular mode. Persistently erratic delivery times will prompt the decision-maker to look for alternatives. So, when do firms typically pursue alternative transport strategies? Decision-making often tends to be a fairly repetitive process, for similar consignments to specific destinations, unless a strong stimulus is exerted to promote change - such as: strike action by carriers; customer requiring urgent delivery; or (as mentioned above) erratic delivery schedules. As the empirical work has shown, it is inappropriate to consider modal split simply in terms of a division between road and rail. Road and rail transport contain within them several quite distinct forms of transport which happen to share the same track and future investigations must recognise this and take it into account. Moreover, very few of the establishments interviewed used just one mode of transport. Another important difference between road and rail modes is that a manufacturer may approach several public road hauliers offering a given service to decide the most competitive rate which also meets the pre-determined service level, whereas choice is restricted to only one provider of a given railway service.

This research has shown that the relationship between

the outcome of the transport decision process and the values of particular determinants of modal split is not straightforward, due to the complexity and variety of interactions involved. The wide variation in behaviour exhibited even in the Paper, Printing and Publishing sector shows that it is highly unlikely that a fully representative model can be developed. Useful insights have been gained from the empirical work through: (a) the realisation of the importance to the shipper of high service levels to the customer; (b) the effect of market predictability on transport choice; and (c) the role of transport in the manufacturers' overall marketing strategy.

It is useful, at this point, to summarize some of the conceptual and methodological issues inherent in freight transport. Discussion centres on the following issues: measurement of variables; level of aggregation; and decision-making in the real world. The first concerns a problem that often besets research, namely defining variables and measuring them in terms of a common metric. In fact, many researchers have been so preoccupied with the search for "commensurability" that they end up losing sight of the initial research problem! Sharp (1970) suggested that the way forward was to express "quality of service" in terms of generalised money costs. In the past, the problem of reducing all variables to a common metric has been unsurmountable and

so has resulted in the tendency to use only those variables which could be expressed in the same units. Perhaps one of the main reasons for the failure to develop a successful modal-split model has been the preoccupation with techniques that rely on the development of a common metric which has led to the exclusion of some important explanatory variables along quite different dimensions.

The second issue concerns the appropriate level of aggregation. In order not to reduce the explanatory power of the key variables, it is important to work at a disaggregate level. But it should be remembered that mere disaggregation of observations does not, in itself, constitute an increase in behavioural understanding. However, models formulated at lower levels of aggregation have greater application - since they can be combined in more ways without loss of information inherent in the process of aggregation. Another important feature of disaggregate over aggregate models is their increased policy sensitivity. Obviously, disaggregate models do have some disadvantages such as the substantial demands made on data. But, overall, the advantages far outweigh the disadvantages - the resultant models will be more flexible; able to cope with a wider range of environmental change; and, to deal with a wide spectrum of policies.

The use of factor analysis enables both the aggregation of information without loss of behavioural reality and the specification of variables in terms of a common metric. The use of this technique is being pursued in other areas including, for example, transport evaluation (Roe, 1984). Factor-analytical techniques offer the potential to overcome many of the theoretical deficiencies of the approaches used to date. Thus, common problems of aggregation and valuation of disparate variables that characterise transport can be addressed successfully.

As has been shown, both in Chapter 4 and in the survey, classical theory bears little relationship to actual decision-making in the real world. Decision-makers have neither perfect knowledge nor the ability to predict accurately the consequences of each alternative and uncertainty is very much a characteristic of real-life decision-making. Conceptually, a decision should be seen as a choice made in terms of objectives from among a set of alternatives on the basis of available information. Decision-makers are thus concerned with adequate choice rather than optimal choice. It is impossible to avoid uncertainty but it is feasible to minimise risk. Generally, decision-makers do seek to minimise risk and this no doubt accounts for the tendency by them to

accept the status quo position. Thus, the transport decision-maker does not necessarily act like a "rational economic man" and so a behavioural approach is necessary, as it can take into account the subjective judgements involved in decision-making.

To date, there has been a lack of an accepted approach towards modal choice and hence modal split in freight transport. As mentioned above, this may be due to the lack of an adequate data-base as well as to the complexity of freight flows. Only by undertaking empirical study will the necessary data-base be established. Hitherto, freight transport has usually been examined within too narrow a framework. As this research shows, it must be placed firmly within the context of the total industrial process. The demand for freight transport is directly influenced by the level, composition and geographical distribution of production and consumption activities. In order for an individual firm to achieve a desired level of economic activity, a number of choices are involved, as was shown in Figure 1.2. These choices may concern long-, medium- and short-term decisions, all of which can influence the actual demand for transport, directly or indirectly. As freight transport is a derived demand, ignoring the

wider context will only produce spurious results.

To be able to develop a model which will be successful in predicting future patterns, one must simulate adequately the existing pattern of flow. This will only be achieved by incorporating all the parameters which determine modal split in the model specification. The main elements therefore that should be included are contained in Table 8.1.

Above all, the design and implementation of any transport policy should be based on a thorough insight into the underlying structural relationships. Thus, the main task of freight transport analysis is the specification of structural relationships which can be used to develop a freight transport model. The aim of any model must be to guide and support policymakers in taking the best decisions. To improve transportation planning it may be more useful to develop partial models aimed at specific policy questions and it is necessary to be able to forecast demand on the different modes so that sound investment decisions can be reached.

Infrastructure policy is one of the main areas of concern to both local and central government; yet, the demand for freight transport is largely determined by factors which cannot directly be influenced by

government's transport policy. In consequence, transport policy is almost invariably aimed at influencing the demand not directly but through changes to the supply side of the transport market.

Jones (1977) considers that the analysis of modal choice is probably the most policy-orientated element in the whole process of analysing and forecasting the demand for travel. By influencing choice of mode, it should be possible to achieve a more efficient use of existing transport systems. But, significant modal change will only be achieved by organisations, such as British Rail, adopting a more aggressive marketing approach to increase the decision-makers level of awareness of the services on offer and improving service levels to increase the transport decision-makers confidence in them.

