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PHYSICAL DISTRIBUTION IN SOUTH AFRICA : A REVIEW AND A SYSTEM DESIGN FOR HANGING TEXTILE MERCHANDISE

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Submitted to the University of Cape Town
in partial fulfilment of the requirements
for the degree of Master of Science in Engineering

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ABSTRACT

The subject of physical distribution was first examined in the early 1900s. It was developed and refined especially during World II under the name of 'Logistics', and began to be adopted in the field of business from the 1950s. From the 1960s onwards, national bodies have been established, both in the U.S. and the U.K., and works and theories have been published leading to the establishment of journals and the establishment of formal education programmes all dealing with physical distribution.

A review of published works on the subject was undertaken. Some books were studied, as well as a number of journal articles dating from the early 1970s. No suitable references were obtained dealing with the subject in a South African context. A project was also carried out to design a system for distributing garments in a hanging mode. The thesis thus concerns a general review of physical distribution management and the distribution of goods and services throughout business and industry, with an emphasis being placed on South African conditions.

The principal objectives of this study were to examine and review the state-of-the-art of the general theory and the use of physical distribution, to suggest means of applying it in South Africa and to briefly examine future trends and developments. These objectives were achieved by examining from books and articles the concept and theory of distribution, its interrelationships with aspects such as marketing, production and business organisations, and its management in business organisations; by discussing some characteristics of South African business and industry; by examining certain areas that provide the greatest potential for improvements; by discussing a project carried out to design a distribution system for hanging garments merchandise; and by examining future trends both overseas and in South Africa.

Physical distribution is shown to be an important subject for business and society and for the economy as a whole. It is always changing in a dynamic environment and requires constant monitoring. This thesis shows how this field, which has been researched and developed overseas, is affected by local conditions and should be applied to specific areas in South Africa.

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CHAPTER ONE

INTRODUCTION

The subject of physical distribution can be called a relatively new one. Recent emphasis has been placed on it by business organisations,this coming after the 'Marketing Revolution' of the 1960s and the attention placed on the strategic management of financial resource. This text will attempt to show its importance and the potential benefits it offers to organisations that have neglected this function in the past.

Most authors reviewed agree that physical distribution is an area of potential cost savings that has not been fully utilised to date. It is also very much related to industrial engineering in such matters as the running of warehouses and transport fleets, and in the use of materials handling equipment and computerised systems. Physical distribution should be seen as a function that provides the means of practically implementing management plans and tactics in following the strategic direction or thrust of any particular business organisation.

1.1 THE SUBJECT OF PHYSICAL DISTRIBUTION

1.1.1 Terminology and Definition

The terminology that has been used to describe the process called 'distribution' has been very varied. Some of the terms that have been used by various authors over time have been: physical distribution, physical distribution systems, physical distribution management, distribution, distribution engineering, materials management, rhocrematics, logistics, logistics management, marketing logistics, distribution logistics or industrial logistics. However, the term 'Physical Distribution Management' has been generally

preferred, or 'physical distribution' in its abbreviated form, and has been used in this text.

This is the term that seems to have been the most used by various authors, and the one that is used by two national bodies: the 'National Council for Physical Distribution Management' (NCPDM) in the U.S.; and the 'Institute for Physical Distribution Management' in the U.K. The NCPDM's definition of the subject is:

> "Physical distribution management is the term describing the integration of two or more activities for the purpose of planning, implementing and controlling the efficient flow of raw materials, in-process inventory and finished goods from point-of-origin to point-of-consumption. These activities may include, but are not limited to, customer service, demand forecasting, distribution communications, inventory control, materials handling, order processing, parts and service support, plant and warehouse site selection, procurement, packaging, return goods handling, salvage and scrap disposal, traffic and transportation, and warehousing and storage."

1.1.2 Importance of Own Definition

Although a definitive definition is given above on physical distribution, it does necessarily apply to all cases. Each organsation should have its own, unique definition of physical distribution. The concept and theory of physical distribution will be discussed in Chapter 2, and its management in Chapter 3. These should be used to define physical distribution: its role in the particular company, i.e. the level of its management in the company's hierarchy; and its scope, the particular business functions and activities over which it will have authority.

Campbell(1) points out that physical distribution has evolved from traffic management and traditionally has had a marketing orientation. He also points out that the definitions of physical distribution overlap between various claimants: the American Production and Inventory Control Society views physical distribution as including the flow of goods from manufacturer to customer; while the International Materials Management Society defines it as a set of management techniques ranging from raw material procurement through to final customer delivery. He argues that there is no single correct definition, but that each organisation should have a unique definition, emphasising: "The key message in our definition of logistics is the importance of flows among functional activities of an organisation."

1.1.3 A Brief History of Physical Distribution

Lambert and Stock(2) describe in brief the emergence of the subject in America. Physical distribution was first written about in the early 1900s. John F. Crowell published a government report entitled 'Report of the industrial Commission on the Distribution of Farm Products' in the U.S. in 1901. Around the 1920s, distribution started being described in a business context, with the term 'physical distribution' first used in 1929 in a text by Ralph Borsodi: 'The Distribution Age' printed in New York.

Physical distribution was then further refined and developed during the World War II years by the military, where it was termed 'logistics'. The 1950s saw the emergence of the 'marketing concept' and it was also during these years that the concept of total cost analyses was introduced. In 1961 the first text on physical distribution management was written by Smykay, Bowersox and Mossman: "Physical Distribution Management". The NCPDM was established in 1963, and since then there has been much literature, research and work carried out concerning the subject. Formal education programmes were also instituted at Michigan and Ohio State Universities in the early 1960s, and since

then have been expanding both at college and university level and as continuing education programmes.

1.2 REASONS FOR STUDYING PHYSICAL DISTRIBUTION

1.2.1 Some Statistics Related to Distribution

The field of distribution and its related activities is an important one both for business and industry, and for society as a whole. In the United States, Lambert and Stock (2) report that a 1978 study showed that manufacturing contributed about 50% to GNP, while distribution and related activities contributed over 20%. In 1980, distribution provided jobs for about 14% of their total labour force. The transportation industry alone in the U.S. consumes: 75% of all the rubber produced, 67% of all lead, 53% of all petroleum, 36% of all zinc, 28% of all steel, 22% of all aluminium, 17% of all cement and 15% of all the copper produced. Ball reported in a 1980 study that in the U.K., the storage and movement of products from plants to markets was estimated to cost between 12 000m and 15 000m annually, including inventory carrying and order processing costs. He also gives the costs of stockholding and distribution activities as in figures 1.1 and 1.2 below (3, tables 2, 3 and 4).

Physical distribution activity	% of total physical distribution costs
Transport	35
Order processing and related administrative activities	20
Carrying costs, taxes insurance, etc.	20
Warehousing (factories and depots)	15
Other	10
	100

Fig. 1.1 : Physical distribution activity costs

	Industrial stockholdings as a % of total capital employed
Country	
U.S.A.	24
Sweden	25
France	28,5
Germany	28,5
U.K.	45
U.K. Industry	
Oil	13
Paper and packaging	21
Textiles	42
Brewing, distillery and wine	54
Motor, aircraft and engines	61
Tobacco	66

Fig. 1.2 : Industrial stockholding by country and by industry in the U.K.

1.2.2 The Importance of Physical Distribution to Companies

Physical distribution has become an important area to be reviewed by companies. This is due to: the proliferation of products; advances in computer technology and quantitative techniques; the application of mathematical techniques for solving business problems; the development of a systems approach and a total cost analysis concept in management; the recognition of physical distribution's role in the firm's customer service programme; the erosion of many firm's profits resulting in their examining areas where cost savings might be realised; and the profit leverage resulting from increased distribution efficiency. These were all listed by Lambert and Stock(2). Sharman(4) lists some other reasons such as: the contraction of many products' life cycles, which can lead to obsolete stocks; the balance of power in the distribution chain shifting away from manufacturers in many instances to the trade; the decline of the value added by manufacturing as costs of materials and distribution climb; and the present-day capabilities of low-cost, high-volume data processing. The overriding reason for business organisations paying attention to distribution, though, can be summarised in the argument put forward by Weeks,(5) that a poor distribution network can add enormously to operating expenses, can effectively destroy carefully planned marketing and inventory strategies, and is often sluggish, unresponsive and resistant to rapid environmental changes. It has thus been regarded as useful and necessary to review the field of physical distribution and all that it entails, its application to business and industry in general and to South Africa in particular, and to note the recent developments in the subject.

1.2.3 The Origin of This Study

This study was initiated by a project involving physical distribution systems and related activities that was undertaken by Woolworths, a large and nationwide retailing group in South Africa. They wished to review and modify the

distribution system, to their retail stores, of their textile merchandise. This was done for various quality and financial reasons, and to keep up with recent overseas trends of distributing textile apparel and garment merchandise in a hanging form. The Woolworths project is included as a case study in Chapter 6 of this text. This project started a review and study of general aspects of physical distribution to determine the state-of-the-art in various countries, especially the U.S. and U.K. The results of this study were then collated and placed in a South African context to form the basis of this text.

1.2.4 Aims of the Report

The basic objectives of the project at Woolworths were to study possible distribution systems, to examine the feasibility of a hanging garments distribution and to recommend a system for carrying this out. This led to the compilation of this report, and its specific aims are:

a) To create an awareness of physical distribution management, and to publicise its complexity, usefulness and importance.

b) To provide information and guidelines on the concept of physical distribution and its practical application by business organisations.

c) To suggest potential sources of improvements in certain areas that are sometimes neglected or taken for granted.

d) To examine South African characteristics governing the application and operation of physical distribution in this country.

e) To illustrate, by way of an example case study, a practical application of the concept and theory of physical distribution.

f) To briefly examine trends and developments in physical distribution in order to attempt to determine the general direction that will be taken by future operations.