This research has presented empirical findings which have broken new ground in consideration of modal choice in freight transport. It has shown the importance and general usefulness of adopting a behavioural approach to the problem of freight modal split in one sector of industry, namely the Paper, Printing and Publishing sector.

It has been shown in this study that not only is transport-decision making very complicated but it often takes into account many non-transport factors. These non-transport factors cannot be represented in a conventional generalised cost model, as these models are less than adequate to the task. It is useful to explore this in a little more detail. Even for the simplest of changes where the price of transport goes up, what happens to the supply of freight services? In terms of economic theory, it would be necessary to look at the price-elasticity of demand and supply. But the idea of demand/supply curves being smooth and continuous is only to be found in economic theory. In reality, demand/supply relationships are characterised by large step functions, which mirror changes in decision-making. It is highly likely, once perception of the decision-making climate in terms of cost/commitment/constraint is fixed in the decision-maker's mind, that it remains largely unchanged until a strong stimulus is exerted. It is only at this stage that reassessment takes place and a new equilibrium emerges to reflect the changed circumstances. Examples of stimuli which may result in this positive reassessment are renewal of existing transport contracts, increases in wage rates and changes in drivers' hours legislation. As demand for transport increases, so does the price and at this stage it may

lead to the re-examination of the transport decision by the firm or establishment. But re-examination usually only occurs when a strong stimulus is exerted otherwise the decision-maker will take the easy option and maintain the present transport position. Clearly, the price of transport service as reflected in costs to the consignor does not capture all the factors found to be important in the transport decision-making process. Thus a generalised cost model formulation excludes some important explanatory variables and a model which is wrongly specified can never represent adequately the phenomena under consideration.

It has been shown that many complex inter-actions take place between modal-split determinants and, while particular circumstances prevail, some may be of more importance than others. Thus, there is probably as much variation within an industrial sector in terms of how firms and individuals behave, as there is between sectors. Consequently, the findings of the empirical work will to a greater extent be reflected in other sectors as the research has focussed on the transport decision-making process.

In consequence, it is highly unlikely that a universal model can be developed due to the complex nature of freight transport. It has been assumed because it has

been possible to develop a universal model of passenger transport demand that the same can be achieved for freight. Furthermore, it has been thought by some that it can be achieved even more readily in this sector as freight is "inert" and cannot think for itself. But this view is a nonsense as, for each consignment made, someone has had to do some thinking and decide which mode to use to transport their goods to the customer.

Although it can be shown in this way that a generalised cost model does not work, an approach is still required to assist in the forecasts of freight transport. The following discussion highlights the main features of an alternative approach which will enable the forecasting of freight transport to become a reality.

Any alternative approach must result in a quantifiable method of forecasting. It needs therefore to contain relatively few variables, as each additional variable will require a large amount of data to quantify it. There are three important reasons for keeping the number of variables to a minimum:

- (1) If the model that is developed already contains within its specification the more important variables, then each additional one will account for a decreasing amount of explanation. The effort

involved in obtaining reliable estimates of additional variables will far exceed the additional explanatory power of these variables and therefore be wasteful of resources. As long as the main variables are contained within the model, it should be good enough for forecasting purposes.

(2) If the purpose of the model is forecasting future values of the dependent variable, it will be necessary to obtain forecast values for each of the independent variables.

(3) The transport decision-makers' attitudes towards rail modes, for example, will determine and explain present choice. The difficulty lies in trying to forecast future attitudes as presumably in the future the actual person making the decision may well be different and the rail service may be totally changed, resulting in future attitudes being quite different to those at the present time.

For these reasons, it is important to keep the variables to a minimum but at the same time there must be enough variables so that, taken together, they can explain the bulk of the variation.

One way of extending the usefulness of a model with rather few variables is to categorise rather precisely the circumstances in which they apply. For example, it

is highly unlikely that a 3 variable model will explain the phenomenon of interest very well over the whole range of application. However it may well provide a far better explanation by restricting the range over which it is applied. Thus, by categorising the field of potential application and then applying a simple model to each of these areas with perhaps different parameter values then a successful forecasting tool will emerge.

A useful next step would be to test the factor-analytic approach used here across other sectors of industry. This could lead to the findings of different studies being integrated into general propositions and given meaning in terms of a theoretical framework. A pre-requisite, however, is that comparison between successive findings is possible so that any emerging patterns can be identified. For example, if a particular factor extracts considerable variance consistently across studies then it will increase confidence in the reliability of the factor. It may suggest also that the importance of the factor is not unique to one study but, rather, is inherent in the process under investigation. In fact, dividing freight activity by commodity may be a red herring and company size or perishability of the product may be the more appropriate basis for categorising freight transport. It is reasonable to

assume that if it had been possible to investigate other industrial sectors that similar attributes would have been found. So dimensions other than commodity may divide up the totality of the whole rather better, such as - size of manufacturing unit, regularity of shipment, value of goods, vehicle type and so forth. On the basis of this study, it looks as though the size and nature of the company are useful dimensions. In Chapter 6, it has been shown that independent and non-independent establishments exhibit different characteristics in respect of their transport decision-making. Significant relationships have been found between independence of establishment and number of employees [99%]; organisational position of transport function [99%]; number of organisational levels [99%]; and sales outside of the home region [95%]. It is generally the smaller establishments in terms of number of employees that comprise independent firms. Size of company as measured by number of employees affects the behavioural response of establishments to the transport decision process. For instance, larger companies often have more transport modes available to them and can usually cope with changing circumstances more easily. This implies that the field of freight transport can be usefully divided up on the basis of this dimension and models developed

on these lines will provide a better explanation of modal choice than overall generalised cost models.

Finally, it is possible to construct factor scales from factor analysis results. Such factors can then be used as source variables in subsequent studies, accounting for the observed interrelations in the data. It is clearly outside the scope of this particular research to discuss in detail the construction of factor scales (see Kim and Mueller, 1982). Suffice it to say that an alternative approach to forecasting freight transport-demand can be developed by dividing the field into relevant categories; utilising an attitudinal-designed questionnaire to obtain the necessary data-base; and, employing factor analysis to devise factor scales which enable the explanatory variables to be quantified. It is not possible to forecast freight transport activity per se. But once the whole field of freight transport is split up into appropriate categories, probably not in terms of industrial sectors but along other dimensions such as size of firm, then a behavioural type model will provide a good explanation of freight activity.

By utilising a behavioural approach, this thesis has

brought into proper focus the importance of the adaptive processes by which an individual and an organisation adjust both to changing internal situations and to a dynamic external environment. Freight flows are complex and so it is highly unlikely that a universal model can ever be developed. Future inquiry should therefore be directed towards developing partial models in response to specific policy questions, along the lines outlined above. In this way, real progress in this difficult subject area of research can be achieved.

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APPENDIX 1

OPERATORS' LICENSING SYSTEM

Prior to the Transport Act of 1968, operators of commercial goods vehicles were regulated under the carriers' licensing system. This system was established by the Road and Rail Traffic Act of 1933 and in its final form under the Road Traffic Act of 1960. Under the 1933 Road and Rail Traffic Act, there were three main types of licence:-

- (1) the public carrier's or A licence - entitles the operator to use the authorised vehicles for the carriage of goods for hire or reward and was valid for two years (eventually valid for five years).
- (2) the limited carrier's or B licence - entitles the operator to use the authorised vehicles for the carriage of goods either for his own trade or business or for hire or reward, subject to conditions about the type of goods carried, the clients and the operating area. This licence was valid for one year (eventually valid for two years).
- (3) the private carrier's or C licence - entitles the holder to use the authorised vehicles for the carriage of goods for his trade or business only,

and was initially valid for three years (later valid for five years).

In 1963, the Geddes Committee was established to examine the system of carriers' licences. Licensing was initially introduced as a device to protect the railways from road haulage competition and safety was a secondary objective. When the Geddes Committee reported, it was found that the system had, as its primary function, the protection of the established haulier. The Committee recommended that this should be replaced by the promotion of safety and even now this is the licensing system's main rationale. Even so, the regulation of competition was still regarded as a prime objective.

Operators' licensing came into force with the 1968 Transport Act. It has been amended by the 1974 Road Traffic Act and the European Communities Act 1972.

Anyone using a vehicle for the carriage of goods, whether for hire or reward or on own-account must have an operators licence. However, vehicles with a maximum gross weight up to 3.5 tonnes are exempted.

The operators' licence can either be a standard operators' licence or a restricted operators' licence.

They are defined as:-

- (1) Standard operators' licence - under which goods vehicles may be used on a road for the carriage of goods for hire or reward or for or in connection with any trade or business carried on by the holder of the licence.
- (2) Restricted operators' licence - under which goods vehicles may be used on a road for the carriage of goods for or in connection with any trade or business carried on by the holder of the licence, not being the trade or business of carrying goods for hire or reward.

In 1977, the Foster Committee was appointed to consider the effectiveness of the Operators' Licensing system of road freight transport. They concluded that the purpose of operators' licensing should be to promote road safety, to help protect the environment from heavy goods vehicles and to prevent undue damage to roads. Since the main objective of licensing in Britain is the safe operation of goods vehicles, the Committee considered whether the desired safety standards for heavy goods vehicles could be otherwise achieved and, therefore, whether any operators' licensing was needed in Britain. In the absence of any firm evidence to the contrary, the Committee concluded that the belief expressed by many

people that operators' licensing does contribute to road safety, should be given weight. They found that, by retaining operators' licensing, other objectives could be served as well, principally the protection of the environment. The Foster Committee were unanimous that operators' licensing did play a useful role and should be kept.

APPENDIX 2

NATIONAL FREIGHT ORGANISATIONS

I. The National Freight Consortium (NFC)

The National Freight Company was formed under the 1980 Transport Act and succeeded the National Freight Corporation which was set up under the 1968 Transport Act. This has now been superceded by the "privatised" National Freight Consortium, although the internal structure is largely unchanged. Table 1 shows the principal operating subsidiaries of the National Freight Consortium.

Table 1: Principal operating subsidiaries of the National Freight Company

1. British Road Services Ltd. Group
2. National Carriers Ltd. Group
3. Roadline UK Ltd. Group
4. Special Traffics Group
5. Pickfords Removals and Travel Group
6. Tempco International Ltd.

Source: National Freight Company. A brief introduction to Britain's biggest Freight Business, 1980.

A brief outline of the services it operates follows:

(1) British Road Services

This group offer a total distribution service through their various regional road transport companies and specialist facilities. Each regional company offers a distribution service for the industry and commerce in its own area. They can call on Group services when necessary and these can extend outside regional territories. Where a national distribution service is required all the resources of the Group can be integrated into a single operating system.

British Road Services sell a wide range of freight transport, although they have been progressively moving into more specialised activities than general haulage. One such activity is contract hire, where BRS will supply, maintain and replace vehicles (mostly in customers' colours) and they will even supply drivers, if required. At the beginning of 1979, they also launched a trailer rental service.

(2) National Carriers Ltd.

NCL are organised as seven regional businesses, offering a range of small freight services through a network of depots. The company's national distribution service will

collect and deliver any consignment up to 3000kg to any business address in the country, including offshore islands and the Channel Isles. National Carriers have moved increasingly into specialised activities, especially contract services tailor-made for individual customers such as Woolworth, Rowntree-Mackintosh and Boots. They also provide a large fleet of vehicles for British Rail's express parcels service.