1.2.5 Scope of Study

Physical Distribution has traditionally been viewed as simply the transportation of finished goods. However, because physical distribution is viewed as a total system and the concept covers many fields of activity, some other areas were examined in this study that are not traditionally associated with physical distribution. Examples of these are warehousing, transportation, customer service and order-processing. Each, however, was examined in the context of its application to physical distribution. The detailed management and running of the operations of these various areas were thus not covered. For example, inventory holding was discussed without considering various inventory models, and the transportation function was discussed without examining means for the routing and scheduling of vehicles. Much other information and literature is available on the operational management of all the component activities making up physical distribution. However, the danger of suboptimising the total distribution function by the selected optimisation of certain individual activities will be pointed out and stressed. Issues dealing with finance and capital were also not dealt with, other than to point out some distribution cost aspects. Distribution activities from the U.S. and the U.K. were almost exclusively examined. Both of these countries are important sources of supply of literature, studies, work and research and development in the field of physical distribution.

1.2.6 Its Relation to Engineering

The entire subject of distribution has important implications for all aspects of trade, and in particular most of the related activities require some form of engineering support in the form of: materials handling

equipment; storage and transportation equipment; vehicle fleets; computerised data and information processing; plant and warehouse design, layout and building; and packaging materials, machinery and equipment. In addition to these, other specific areas of interest to industrial engineers include: inventory control and management; plant and warehouse site selection and layout planning; materials handling system and equipment; the control of waste and recyclable materials; transportation and shipment methods, routing and scheduling; and safety and security considerations.

1.2.7 Layout of the Report

The subject of physical distribution in this report begins with a discussion in Chapter 2 of the concept and theory of physical distribution. The total concept is discussed, and so is the relation between physical distribution and a number of other business activities such as marketing, customer service, production and the organisation itself. Chapter 3 examines aspects of managing and controlling existing distribution activities, such as information requirements and performance monitoring. Chapter 4 then places physical distribution in a South African context by examining the characteristics of local business operations, aspects of South African markets and the transportation sector. Chapter 5 then examines potential improvement areas. Areas discussed include warehousing and materials handling, inventory management, transportation management and customer service. The Woolworths project is then highlighted in Chapter 6 as a case study. Finally, Chapter 7 concludes the study with a look at the future. Trends and developments are examined, both for overseas and South African operations, and some concluding comments are made on the implementation of physical distribution management.

CHAPTER TWO

PHYSICAL DISTRIBUTION - CONCEPT AND THEORY

An in-depth discussion is given in this chapter on the importance of physical distribution in a modern business organisation. Section 2.1 is on the total distribution concept and describes how distribution should be seen as a total system of materials flow, from the supply of raw materials to the consumption of the finished product. This concept encompasses all organisation involved in the supply, conversion, handling, retail and consumption of the goods or services. It also describes how a systems view has important implications for the management and organisation of any single firm.

Sections 2.2 and 2.3 focus on the effect that marketing has on the distribution process, and on the goal that both are trying to achieve: a desired level of customer service. The concept of marketing channels is discussed to show how this is put into practice by the distribution function of an organisation. The effect on physical distribution of changing the product mix is noted, and the varying support that a product requires from distribution during its life cycle is also highlighted. A short note is included on the necessary criteria for measuring service levels and performance, and on the definition of customer service.

A comment is made in section 2.4 on the interface between distribution and the production function and on certain decisions that have to be considered jointly. Particular reference is made to production scheduling. The implications to the distribution process of an organisation using MRP and/or JIT production methods are emphasised.

The final two sections of this chapter, 2.5 and 2.6 include a list of all the activities that are included in physical distribution management, as well as the role and importance

that physical distribution should assume in modern corporate organisations.

2.1 THE TOTAL DISTRIBUTION CONCEPT

2.1.1 Adopting a Total Systems View

Physical distribution is seen as being a total system of materials flow: from the acquisition of raw materials to the delivery of the end product to an end user. It does not only concern the transportation of finished goods. The emphasis of the total approach to physical distribution is primarily directed at the reduction of costs, but it must not be forgotten that it also has a revenue-generating function. The influence of distribution service on both costs and revenues must be seen.

Systems theory and the total view of physical distribution requires that emphasis is placed on all members or agents in the distribution process, including raw material suppliers, producers and consumers. Pearson(6) points out that a product is not simply distributed through intermediaries and retailers, to consumers. He describes the distribution concept as: "... a series of related transferences through different institutions involving not only the physical possession of the product, but also the ordering, ownership, financing, risking, promotion and payment."

This total approach to distribution, however, need not necessarily apply only to consumer goods. The theory can also be used by manufacturers of other goods and by providers of services. The concepts of physical distribution management still apply, provided that each organisation defines its own 'raw materials, products and customers'. For example, even organisations that 'distribute' electricity on a national basis, such as CEGB

in Britain and Escom in South Africa, can define coal as a 'raw material', the generation of electricity in power stations as a 'production process', the establishment of grid and reticulation networks as investments in 'warehousing and transportation', the electricity itself as the 'product' to be marketed and sold, and industry and other consumers as various classes of 'customers'. The total distribution system in this case is dealing with energy in its various forms, and one of its objectives may be to distribute a certain amount over a certain area as cheaply as possible. Another may be to conserve energy by minimising losses and wastage.

2.1.2 The Implications of a Total Systems Concept

Taking a total systems view requires that all component activities included in distribution be treated as interrelated and interdependent. The effect of any particular action in one area on the entire system must be considered. Hopkins, as quoted by Christopher(7), has identified a number of important implications inherent in accepting any total systems approach:

a) The whole is primary and the parts are secondary.

b) Integration is the condition of the inter-relatedness of the many parts within one.

c) The parts so constitute an indissoluble whole that no part can be affected without affecting all other parts.

d) Parts play their role in the light of the purpose for which the whole exists.

e) The nature of the part and its functions is derived from its position in the whole, and its behaviour is regulated by the whole to part relationship.

f) The whole is any system or complex or configuration of energy and behaves like a single piece no matter how complex.

g) Everything should start with the whole as a premise and parts and their relationship should evolve.

This clearly means that all functions and activities included in physical distribution should be identified and managed in order to satisfy overall distribution objectives. This view is compatible with recent management attitudes of a firm being a complex system of multiple activities - a corporation with emphasis placed on total, overall corporate results. Understanding distribution, therefore, requires a macro overview rather than a micro one. And when comparing alternative distribution systems, the effectiveness and costs of the total systems must be compared, rather than the efficiencies of the individual component functions.

2.1.3 Interface with Other Business Functions

Integrating distribution activities into a single system often means cutting across traditional organisational, functional and departmental boundaries. Traditionally, management decisions have not been carried out in an interdependent way. Very often, decisions are taken that improve the performance of a particular department successfully, but which may be detrimental to the overall system. Included in companies are also many activities, such as production, which are not normally associated with distribution, but which cannot be treated as unrelated components.

Christopher and Wills(8) suggest: "It is useful to view Physical Distribution Management as the bridge between production and marketing", where the role of production is to create goods and the role of marketing is to create customers. Physical Distribution management is concerned

with integrating the sets of activities comprising the distribution system, by trading-off alternative possibilities in one area with alternatives in another. The ultimate objective of physical distribution management is product availability: managing distribution with regard to total cost and customer service implication. This may be achieved by either:

a) Providing the least total cost distribution system for a pre-determined customer service level, or

b) Providing the highest possible level of customer service within given costs.

The interface between physical distribution and marketing is discussed in more detail in section 2.2, and that between distribution and production in section 2.4.

2.1.4 Analysing Total Systems Costs to Avoid Suboptimisation

Managing physical distribution requires an ongoing analysis of the total system's costs. Management should strive to reduce total costs, and realise that attempts to reduce the cost of individual activities may be suboptimal and could lead to increases in the total costs. Gattorna(9, Ch.1), Sharman(4) and Christopher(7), amongst others, all warn about the dangers of suboptimisation, and advocate the successful identification of trade-offs between value and cost as being the key to physical distribution management. Gattorna(9, Ch.1) identifies four levels of trade-offs:

a) Intra-element. These are trade-offs between alternatives that remain within the individual component activities or elements of the distribution system. An example would be a cost-value trade-off between the use of an owned fleet or a contracted carrier to carry out the transportation activity.

b) Intra-functional. These occur between various elements of a business function such as distribution. An example would be the decision to either increase the number of depots, or alternatively to change transportation modes, in order to improve the distribution function.

c) Inter-functional. These are trade-offs between distribution and the firm's other corporate functions. For example, these would occur between distribution and production, finance and marketing.

d) Inter-organisational. These occur between the firm and other external business organisation. Examples are between manufacturers and retailers. These trade-offs also involve service companies, such as trade-offs between manufacturers and transporters.

An example is given in Fig. 2.1 of an intra-functional trade-off between depot costs and transport and stock-out costs(7).