(3) Roadline UK

The main activity of this company is a door-to-door collection and delivery service for industry and commerce through a nationwide network of branches. Each consignment is consolidated with others bound for similar destinations. There are six operating regions. The specialist services provided include "express" deliveries within 24 hours; break-bulk and distribution for customers' trunked-in traffic; cash-on-delivery; warehousing and distribution; and an air-freight service for importers and exporters. The majority of Roadline's traffic comes from medium and small businesses, both industrial and commercial.

(4) Special Traffics

As the name implies, this group deals with very specialised traffic. Examples are Cartransport which collects, stores and delivers finished motor vehicles;

Pickfords Heavy Haulage which moves loads of from 4 to over 100 tons, such as oil-rig equipment, turbines and brewery tanks; Tankfreight which transport liquids and powders in bulk.

(5) Tempco International

This offers temperature-controlled storage and distribution services and is one of the expanding areas of NFC's business.

II. Royal Mail Parcels

Royal Mail Parcels may be either totally road or road/rail based. The Royal Mail Parcels can offer pre-arranged collection from regular senders as well as acceptance points for occasional users. The Royal Mail offers the business customer an extensive range of services. These include local delivery, important for (say) High Street shopkeepers. Datapost which provides a secure overnight delivery throughout the UK, as well as an international service. County Parcels which handles zonal deliveries at reduced rates. The majority of business parcels are on tailor-made contracts. The Royal Mail sees the following points as being the most distinct advantages for negotiated contracts:

- (1) Bulk handling - the contracted customer does not have to weigh or stamp his parcels individually;

- (2) Scheduled collection - collections of over 20 parcels a day are free. They will also collect smaller numbers of parcels from contracted customers;
- (3) Custom-built contracts - price terms under a variety of contract options;
- (4) Flexibility - they are willing to adapt their system to the particular demands of the individual customer's distribution pattern.
- (5) Convenient billing - customer received regular accounts. This removes the need for stamps or a postage meter.
- (6) Returned parcel service - for large-scale users seeking to stimulate "on approval" sales by paying postage on returned goods.

III. Freightliners

Freightliners Ltd., is a complete national distribution system based on modular containers which travel by road and rail, employing container-trains for long hauls and road vehicles for door-to-door deliveries. The whole operation is under real-time computer control. This is known as COPS - Container Operations Processing System. This monitors the service so, at any one period of time, it can locate a particular container and then supply all information concerning its transit and status. It is a very flexible service in that many permutations are

possible. For example, it is possible to use your own containers or theirs; your own road fleet or theirs; the goods can be taken from terminal-to-terminal or door-to-door. There are 39 Freightliner terminals currently in operation.

The Freightliner system is based on the carriage of high capacity containers on high-speed trains. The trains run in fixed-formation to provide fast reliable services over medium and long distances at a low cost. The units run to an agreed timetable. The majority of the containers carried meet International Standards Organisation specifications, which aim to make possible the most efficient combination of rail, road and sea transport. The 1978 Transport Act transferred total ownership of Freightliners Ltd. back to the British Railway Board. It is now a separately accountable company within the rail freight product portfolio.

IV. Railfreight

Railfreight is British Rail's specialist service to industry. It is specialist, particularly in moving materials in bulk between industrial and commercial areas within the UK. Today every rail-wagon movement is monitored by a real-time computerised information system called TOPS - Total Operations Processing System (British Railways Board). It enables rail staff to have

precise control of every wagon, locomotive and train movement. In London, the TOPS computer is connected through British Rail's own telecommunications network to all the Area Freight Centres. Most of these are located in marshalling yards and major traffic centres and are under the direct control of Area Managers. Information from the Area Freight Centres is fed into the central computer, covering such items as wagon-loading and movement; make-up, arrival and departure of trains. The data is processed instantaneously and is transmitted to other Area Freight Centres in the form of operating instructions or information. As the trains move, or wagons become loaded or unloaded, the information in the computer files is updated. All customers are given access to TOPS either directly by Telex, or through local Area Manager's Offices, Regional, Divisional or British Rail Headquarters (British Railways Board).

Railfreight can be moved by a single-customer (company) train or a multi-customer train. Single-customer trains account for 75% of British Rail's freight business. And 75% of this traffic starts from a company's own siding and runs into another company-owned siding at the destination. Obviously, movement on this scale requires investment both by British Rail and by the customer. In fact, many firms have planned their transport operations around rail, investing large sums of money in sidings,

loading and unloading facilities and specialised wagons. Multi-customer trains are designed for forwarding traffic in less than trainload quantities, but the convenience of a private siding and the capacity offered by rail are required. They are also used extensively by trainload customers, as it affords them the opportunity to obtain further use of their sidings and installations.

Under Section 8 of the 1974 Railways Act, any firm or local authority intending to send traffic by rail can apply for a Government grant of up to 50% of the cost of sidings, terminal facilities and wagons (Department of the Environment, 1975). After tax-relief, this can reduce capital commitments to 25% of the gross capital outlay. It should be noted that British Rail themselves are not eligible for a Section 8 grant but Freightliners have been since October 1982.

However, in order to make a grant, the Secretary of State has to be satisfied that there will be significant environmental benefits if rail is used, as compared with road, and that it will be commercially viable for British Rail.

However, there are some circumstances with existing plants where, for historical reasons, it is not possible

to make a direct rail connection. In other circumstances, it may be inappropriate for example, where distribution or collection is over a wide area, and a rail transshipment centre may well provide the answer. There are two basic kinds: a distribution centre for bulk materials (for example, coal, oil, aggregates, cement or steel) and a transshipment warehouse for general merchandise, for companies requiring a local road delivery. At the present time, private developers are showing a great deal of interest in creating complexes of rail- and road-served transshipment and warehousing facilities, strategically sited for best rail and trunk road access and for local distribution.