2.1.5 Materials Managements

Another important aspect of distribution management is the materials management activity. Materials management covers the administration and control of raw materials and work-in-progress or in-process inventory. Materials management has no direct link with final customers, but the availability and reliability of its inputs will determine the ultimate availability of products to customers. Lambert and Stock(2) have identified four basic activities that comprise materials management:

a) Anticipating materials requirements,

b) Sourcing and obtaining materials,

c) Introducing materials into the organisation, and

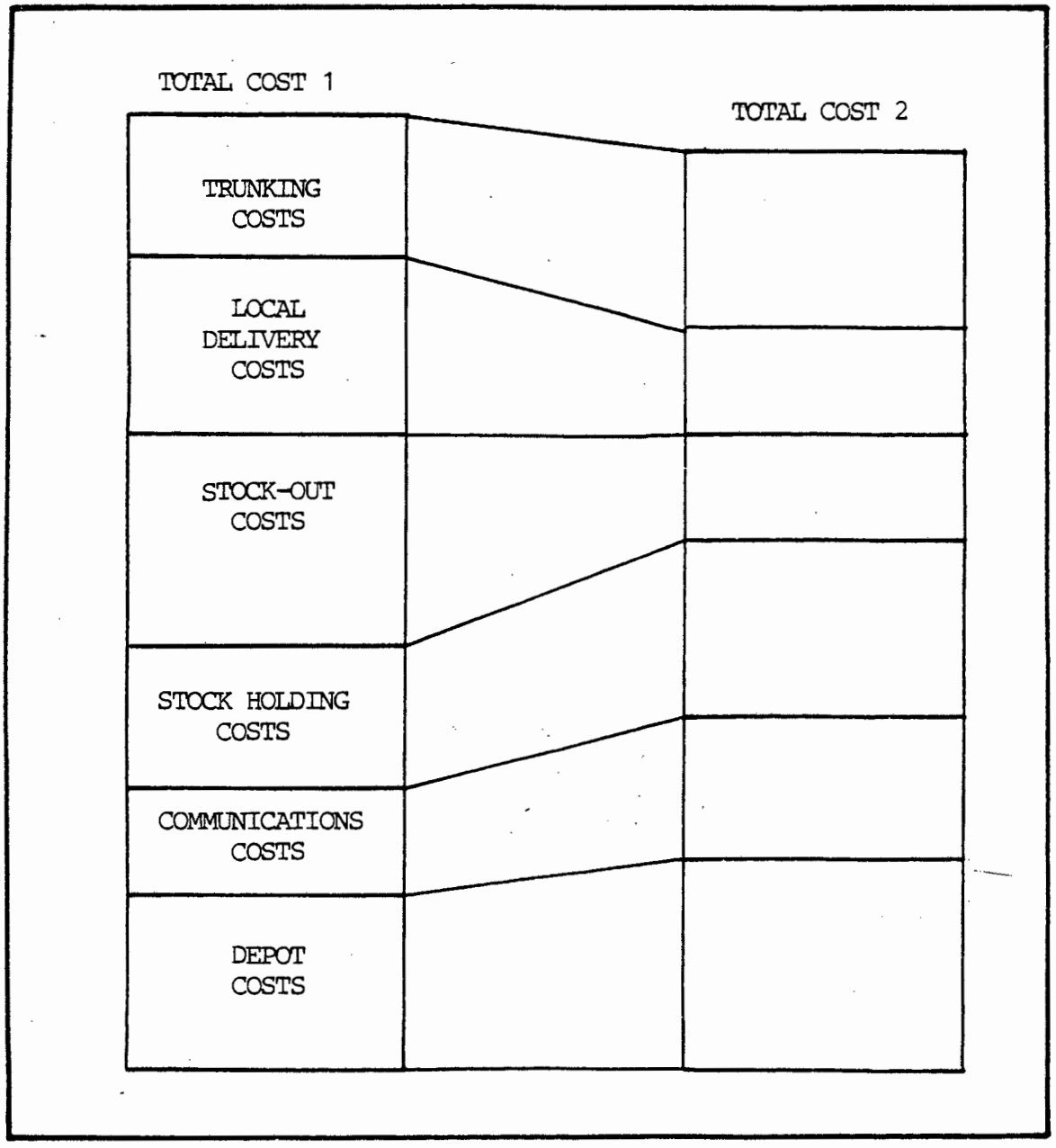


Figure 2.1 : Example of an intra-functional trade-off

d) Monitoring the status of materials as a current asset.

This means that materials management is also concerned with, and directly involved in many functional areas, most of which are also covered by finished-goods distribution. These include: inventory control, warehousing, storage, order processing, transportation, production planning,

product design, facilities planning and the maintenance of plant and machinery. The essential difference from finished-goods distribution is that materials management is concerned with the inputs of raw materials, component parts and subassemblies, for receipt by production or manufacturing in order to supply marketing and sales with products. Slater(10) describes the materials management task as one of integrating external suppliers and internal departments in order to provide a smooth product flow process. He also identifies that a large proportion of the costs within materials management are those payable to third parties, such as suppliers, transporters and customs duties. This is entirely compatible with the total systems view where each organisation is a unit in the distribution system of a product. It is immaterial whether the organisation sees itself as the central pivot of the system with all its inputs and outputs, or whether it considers its role as integrated within the system. In either case, distribution is the total system of material flow from raw material acquisition to the final consumption of the end product.

2.2 MARKETING EFFECT ON PHYSICAL DISTRIBUTION

The total distribution concept discussed above emphasises that distribution should be incorporated in the overall corporate objectives. Marketing is normally a very important facet of corporate strategies and in many ways guides the distribution function. Without attempting to define or analyse the various aspects of marketing, the influence that this activity exerts over distribution is extremely important and must be recognised.

2.2.1 Marketing Objectives Govern Distribution Strategies

One of the primary aims of marketing is to create product demand, while distribution must service or fulfill that demand. In this sense, distribution is a marketing tool.

Distribution must be used as a means of achieving certain desired marketing objectives such as maintaining the required customer service levels, servicing the chosen distribution channels, achieving the required geographic distribution coverage and supplying the promotional activities to achieve the desired market segments penetration. Distribution exposes the products or services to the chosen markets. It is therefore important to clearly define marketing objectives first, in order to plan, develop and implement a distribution strategy. However, once again referring to the total concept, definitive marketing objectives should not be set without considering the impact on the distribution process. A cost - value trade-off analysis is required to balance the value obtainable from a marketing objective with the distribution costs necessary to achieve it.

However, a distribution system must be designed and chosen carefully to suit the chosen competitive strategy. Sir Daniel Pettit(11) maintains that: "The planning of marketing and the organisation of physical distribution are intimately connected." When considering steps such as product development, succession and diversification, he says: "It becomes necessary to plan distribution so as to minimise costs and disruption and to maintain service levels as the diversification or changeover takes place." Shapiro(12) also describes an innovation-based strategy as entailing rapid product changes, uncertainty about volumes, low density of demand and possible shifts in customer preferences. These characteristics require a distribution system that maintains flexibility in supplier contacts, since raw materials specifications may change, and low levels of inventory must be kept to minimise obsolescence.

2.2.2 Marketing Concepts Affecting Distribution

A role of marketing in the firm is to seek to provide customer service and satisfaction. A proposed definition of customer satisfaction is: purchasing a favoured brand, at a

preferred place, when the need is strongest(13). The implication of that statement is that distribution is required to provide the article at the desired place in order to satisfy the customers and achieve a sale. A related concept in marketing is that products have utility value which should be maximised. The product itself has 'form' utility, distribution gives it 'time and place' utility and marketing gives it 'possession' utility. Lambert and Stock(2) describe possession utility as: "... the value added to a product by allowing the customer to take ownership of the item ... and provides a culmination to the distribution process."

Although marketing is not solely concerned with distribution, the four traditional elements of the Marketing Mix are all affected to a certain degree by the distribution process:

a) Product: the specific product characteristics and attributes will affect certain aspects of distribution such as materials handling and transportation, as well as demand. Also, product quality, built into it by Production, must not be reduced by the distribution process.

b) Price: the price of a product will depend to some extent on the cost of the distribution channel used.

c) Promotion: the amount of sales support required by the product also depends on the chosen distribution channel. For example, food sales through retailers require the availability of local stocks on the shelves, while certain motor car dealers only maintain display stocks.

d) Place: this is an output of the physical distribution process and is a customer service variable.

2.2.3 Area of Interaction Between Marketing and Distribution

Lambert, as quoted in Lambert and Stock(2), has shown the interactions and cost trade-offs between distribution and marketing as in Fig. 2.2 overleaf.

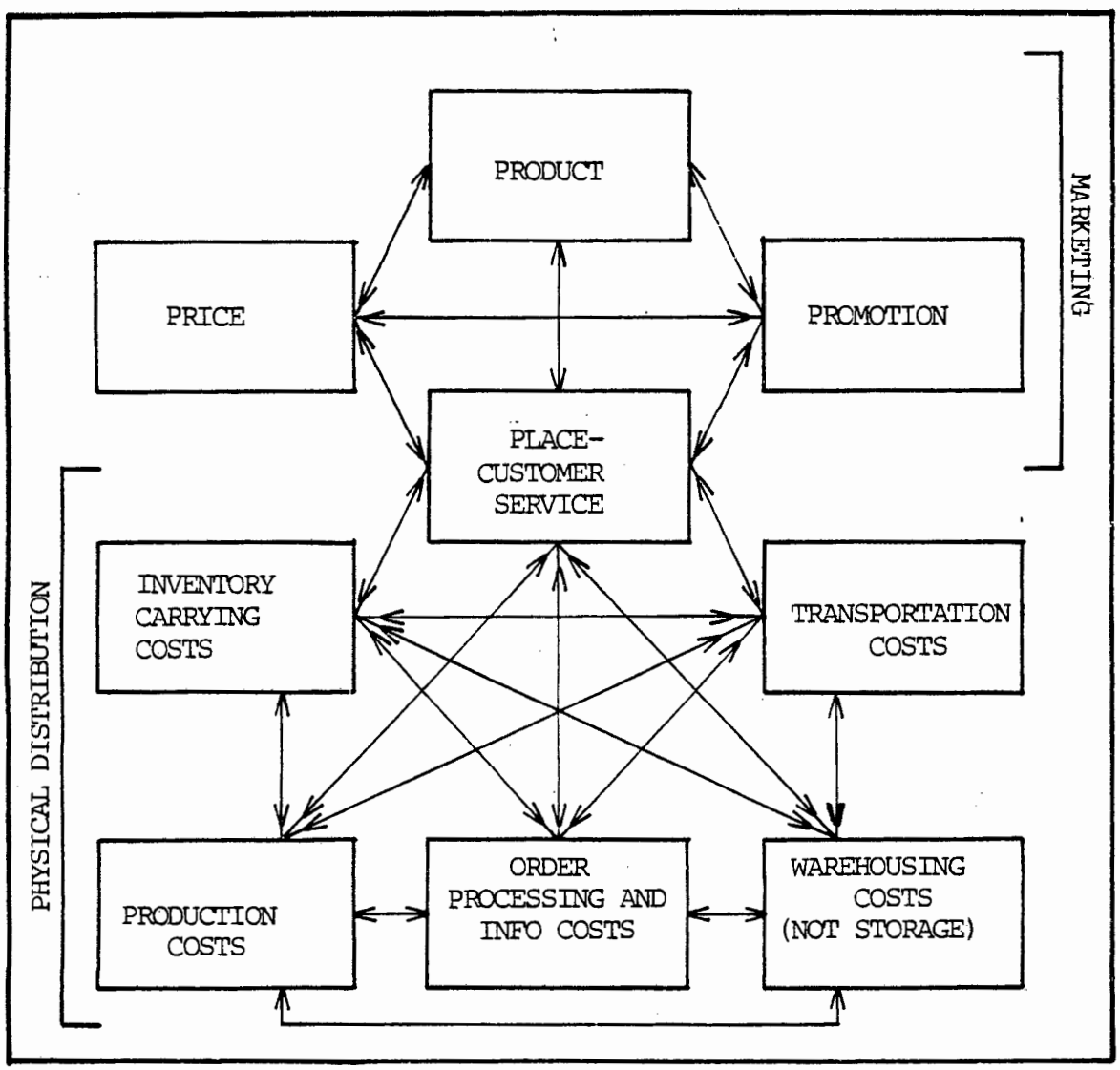


Figure 2.2 : Interactions and cost trade-offs in physical distribution

Another aspect of marketing, that of generating sales, can also be greatly influenced by the performance of the distribution process. Murdoch(14) highlights the importance of distribution on sales and advocates using a concept that he calls the 'Distribution Pipeline': "The objective of any retailer ... is to ensure that supply of product is always available on the shelf for his customers. He does not want 'out of stocks' as this is clearly opportunity lost and both sales/square foot and customer satisfaction will suffer. At the other end of this pipeline, the supplier, having made it attractive for the retailer to place his product on the market, will not wish to see his allocated shelf space vacant - producing loss of sales and maybe defection to a competitive product as a substitute."

It can thus be seen that there must be a very strong interaction between marketing and distribution. Ball(3) describes: "Customers are demanding an increasing variety of models, styles, colours, packages and price variations in the goods they buy ... the revolution in the marketing of consumer goods has carried over into the distribution of industrial goods. Pressure for lower prices has forced the development of new, more direct, and more efficient channels of distribution." Gattorna(9, Ch.2) lists nine areas of interaction between the marketing and distribution functions: product design, pricing, market and sales forecasts, customer service policies, number and locations of warehouses, inventory policies, order processing, distribution channels and trade practises. And Lambert and Stock(15) suggest that: "Markets can be classified by service levels on the basis of profitability, geography or lines of trade." It is thus necessary to decide on the specific target market segments of an organisation. Next, the variables and characteristics upon which marketing will concentrate must be chosen. All of these activities must be carried out in conjunction with distribution management so that distribution channels can then be chosen that are compatible with these objectives. It is also a marketing

task to identify changes in consumer demands, and to consider possible changes in distribution requirements and corporate strategy.

2.2.4 Distribution Channels

Another important area of interaction between marketing and distribution, that depends both on marketing aims and objectives as well as on distribution capability, is the choice of distribution channels. Distribution channels are also often called 'Marketing channels'. Some authors differentiate between the two terms, meaning that distribution channels are concerned with the physical facilities required for the flow of goods and services, while marketing channels involve the physical facilities as well as institutional or retail aspects of the distribution channels. The use of either term, interchangeably, both having the same meaning to indicate the latter, broader concept, is preferred here in view of the total, integrated system context. As described by Lambert and Stock(2), it must be realised that: "... distribution channels and the process of physical distribution are interdependent marketing activities which, when combined into one system, culminate in a satisfied customer."

Rosenbloom, as quoted by Lambert and Stock(2, Ch.1), defines a channel of distribution or marketing channel as: "The set of all firms and individuals that co-operate to produce, distribute and consume the particular good or service of a particular producer." These elements of a distribution channel often also perform a number of other vital functions, including: merchandising, selling, transporting, storing, grading, financing, credit controlling, risk bearing, advertising and providing information and product service.

Distribution channels must not be regarded as being too simplistic: an example is the prescription drug industry. Here it is neither the manufacturer, nor the retailer, nor

the customer who influence a sale, but only the physician. Marketing should thus be aimed at him, and he must be part of the distribution channel even though he is not involved in handling the physical flow of goods. It is often useful to consider the consumer and analyse the who, what, where, when, how and why of the buying decision. A similar analysis of retailers' behaviour, as well as all other channel members, leads to an understanding of the entire channel.

It must also be remembered that each element or member of a distribution channel is an organisation in its own right. It will have its own aims and objectives as well as its own perspective of the channel: manufacturers strive to sell their products through wholesalers and retailers to consumers. Retailers, out of loyalty to their customers, attempt to buy the best possible merchandise through wholesalers. There is often also one or other powerful organisation that will have a dominant position, and that will use its leverage to run the channel for its own maximum benefit. This could be the manufacturer, the retailer, or any of the intermediaries. However, no one organisation can manage a channel by itself. Necessary considerations must include the economic climate, environmental conditions, other channel members and competitors as well as legal and regulatory constraints. It must be remembered as Mallen, quoted in Pearson(6), explains: "All members have a common interest in selling the product; only in the division of total channel profits are they in conflict."

When choosing a distribution channel, Ratnatunga(16) points out: "Identify several major channel alternatives for reaching the market. ... Each alternative will produce a different level of sales and costs. The better system is not the one producing the greater sales, or the one producing the lesser costs, but rather the one that produces the best profits."

2.2.5 The Effect of Product Mix on Distribution

The introduction of a new product to a firm's product mix can also greatly affect the physical distribution process. Before introduction, consideration should be given to the support the new product will require from such distribution activities as: transportation modes and methods, inventory levels and location, and warehousing and materials handling equipment capacities and capabilities. Slight modifications to existing facilities may be acceptable in order to accommodate the new product. But the design of a completely new distribution system, or extensive changes to an existing one, may cost more than the increased value generated by the product. Similar effects can also be produced by re-launching an old product in a new package, or by introducing variations on the original, such as different colours or trim.

2.2.6 The Effect of Product Life Cycles on Distribution

Another factor, related to marketing, affecting the distribution process is the product life cycle concept. The marketing, and thus distribution of a product, must react to a dynamic environment as the sales trends of the product go through five typical stages: design, introduction, growth, maturity/saturation and decline. During each stage, emphasis is placed on a different marketing variable. The distribution requirements therefore change in order to support the marketing emphasis of the product's current life cycle stage.

Fig. 2.3 (9, Ch.2, Fig. 2.2) shows a typical product life cycle and the marketing variable that is emphasised at each stage. Rink and Kaminski(17) have proposed a model, based on product life cycles, to aid planning and decision making in distribution. The various stages and their effect on some physical distribution activities are summarised overleaf