Speedlink is based on a network of direct timetabled trains, travelling between principal industrial and commercial centres. It is very useful for movement of wagon-loads of freight particularly over longer distances. The system can cope with a wide range of traffics, from bulk materials to general merchandise. Speedlink customers can also use TOPS to follow the progress of their freight.

The Red Star Parcel Services are timetabled so that you know accurately when your packages leave and when they arrive at their destination. It is basically a Monday to Friday service but there is a limited Saturday service

to certain destinations. Red Star is offered solely as a station to station service. But some customers may be unable to take their parcels to a station or require delivery after arrival at the destination. In either event, British Rail suggest that senders contact City Link Transport Services Ltd. City Link have developed a nationwide service specialising in collection and delivery to complement the Red Star service. By using Red Star and City Link, customers can obtain a same day collection and delivery service covering almost the whole country.

APPENDIX 3

DATA ANALYSIS

1 DATA ANALYSIS TECHNIQUES

The data has been analysed using the SPSS computer program package.

Initially frequency tables for each variable have been generated. This has been done in order to eliminate errors in the data as quickly as possible. Unexpected codes in a table may indicate errors in data entry or coding. Cases with values that are unusual but possibly correct could be identified also and the data then examined to ensure that the figure is correct.

1.1 Factor Analysis

There are three possible uses for factor analysis, of which the first is the most common:

- (1) exploratory - exploration and detection of the patterning of variables with a view to the discovery of new concepts and a possible reduction of data;
- (2) confirmatory - testing of hypotheses about the structuring of variables in terms of the expected number of significant factors and factor loadings;

and

(3) uses as a measuring device - the construction of indices to be used as new variables in later analysis.

Factor analysis assumes that the observed (measured) variables are linear combinations of some underlying source variables (factors) (Kim and Mueller, 1982).

Factor analysis consists of three main steps:

- (1) preparation of the correlation matrix;
- (2) extraction of the initial factors; and
- (3) rotation to a terminal solution.

The application of factor analysis involves several procedural problems. Some of the technical issues are concerned with the question of transforming the data, the type of method to be used in extracting the initial factors, the number of factors to be extracted and the type of rotation, if any, to be employed.

To determine the number of initial components to be selected for further analysis, it is possible to use various criteria - for example, it may be based on the Eigenvalue and/or the interpretability of a factor in determining the number of factors to be extracted. Each

factor should have an Eigenvalue of at least 1.0 (Kaiser's criterion), in other words, each factor should account for at least as much variance as one of the original variables.

In an orthogonal rotation, there is only one factor matrix but in an oblique rotation two factor matrices are delineated: a pattern matrix and a structure matrix. The pattern matrix has been found to be better for determining the clusters of variables defined by the oblique factors (Nader, 1981).

There is some debate as to the relative merits of the two types of rotation. In oblique rotation the best definition of the clusters of variables is sought, irrespective of whether the resulting dimensions (factors) are correlated or uncorrelated; whereas, in orthogonal rotation, the best definition is sought from among sets of uncorrelated dimensions. As Rummel (1970) states "the orthogonal rotation is a subcase of the oblique. If orthogonality empirically exists between the clusters of variables, then an oblique rotation will result in orthogonal dimensions". Thus, an oblique rotation describes more accurately the observed patterns of relationships among the variables. But orthogonal rotation is much simpler to understand and interpret and it can even be argued that (if for no other reason) it

may be preferred over oblique rotation (Kim and Mueller, 1982).

It should be noted that no method of rotation improves the degree of fit between the data and the factorial structure. Rotation is used in order to lead to possible "simplification" and therefore aid interpretation.

Rotation of the factors redistributes the variance of the variables across the set of rotated factors resulting in a simplified structure. This "simple structure" refers to changing the pattern of loadings so that each factor has a few high loadings and the rest of the loadings are as near to zero as possible.

The most common type of factor extraction procedure is the principal factors analysis. A salient feature of the principal factors procedure is that the first factor extracted is calculated to maximise the variance accounted for in the correlation matrix. Each succeeding factor is, in turn, extracted to maximise the residual variance explained. If the original communality estimates are 1.0, the principal factors procedure is referred to as a principal components analysis. When the initial communality estimates are less than 1.0, the same principal factors procedure is called a principal axis solution. Thus, the principal components procedure

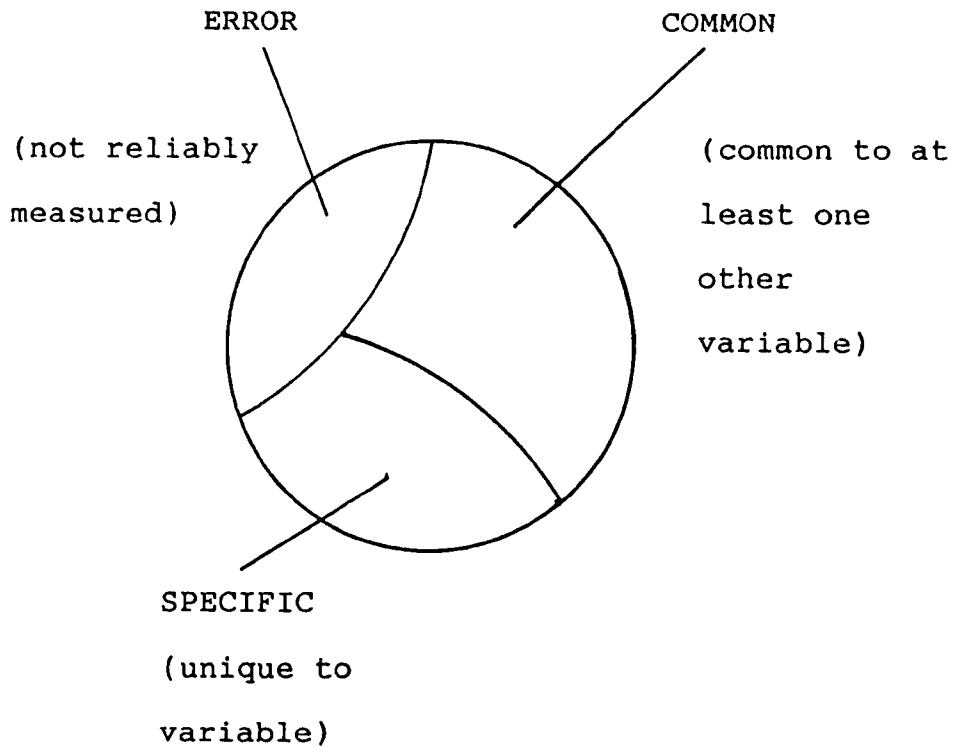
analyses all of the variance whereas the principal axis procedure analyses only the variance estimated to be common variance. Both of these procedures are descriptive and are used in exploratory research.