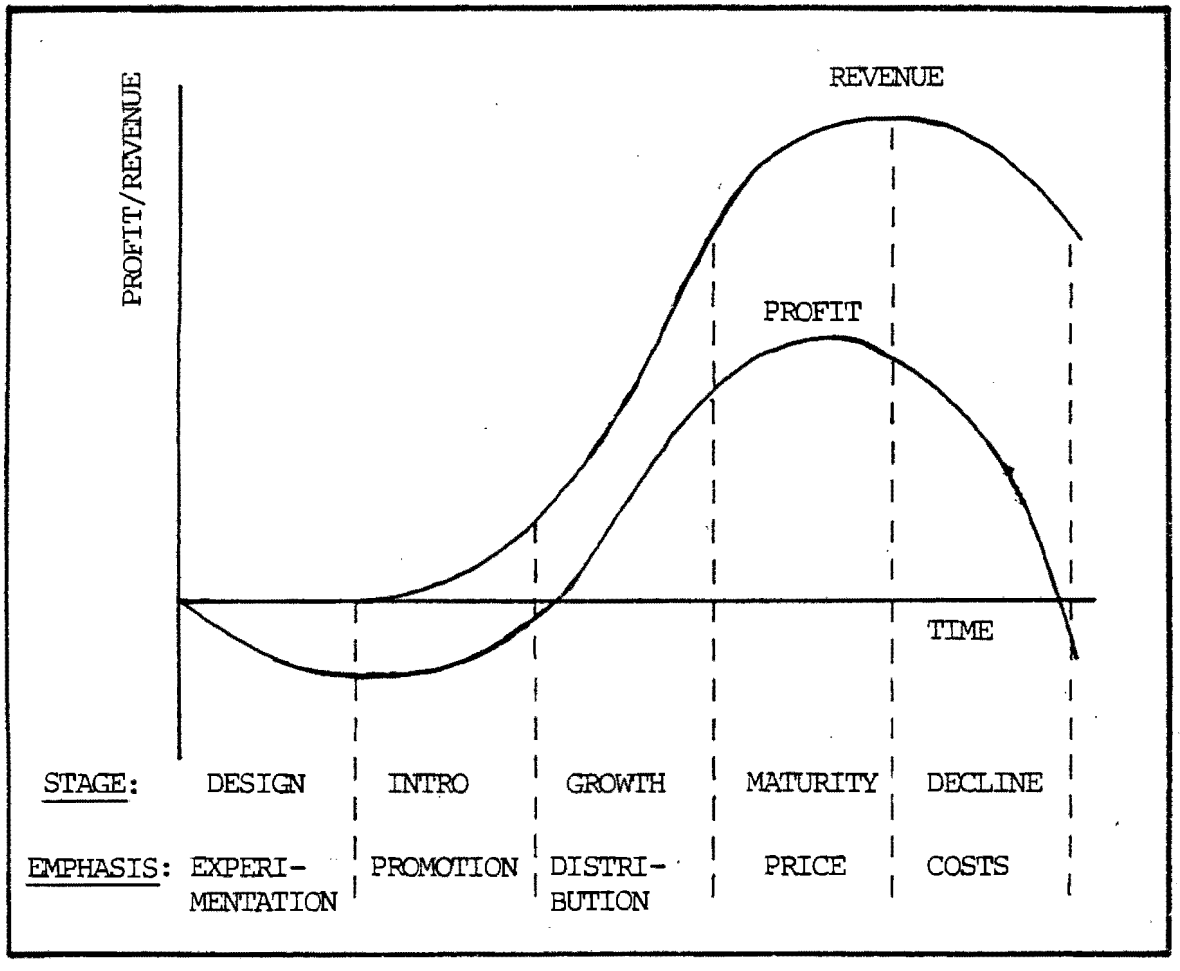


Figure 2.3 : A typical product life cycle

a) The design stage. This stage encompasses all activities prior to market introduction of the product or service. The set-up costs of this stage are large, while no sales have yet been made. Test markets may be conducted at this stage. This is when alternative distribution channels are evaluated, and the effects of product design and packaging on transport and materials handling equipment are evaluated. Inventory is built up at central locations in anticipation of product introduction and general-purpose materials handling equipment is used. Should additional space or equipment be required at this stage, hiring or short-

term lease agreements are used. An information system is established that closely monitors product performance.

b) The introduction phase. The product is introduced to the market at this stage, which decides its success or failure. Flexibility is required and teething problems are resolved. Product availability is essential at this stage, and reports are closely monitored. Also, performance standards and controls are developed, and the performance of middlemen and carriers is controlled for desired customer service levels. Premium transport modes may be necessary as a 'no stockout' policy is maintained. Storage and handling facilities, and product packaging are revised. Investments in fixed materials handling equipment are minimised. Sales levels and order filling accuracy are closely monitored.

c) The growth stage. Sales forecasting becomes critical as new customers are encouraged and brand loyalty is developed. Customer service is critical and costs become secondary as competitors enter the market. Customer service is improved through: using premium transportation when necessary, identifying and resolving service failures, introducing decentralised warehousing and regional customer service centres, direct selling, greater order filling accuracy, reducing back-orders and increasing order transmittal speed. Security systems are established and product packaging and its procedures are reviewed to control shrinkage, deterioration and damage. Customer service levels and inventory costs are balanced. Additional materials handling equipment is purchased and mechanisation is increased.

d) The maturity stage. Sales level off and price-cutting tactics and promotions are increased to maintain sales

against competition. Product improvements in quality, style and accessories are encouraged. Cost control and improvements in efficiency become important, and customer service is adjusted to competitive parity. Transport modes are re-evaluated on cost - service trade-offs and inefficient warehouses and handling facilities are phased out. Mechanisation is now at its optimum to reduce costs. The information system continues monitoring new product development.

e) The declining stage. Sales drop rapidly in this phase and product abandonment is anticipated. Flexibility is thus maintained while risk is minimised and marketing effort is reduced, but still remaining watchful for market opportunities. Additional facilities capacity is transferred to newer products and a rigid cost control is implemented. Inventory is centralised, orders are filled on an 'as necessary' basis only and a facility for spare parts, repairs and recalls is established. Salvage plans are implemented for specialised equipment and more flexible ordering policies are adopted. Major trading partners are also advised of impending product abandonment.

2.3 THE ROLE OF CUSTOMER SERVICE

2.3.1 The Relation of Customer Service to Marketing and Physical Distribution

Customer service, sometimes called distribution service, is an important aspect of a company's marketing strategy. It affects the place and the price of a product. Customers may be willing to pay more for a better service in the form of better product availability or a shorter delivery time after placing an order. Defining customer service is very difficult, since it means many different things to different people. However, La Londe and Zinszer, as quoted in Lambert

and Stock(2), have classified almost all definitions into one of three broad categories:

a) An activity that has to be measured. Examples are order processing, invoicing or handling customer complaints,

b) Performance measures of the ability to achieve desired service level objectives, or

c) A corporate philosophy whereby customer service is treated as an element of total corporate objectives.

The entire area of customer service must be seen as the output of the physical distribution function. Lambert and Stock(2) describe customer service as being the interface between physical distribution and the demand creation portion of marketing. The level of customer service offered by a firm is a measure of the effectiveness of its physical distribution process, and determines whether existing customers remain and whether potential customers become customers. An organisation can create a market advantage for itself by out-performing its competitors on customer service and product availability.

2.3.2 The Costs and Value of Customer Service

It is important to try and determine the costs and the value of customer service to a firm, in order to carry out meaningful trade-off analyses. The cost of customer service is in fact the cost of lost sales, and its value lies in its contribution towards attracting future sales. However, neither of these values can be measured objectively. Normally, a level of customer service is set, based on marketing strategy, customer expectations and competitive standards. The measurable costs of achieving that level, such as back-ordering costs, order expediting costs and inventory holding costs, are then minimised. The optimum is reached at a particular service level when an increase in

service means an increase in costs, and a decrease in costs means a reduction is service. Buxton(13) describes the market response, in terms of sales revenue, to levels in customer service as the "service elasticity of demand". He suggests that the optimum service level for any firm is the level where the difference between its revenues and costs, and thus its profit contribution, is greatest. This is shown graphically in Fig. 2.4 (13, Ch. 2, Fig. 2.5).

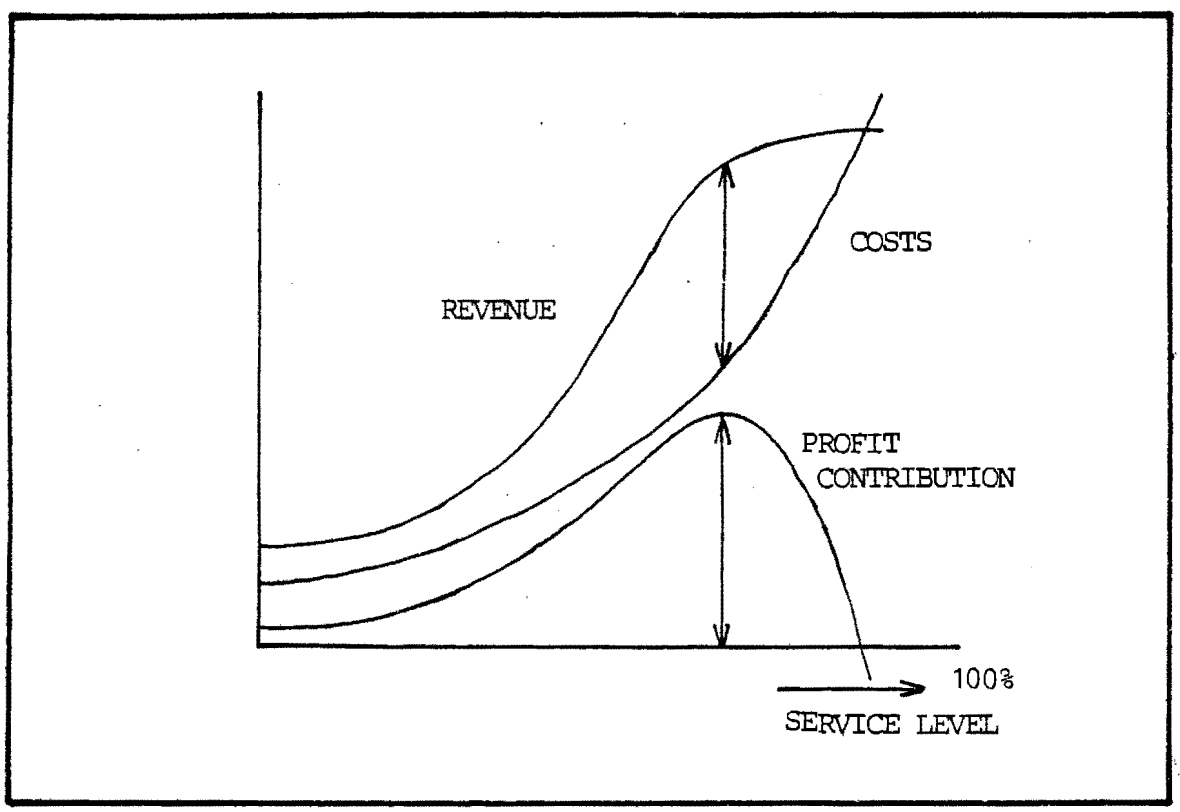


Figure 2.4 : The effect of customer service levels on profit contribution

2.3.3 The Elements Constituting Customer Service

The elements of customer service that should be specially noted are those concerned with the sequences of activities necessary to fill orders. A typical order-cycle is made up of six stages: order preparation and transmittal, order receipt and entry, order processing, order picking and packing, transportation and customer delivery. However, there are many more elements to customer service in order to

achieve this smoothly and efficiently. Perreault and Russ(18) list 15 elements of customer service: order processing time, order assembly time, delivery time, inventory reliability, order size constraints, consolidation allowed, consistency, salesmen visit frequency, ordering convenience, order progress information, inventory backup during promotions, format and organisation of the invoice, physical condition of goods, claims (returns and allowances) procedures and billing procedures. La Londe and Zinszer, as quoted in Lambert and Stock(2), suggest that customer service elements could be categorised into three groups:

a) Pre-transaction elements. These are elements concerned with management policy on customer service. They are essential components of any marketing strategy and have a significant impact on product sales. The specific elements include: a written statement of customer service policy, for use both by the company and its customers; and an organisational structure capable of accommodating easy communications with customers, staff and customer training and flexibility in dealing with contingency requirements.

b) Transaction elements. These comprise the direct activities associated with order processing. They are normally informative or performance oriented, such as: product availability or stock-out level, order status information, order-cycle elements efficiency, order-cycle elements accuracy, order placing convenience, expedited or trans-shipments and stock-out products substitution.

c) Post-transaction elements. Also known as 'after-sales service', these support the use of the product after it has been sold. These elements include: the installation, repairs, guarantees, spare parts and alterations to the product; the handling of claims, complaints, returns and replacements for customers;

and the ability to trace products in case of recall of dangerous or defective goods.

2.3.4 Viewing Customer Service as a Product

It is important to realise that customer service is also a product in its own right. It should be tailored to market requirements, its quality should be controlled and its existence should be made known through advertising and promotion. Schary(9, Ch.3) describes its importance: "When a firm sells and processes an order for a product, it is actually creating two products. The first is the one that the customer expects to buy; the second is the output of the seller's distribution system . While the first product determines the initial order, the second determines the volume of repeat business." This fact is obvious to service-type companies, but is not always recognised by product-type companies. Shapiro(12) cites some examples of organisations that provide their markets with a bundle of products and associated services that is, or appears, unique: Coca-Cola promote brand identification, Mercedes-Benz emphasise product performance and Xerox use customer service. The degree and importance placed on customer service also depends on a product's life cycle stage, as mentioned before.

2.3.5 Examination of Service Level and Performance

The level of service offered by a company should only be set after thorough investigation by doing a market audit and an internal assessment. The external market audit should consider market needs, the product mix, competition, available technology and regulations. In this way, the firm should adopt a customer service policy that is based on customer needs. Such a policy will then determine the structure and character of the distribution service. This is suggested because suppliers often have inaccurate perceptions of the service they give, but customers are very aware of the service they receive. Customers should be contacted to determine what they mean and how they define

customer service, as well as the level of service they expect. Sabath(19) believes that the most important information to be obtained from customers is:

a) Their definition of service,

b) Their expectations of order-cycle times, and

c) The relative importance they place on service reliability and speed.

From past customer surveys, the overriding characteristics that customers generally prefer are: the duration of the order-cycle, its consistency, the efforts necessary to place an order and the time and energy required to determine order progress.

Gustafson and Richard, quoted by Lambert and Stock(2), have identified four main areas of customer service performance. Almost all measures and performance criteria are based on one or more of these:

a) Time. Response time requirements, that is, the order-cycle time.

b) Dependability. Response time variability; consistency and reliability; accuracy; and quality of goods on arrival.

c) Communications. Feedback on expectations and deviations from the norm; on information flow such as product availability, order status, advance information of price changes and shipping data; and on order reminders.

d) Convenience. In ordering and backordering out of stock products, in product substitution during stock-outs, in information flow, in materials handling, in shipments

and expediting orders, in schedules and carriers and in being able to cancel or complain

2.3.6 Reviewing Customer Service Levels

Philip Schary(9, Ch.3) points out that decisions to improve customer service levels and performance can be differentiated into short- and long-term; those dealing with the design of the system, and those dealing with its operating parameters. Short-term type decisions usually concentrate on order-cycle time and stock availability. Stock availability is regarded as an inventory problem and generates ABC-type analyses. Order-cycle times involve considerations of technical adaptations and internal order-processing path innovations, such as implementing computerised systems and eliminating bureaucratic delays, to speed up order receipt, and data processing. The establishment of incentives to control order profiles also help to improve customer service.

Another possibility is to implement a flexible customer service policy, whereby customers having similar service needs or preferences are grouped. Cost - value trade-off analyses can then be done for each of the various groups. Customer profiles also give an indication of the desirability of certain customers.

2.4 THE INTERFACE BETWEEN DISTRIBUTION AND PRODUCTION

It can be seen that the production or other conversion process of an organisation is constrained, both front and back, by aspects of physical distribution. Materials management controls its raw materials and other inputs, as well as work-in-progress, while distribution takes care of its outputs. However, in accordance with the total systems concept, the two functions of distribution and production

must be carefully analysed and integrated in order to prevent overall suboptimisation.

2.4.1 Some Areas of Interaction Between Distribution and Production

Certain business considerations, such as product safety requirements, new product launches, new lines of business and shifts in the balance of products, can have a marked impact on both production and distribution decisions. Also, production problems such as breakdowns, line stoppages, stockouts, product quality problems and excessive manufacturing lead times, can cause difficulties in the distribution process and possible reductions in customer service.

Both production and physical distribution should influence decisions on: the number and location of manufacturing facilities, sources of raw materials and other goods, the number, location and size of stockholding points, traffic schedules and transportation as well as inventory management and administration. In conventional manufacturing operations, considerable savings can be achieved through the use of long production runs and level load production. Physical distribution must be aware of the effects on the production process of varying demand loads: overtime, equipment wear and tear, personnel training, labour hiring and layoff, machinery over- or under-utilisation and maintenance inconvenience.

2.4.2 The Effect of Sales Forecasts and Production Schedules

Buxton(13) describes scheduling as the most important factor that links a firm's distribution and production systems: "... the manufacturing department is principally concerned with efficiently scheduling its production lines, and therefore requires an inflow of raw materials and other supplies which is compatible with production planning targets." These targets are normally set from forecasts of product demand.

It is usual for marketing to produce sales forecasts and for distribution to set inventory deployment policies. The production function must be included in both these decisions to take into account such factors as manufacturing efficiency and available capacities. It is thus important to jointly set demand forecasts and production schedules in order to make the required inventories available for distribution and marketing.

2.4.3 The Effects of MRP and JIT Production Methods on Physical Distribution

These two methods of production have a great effect on the materials management aspect of reducing work-in-progress. They also generate accurate and timely requests for raw materials, component parts and other inputs, including tooling and specialised equipment requirements. They do have varying effects, though, on finished-goods distribution.

MRP is driven by demand forecasts and produces a practical production plan and master production schedule, accounting for available capacity, inventory requirements and lead times. Although reducing work-in-progress is not a direct objective of MRP, this is achieved in an indirect way. MRP produces feasible production schedules, work centre loads and capacity requirements, planned releases of purchase orders and reschedules due dates if necessary. Also, being computer based, MRP can be updated at any desired frequency.

MRP attempts to minimise the total inventory of a firm by considering forecasted demand instead of a smooth, repetitive demand pattern. The work-in-progress in production is reduced by: timely and accurate ordering of matched parts, the correct parts being scheduled through work centres, work centre schedules being balanced to their capacities and bottlenecks being considered thereby eliminating lead-time lengthening queues. The entire system, though, is driven by sales forecasts jointly derived

with marketing, as is the distribution of finished goods. The only effect on finished-goods distribution, thus, occurs if the MRP system reschedules production due dates.

On the other hand, JIT strives to eliminate inventories altogether. This is not only due to stockholding costs, but rather to the view that inventory covers up inefficiencies in raw materials procurement, production and marketing. Safety stocks are eliminated by getting suppliers to shorten leadtimes to less than the production department's definite production plan, to deliver smaller quantities more often and to guarantee a low reject rate. Work-in-progress is seen to clog the production system: parts are hard to find and retrieve, shop floor space is used up, machines are distant from each other, queues are formed and communications are impaired. Reducing work-in-progress increases productivity and the integration of work centres. It also forces production process problems to emerge. Reducing input and work-in-progress inventories have severe implications for materials management.

JIT companies have also managed to reduce finished-goods inventories. They have achieved this through reducing transit times by locating supplier and manufacturing facilities in close proximity to each other and to customers, through direct deliveries to end users, and through using small delivery vehicles with predetermined load sequences to facilitate loading and unloading. They achieve economies by shipping mixed loads, by using load-switching and consolidation points, by using small trucks and by careful routing and scheduling. In the total systems view, reducing finished-goods inventory is compatible with the JIT philosophy of reducing work-in-progress between adjacent supplier-customer work centres. According to Sauers(20), JIT adopts an overall systems approach in two ways. Firstly, it seeks to optimise the production-distribution interface by avoiding suboptimisations such as economic order or economic production quantities. Secondly,

it forces process inefficiencies to surface in order to reduce total costs.