According to the common factor model, a variable can be thought of as containing common ($h[2]$), specific ($s[2]$) and error ($e[2]$) variance (Figure 1). Thus, the common factor model takes the following form:

$$1.0 = h[2] + s[2] + e[2]$$

Using the principal axis method, those factors which were dropped are believed to explain the specific and error components of the matrix.

Figure 1 Types of variance contained within a variable



2 SURVEY STATISTICS

2.1 Reasons for buying a particular vehicle

To facilitate statistical analysis, the record of each response must be scored. A rank ordering of 1 to 6 has been used, with the value of 1 always indicating "most significant". The resulting matrix is shown in Table 1.

Table 1 Weighted Frequency Distribution for each Attribute of Rank Orders Selected (*)

	1	2	3	4	5	6
A	66	82	47	34	7	0
B	21	19	70	48	56	11
C	5	0	1	50	77	97
D	136	49	46	6	5	0
E	1	71	62	71	31	1
F	13	20	11	23	49	121

where A represents price of vehicle

B " cost of ownership
 C " residual price
 D " reliability
 E " fuel consumption
 F " model availability

(*) The survey was based on verbal responses and consequently there are limitations of statistical inference. When descriptive data (nominal) is converted into numbers only certain calculations are permitted.

However, provided that one is willing to accept the higher level assumption that the difference between successive orders in the ranking are equal, then an

unweighted arithmetic mean can be calculated. The factors A to F have been ranked according to the mean and the lowest mean value gives the most significant factor and so on. For each factor, the mean is given by the score values divided by the number of scores and the results are shown in Table 2.

Table 2 Mean values of factors A to F

A	2.30
B	3.59
C	5.11
D	1.74
E	3.27
F	4.85

2.2 Attitudinal Findings

To facilitate the statistical analysis, the record of each response must be scored. A rank ordering of 1 to 5 has been used, with the value of 5 always indicating "very important" (Table 3). The mean of each attribute has been obtained and the highest value represents the most important attribute. The results are given in Table 4.

Table 3 Weighted Frequency of Subjective Response to the Various Attributes in the Attitude Section of the Questionnaire

	1	2	3	4	5
AT1	-	-	-	10	357
AT2	4	-	33	83	247
AT3	-	32	40	150	145
AT4	1	25	25	26	12
AT5	-	-	5	114	248
AT6	-	6	19	65	273
AT7	14	1	24	119	204
AT8	-	-	-	1	366
AT9	82	47	77	97	58
AT10	70	67	63	123	38
AT11	14	23	29	136	165
AT12	-	-	7	81	279
AT13	24	36	24	61	97

KEY: 1-very unimportant; 2-somewhat unimportant;
3-neither important nor unimportant;
4-somewhat important; 5-very important.
AT1-reliability; AT2-control over despatch;
AT3-minimum transport cost; AT4-level of inventory;
AT5-control over delivery time;
AT6-avoidance of damage to goods when in transit;
AT7-security of goods in transit;
AT8-service level to customer; AT9-length of haul;
AT10-size of consignment; AT11-transit time;
AT12-ready availability of transport;
AT13-regularity of shipment.

Table 4 Score and Mean Values of Attitudinal Attributes

Attribute	Score	Mean
AT1	1825	4.97
AT2	1670	4.55
AT3	1509	4.11
AT5	1711	4.66
AT6	1694	4.67
AT7	1584	4.38
AT8	1834	4.99
AT9	1085	3.01
AT10	1075	2.98
AT11	1516	4.13
AT12	1740	4.74

- KEY:
- AT1 - reliability;
 - AT2 - control over despatch;
 - AT3 - minimum transport cost;
 - AT5 - control over delivery time;
 - AT6 - avoidance of damage to goods when in transit;
 - AT7 - security of goods in transit;
 - AT8 - service level to customer;
 - AT9 - length of haul;
 - AT10 - size of consignment;
 - AT11 - transit time;
 - AT12 - ready availability of transport;

APPENDIX FOUR

QUESTIONNAIRE

GENERAL INFORMATION

Name of establishment: _____

Address of establishment: _____

Telephone number:

Name of interviewee:

Position held in company:-

- Managing Director 1
- Director 2
- Company Secretary 3
- Production Director 4
- General Manager 5
- Distribution Manager 6
- Transport Manager 7
- Other - please specify:- 8



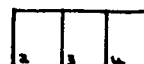
Interviewer: _____

Date: _____

Time Started: _____

Time Finished: _____

Serial Number of Establishment



Note for interviewer:-

Where answers are unknown enter "9"

Where the question is inappropriate leave answer blank

CURRENT STATUS OF THE FIRM

1. Does this firm run any other establishments besides this one?

Yes 1

No 2 go to 3

2. Please give details of the structure of the firm:-

Prompt:- Establishments, addresses, parent company, levels of control, products, size