2.5 ACTIVITIES INCLUDED IN PHYSICAL DISTRIBUTION

It is clear from the above discussions that the scope of physical distribution is very wide and extensive, and includes many activities that overlap into other business functions. Also, certain distribution activities will be more important in some firms than in others. However, one activity of paramount importance in any distribution system, is that of dealing with costs. The realistic costs of performing various activities must be captured and assessed. It is important to monitor and control the costs of distribution activities in order to carry out trade-off analyses, to evaluate alternatives and to detect variations in efficiency. These will be examined more closely in Chapter 3.

Lambert and Stock(2) have identified 14 activities that form part of a distribution system. These are summarised below:

a) Customer service. This includes any activities related to the level of satisfaction obtained by the firm's customers or suppliers. The activity should attempt to provide satisfaction at the lowest possible total cost.

b) Demand forecasting. This activity is important to marketing, manufacturing and to physical distribution. It is important to know where demand originates in order to determine the flow of materials from their origin to their consumption.

c) Distribution communications. This should include information processing. This is a vital link that integrates and co-ordinates the entire distribution

process, as well as the various activities among each other.

d) Inventory control. Inventory connects the production and sales functions, but it also consumes space and capital resources. The level of inventory must be determined that is required to achieve the desired customer service while considering costs.

e) Materials handling. Added costs are incurred every time an item is handled, while generally adding no value to the item. Excessive and/or incorrect handling can lead to product damage, production delays, customer dissatisfaction and idle employees.

f) Order processing. This activity triggers off the distribution process and directs the actions to be taken to satisfy order demand. The objectives are to increase order processing accuracy and to reduce response time.

g) Parts and service support. This includes the repair and servicing of products after sales. An important factor here is the availability of replacement parts.

h) Plant and warehouse site selection. Included in this is the layout and operations requirements to satisfy the distribution function. All the relevant factors, such as market locations, must be considered.

i) Purchasing and procurement. The acquiring of materials and services for the operation of the business. This involves such factors as the selection of sources of supply, the form of the material required, the timing of purchases and quality control.

j) Packaging. Two functions are fulfilled by packaging: a marketing one of advertising and promoting the goods,

and a physical distribution one. In the distribution context, packaging protects the goods and eases their handling and storing.

k) Return goods handling, sometimes called reverse distribution. This is due to items being returned because they are defective or incorrect. The handling of returned goods is often very much more expensive.

l) Salvage and scrap disposal. The disposal of waste materials and by-products involves handling, transportation and storage. Recyclable materials are also included here.

m) Traffic and transportation. This is the management of the movement of products: for example the method of shipment, the routing and regulation requirements. Other duties include the selection of the transport mode, surveying the services and routings offered by each mode and by the carriers in each mode, and also the negotiation of rates. This activity is often the single largest cost contributor of the physical distribution process.

n) Product warehousing and storage. This is a function of the lag between the time a product is manufactured and the time it is consumed. Storage activities include: own/rent/lease decisions, warehousing and storage design, safety and security considerations and personnel training.

2.6 THE CORPORATE ROLE OF PHYSICAL DISTRIBUTION

2.6.1 Physical Distribution as a Business Function

Physical distribution should fit into an organisation as a business function, a separate entity, similarly to other

functions such as production, marketing or finance. Also, the total systems concept requires that the distribution function works for, and in conjunction with, all the other functions of the business. It is therefore very important that lines of communication be wide open at all levels of the business hierarchy, and not only at top management level. Figure 2.5, adapted from Gattorna(9, Ch.1), illustrates the role of physical distribution management and its two components, materials management and finished-goods distribution, in managing the flow of materials through an organisation.

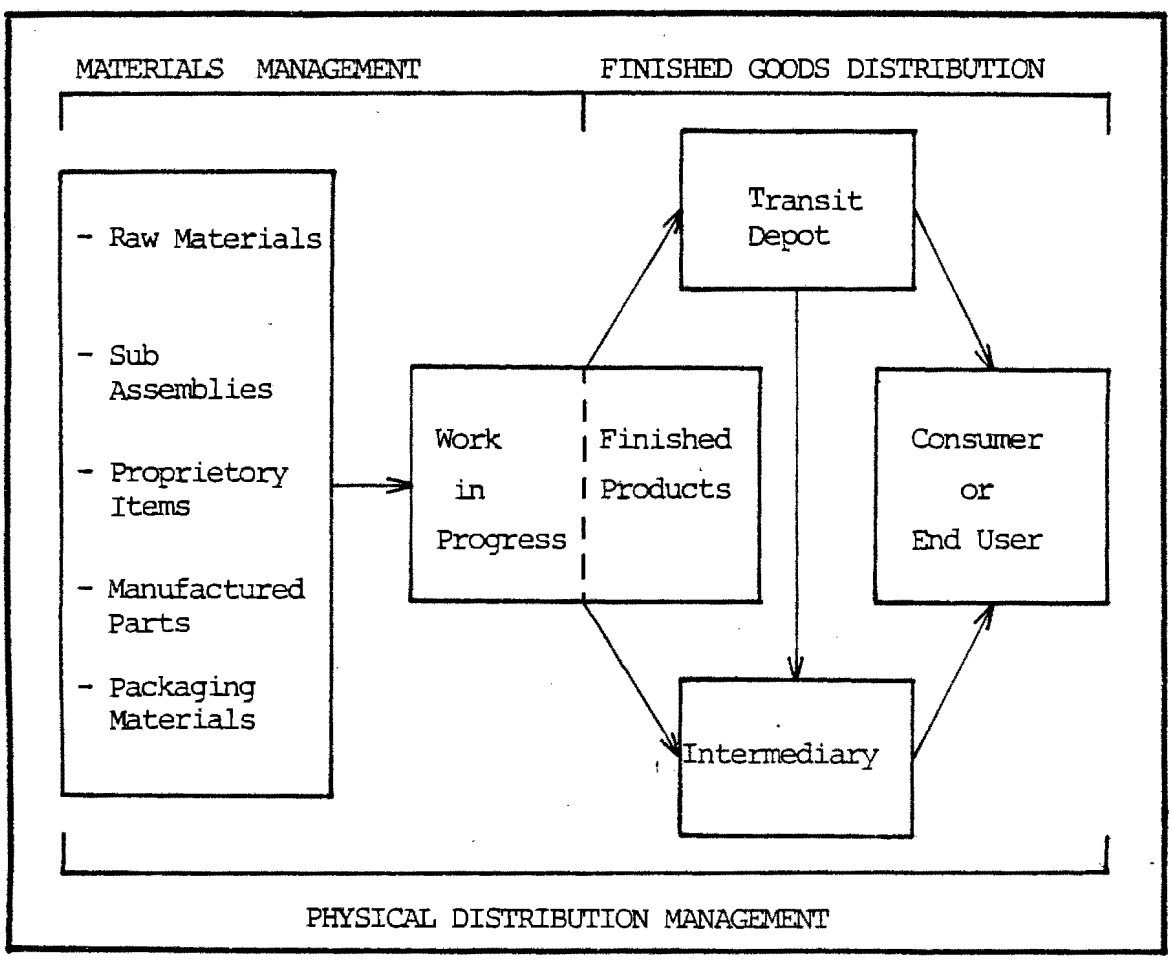


Figure 2.5 : Physical distribution : managing the materials flow through an organisation

Part of its duties should be to help carry out vendor analyses and to select sources of supply with the departments concerned. An important factor to consider in

this decision is the vendor's distribution system - and therefore the availability of raw materials and other supplies to fit in with production scheduling requirements.

Another important requirement of physical distribution is to have a person within the organisation who is responsible for system design and for the development of this function. This is necessary to make continuing adjustments and minor changes as the distribution process evolves. It is also this person's duty to appraise the function and to undertake major studies, redesigns and overhauls at strategic times during the life of the distribution system.