3. Is this firm one of a group of companies?

Yes 1

No 2

If YES, please give details:-

4. Type of business 7
- | | |
|------------------------------|---|
| Manufacturing final products | 1 |
| Manufacturing components | 2 |
| Processing | 3 |
| Other - please specify:- | 4 |

5. What do you produce at this site? 8
- Product
-
-

6. Have any changes occurred in the product or type of production undertaken by this establishment? 9
- | | |
|-----|---|
| Yes | 1 |
| No | 2 |

7. Which of these descriptions best describes the operations of your establishment? (more than one can be used) 10
11
12
- | | |
|---------------------------------------------------|---|
| Production of units to requirements
(one-offs) | 1 |
| Production of small batches to requirements | 2 |
| Production of large batches | 3 |
| Continuous flow production | 4 |
| Mass production | 5 |
| Other:- | 6 |

8. Could you give an indication of the overall value of your output from this establishment last year?



0 - £100,000	1
£100,001 - £200,000	2
£200,001 - £300,000	3
£300,001 - £500,000	4
£500,001 - £750,000	5
£750,001 - £1 M	6
£1 M - £1.5 M	7
Over £1.5 M	8
Unknown	9

9. Of this sum, what proportion is attributable to the costs of transport?



EMPLOYMENT AND ORGANISATION OF THE FIRM

1. How many people on average did you employ at this establishment last year?

Full - Time		Part - Time	
male	female	male	female
- - -	- - -	- - -	- - -

2. Total employees:-



3. Could you give me brief details of the management structure of the firm?

Prompt:- Who is responsible to whom
Who controls what

4. How many organisational levels are there including the Managing Director and the production line workers?



1 level	1	
2 levels	2	
3 levels	3	
4 levels	4	
5 levels	5	
6 levels	6	
More than 6 levels	7	Specify number:-

5. The transport/distribution function falls into which organisational level (Identify level as in Question 4)

17

6. How many people are there in this firm who are purely concerned with transport/distribution?

18	19	20
----	----	----

7. Are the transport decisions taken solely by someone within this establishment?

21

Yes 1

No 2

If YES, please give position:- _____
and go to 9 _____

8. What is the position and location within the firm of the person with overall responsibility for transport?

Position: _____

Address: _____

9. If there is a transport manager to whom is he responsible? (Identify level as in Question 4) _____

22

10. Do any transport decisions require the approval of the Board or Managing Director?

23

Yes 1

No 2

If YES, please specify:-

11. Do you provide information to your superiors on transport expenditure?

24

Yes 1

No 2

12. How is the transport function seen within the firm? (More than one can be used)

25
26
27

As a clearly defined task 1

As an integral part of the firm's operations 2

As a profit-centre in its own right 3

Other:- _____ 4

3. Do you have any goods vehicles operating under 'O' licences from this establishment?

Yes 1 go to 5

No 2

4. Do you have access when required to a pool of suitable goods vehicles owned by the firm but operated from another establishment?

Yes 1

No 2 go to 6

If YES, what is the address of the pool?

5. How many goods vehicles requiring 'O' licences do you operate analysed by size and type?

Type of body	Gross vehicle weights (tonnes)							
	Up	7.5	13	16	20	24	30	Over
	to	to	to	to	to	to	to	
	7.5	13	16	20	24	30	32	32
Flat or sided								
Boxbody with special fittings								
Boxbody without special fittings								
Articulated								
Other:-								

37	38	
39	40	
41	42	
43	44	
45	46	
47	48	49

Total number:-

6. Do you operate any goods vehicles which do not require 'O' licences?

50

Yes 1

No 2

If YES, number of vehicles:-

51	52
----	----

7. As you have your own road fleet, do you have sufficient capacity to meet upward fluctuations in demand?

Yes 1

No 2

If NO, do you use public operators (either road or rail) to meet upward fluctuations in demand?

Yes 1

No 2

8. What advantages do you get from having your own vehicles rather than using a specialist haulier?

Please specify:-

9. Who is responsible for the purchase/disposal of your own vehicles? (Identify level as in Q4 of Employment and Organisation of the Firm)

Position:- _____

10. Do you buy your vehicles on the recommendation of a van or truck distributor?

57

Yes 1

No 2

11. Do you set your own specification for your vehicles and ask the distributor/manufacturer to build the vehicle to that specification?

58

Yes 1

No 2

12. Could you put the following reasons for buying a particular vehicle in order of their importance to you? (Most important = 1)

59	60	61
----	----	----

- A Price of vehicle
- B Cost of ownership
- C Residual price
- D Reliability
- E Fuel consumption
- F Model availability

13. Do you always employ the same public road hauliers?

Yes 1

No 2

If NO, what is the reason for this?

14. Are there any deficiencies in the road haulage service which matter to you?

Some 1

None 2

Please specify:- _____

15. Have you any formal contract with a haulier?

Yes 1

No 2

If YES, typically for what period?

16. Have you any informal arrangements with particular hauliers?

Yes 1

No 2

Please specify:-

17. Are you expecting to make more or less use of road haulage in the future?

More 1

Less 2

Same 3

If More, why?

If Less, why?

18. What is the weight of your consignments?

19. Are there any railway wagons at the disposal of this establishment which are owned or hired?

69

Yes 1

No 2

If YES, how many are owned or hired?

Number owned

70	71
72	73

Number hired

74	75	76	0	1
77	78			

20. Which British Rail Service do you use?

(More than one can be used)

- Freight Liners 1
- Red Star 2
- Speedlink 3
- Single customer train 4
- Multi customer train 5
- Other:- _____ 6
- Uncertain 7

1
2
3

21. Are there any deficiencies in the rail service
which matter to you?

Some 1

None 2

Please specify:-

22. Have you any formal contract with British
Rail?

Yes 1

No 2

If YES, typically for what period?

23. Are you expecting to make more or less use
of rail in the future?

More 1

Less 2

Same 3

If More, why?

If Less, why?

24. What is the weight of your consignments?

25. Have you any formal contract with the Post Office?

Yes 1

No 2

If YES, typically for what period?

26. What is the weight of your consignments?

27. Is the decision as to the mode of transport used made at this establishment?

Yes 1

No 2

28. Has any major change occurred in the last five years in the modes of transport that you use?

Yes 1

No 2

If YES, what was the nature of and reasons for this change?

29. Do you plan any major changes in the modes of transport used in the future?

Yes 1

No 2

If YES, what will be the nature of and reasons for this change?

30. Could you give me an indication of how much this establishment spends on transport/distribution per year?

0 - £5,000	1
£5,001 - £10,000	2
£10,001 - £25,000	3
£25,001 - £50,000	4
£50,001 - £75,000	5
£75,001 - £100,000	6
Over £100,000	7
Unknown	8

31. Has the firm invested in a particular mode of transport?

Yes 1

No 2

If YES, please specify: _____

Level of investment: _____

32. As a firm do you have a transport - distribution strategy?

Yes 1

No 2 go to 35

If YES, please give a brief outline of your transport/distribution strategy

33. How often do you review your transport/distribution strategy?

Continually 1

Monthly 2

Quarterly 3

Half Yearly 4

Annually 5

Irregularly 6

Never 7

34. Do you use computers to plan your transport/
distribution strategy?

Yes 1

No 2

35. Have you ever obtained information from
outside haulage firms, British Rail, Royal
Mail etc.?

Yes 1

No 2

36. Have you experienced difficulty in getting
information and quotations?

Yes 1

No 2

Please specify:- _____

37. Do you use the services of a Freight
Forwarder?

Yes 1

No 2

Please give details:-

LINKAGE PATTERNS AND PRODUCT CHARACTERISTICS

1. Where do you transport your product to from this establishment? (More than one can be used)

		%	%	%
		Value	Weight	Consignment
Parent Company	1			
Warehouse	2			
Wholesaler	3			
Customer direct	4			
Other:-	5			

V	W	C
25	26	27
28	29	30
31	32	33
34	35	36
37	38	39

2. Number of customers

40

3. Who bears the cost of transporting your product? (More than one can be used)

41	42
----	----

- This establishment 1
- Parent Company 2
- Customer 3
- Other, please specify:- 4

4. Do any customers specify a particular mode of transport?

43

Yes 1

No 2

If YES, give reasons:-

44

5. Could you tell me what proportion of your total sales are sold in the following areas?

Yorkshire and Humberside

South East

East Anglia

West Midlands

East Midlands

North - West

North

South - West

Wales

Scotland

Overseas

45
46
47
48
49
50
51
52
53
54
55

6. Does destination of product affect mode of transport used?

Yes 1

No 2

If YES, please explain:-

7. If a consignment is required more urgently than usual, does this affect mode of transport used?

Yes 1

No 2

If YES, how?

8. Does your product require any special handling facilities?

Yes 1

No 2

If YES, give details:-

ATTITUDES

When considering the transport of your product how important to you are the following features. Place a tick in the column you think most appropriate.

	Very Unimportant	Somewhat Unimportant	Neither Important Nor Unimportant	Somewhat Important	Very Important
1. Service to customer					
2. Minimum length of haul					
3. Optimum size of consignment					
4. Minimum transit time					
5. Ready availability of transport when required					
6. Regularity of shipment					
7. Reliability					
8. Control over despatch					
9. Minimum transport cost					
10. Optimum level of inventory					
11. Control over delivery time					
12. Avoidance of damage to goods in transit					
13. Security of goods in transit					

ATTITUDES

When considering the transport of your product how important to you are the following features. Place a tick in the column you think most appropriate.

	Very Unimportant	Somewhat Unimportant	Neither Important Nor Unimportant	Somewhat Important	Very Important
1. Reliability					
2. Control over despatch					
3. Minimum transport cost					
4. Optimum level of inventory					
5. Control over delivery time					
6. Avoidance of damage to goods in transit					
7. Security of goods in transit					
8. Service to customer					
9. Minimum length of haul					
10. Optimum size of consignment					
11. Minimum transit time					
12. Ready availability of transport when required					
13. Regularity of shipment					

PERSON RESPONSIBLE FOR TRANSPORT DECISIONS/
OPERATIONS

1. Title of person: _____

2. Years with the company?

0 - 4.9	1
5 - 9.9	2
10 - 19.9	3
20 - 29.9	4
30 - 39.9	5
40 and over	6

3. Did you have any post-school education?

None	1
College	2
University/Polytechnic	3

4. Have you undertaken any formal education
in transport/distribution?

Short Course	1
Diploma Course	2
Degree Course	3
CIT Examinations	4
Other:- _____	5
None	6

5. Do you have membership of any of the following? (More than one can be used)

- | | |
|---------------------------------------|---|
| Institute of Road Transport Engineers | 1 |
| Chartered Institute of Transport | 2 |
| Institute of Transport Managers | 3 |
| Other:- _____ | 4 |
| None | 5 |

6. Have any of your previous jobs given you experience in transport?

- | | | |
|-----|---|---------|
| Yes | 1 | |
| No | 2 | If YES, |

Industry (SIC) _____
Years experience _____

7. What level of responsibility do you have?

- | | |
|-------------------------|---|
| Manage | 1 |
| Manage and account | 2 |
| Other, please specify:- | 3 |
- _____

8. Do you have any knowledge of alternative modes of transport?

Yes 1

No 2 Please specify:-

Prompt:- Charges; reliability; propensity to damage product; recent look at options; acceptance of status quo.

9. Do you experience any constraints on freedom to choose mode of transport?

Yes 1

No 2

Do not know 9

If YES, please specify:

Prompt:- company customer requirements, detailed knowledge of alternatives, volume.

71	72	73	0	2
----	----	----	---	---

THANKYOU FOR YOUR CO-OPERATION