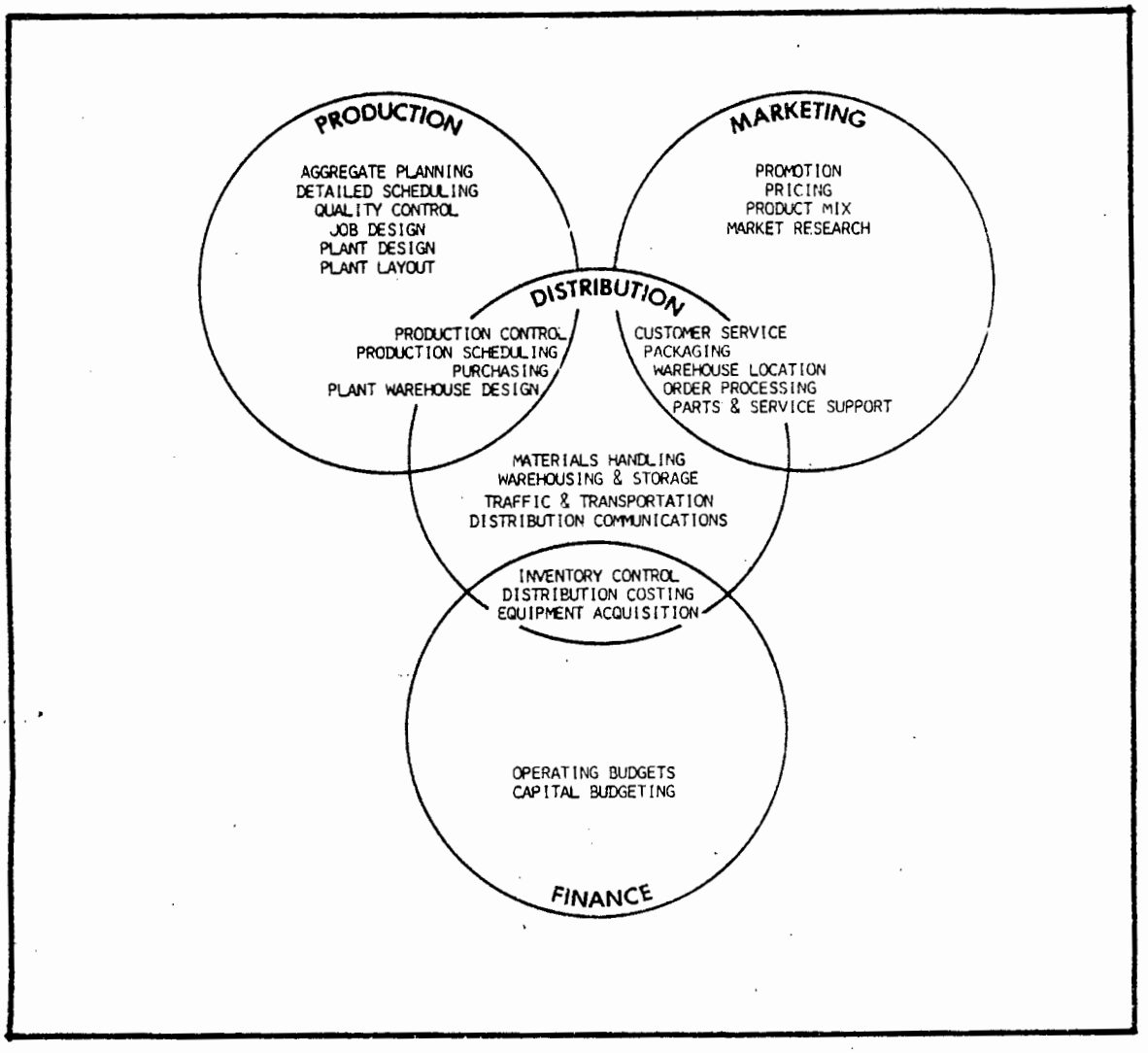


Figure 2.6 : The relations between distribution and the other corporate functions

2.6.2 The Interrelationships Between the Corporate Functions

The interface between physical distribution and marketing, and that between distribution and production, has been discussed above. Apart from these, distribution also has a strong relation with the financial function in a company. Of this, the purchasing and procurement department should be a part of the materials management activity.

The financial management of an organisation should also be closely involved in major distribution investment decisions such as acquiring warehouse facilities, vehicles or computing facilities. It is also a financial responsibility to carry out effective cost assessments to be used in trade-off analyses. The finance department normally sets up the budgets and financial controls of the various distribution activities. Gattorna (9, Ch.1) showed the inter-relationships between corporate functions as in Figure 2.6.

2.6.3 The Relationship Between an Organisation and its Distribution Function

Magee(21) described the relation between the function of an organisation and the form of its distribution system. He classified them into four different types of organisations. In each of these, the relative importance of the physical distribution function to the other business functions of the organisation differs. Similarly, so does the relative importance of the various activities making up the distribution function differ between the various organisations. The characteristics of each type that Magee identified are summarised overleaf:

a) Extractive organisations. These are the primary, raw materials producers and suppliers, such as agricultural, mining, oil production or timber production types of firms. Their distribution activities are shown graphically in Figure 2.7 (21, Fig. 7.1). These are normally separated into an inbound, supply activity and an outbound,

transportation activity. The supply activity is often concerned with inventory investment and management,

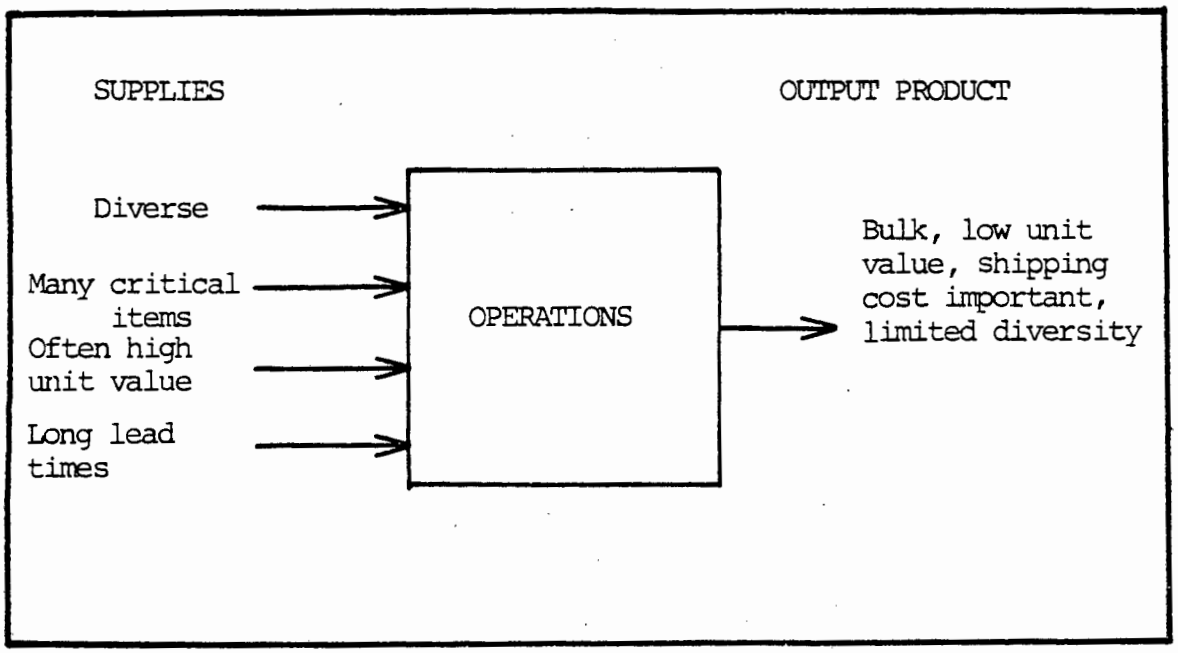


Figure 2.7 : Distribution activities of extractive organisations

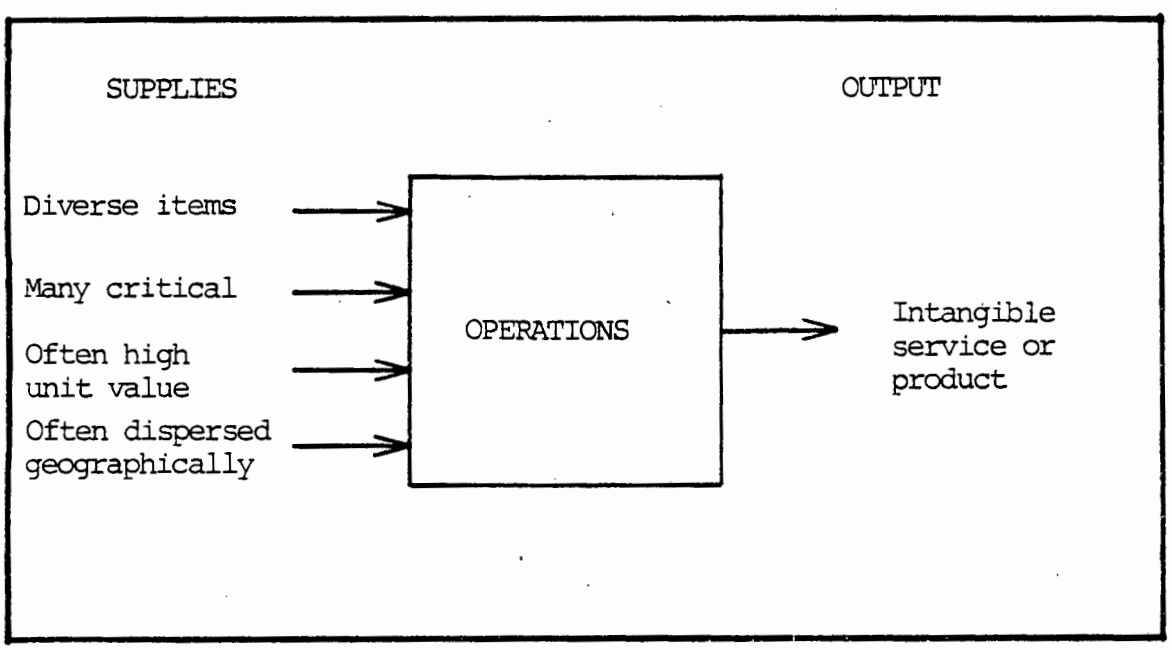


Figure 2.8 : Distribution activities of service organisations

and with the maintenance of high service standards in order to supply the production operations with diverse, and sometimes critical, supplies. The outbound transportation activity is often concerned with the effective management of the transportation of large bulk, low unit-value products.

b) Service organisations. The distribution activities of service organisations such as government agencies, transportation common carriers or communications utilities are shown in Figure 2.8 (21, Fig.7.2). Their primary physical distribution activity is supply, and they are thus concerned with procurement and inventory management. Sometimes, certain activities such as purchasing, are performed as central activities while others, such as inventory management, are performed at geographically dispersed operating divisions.

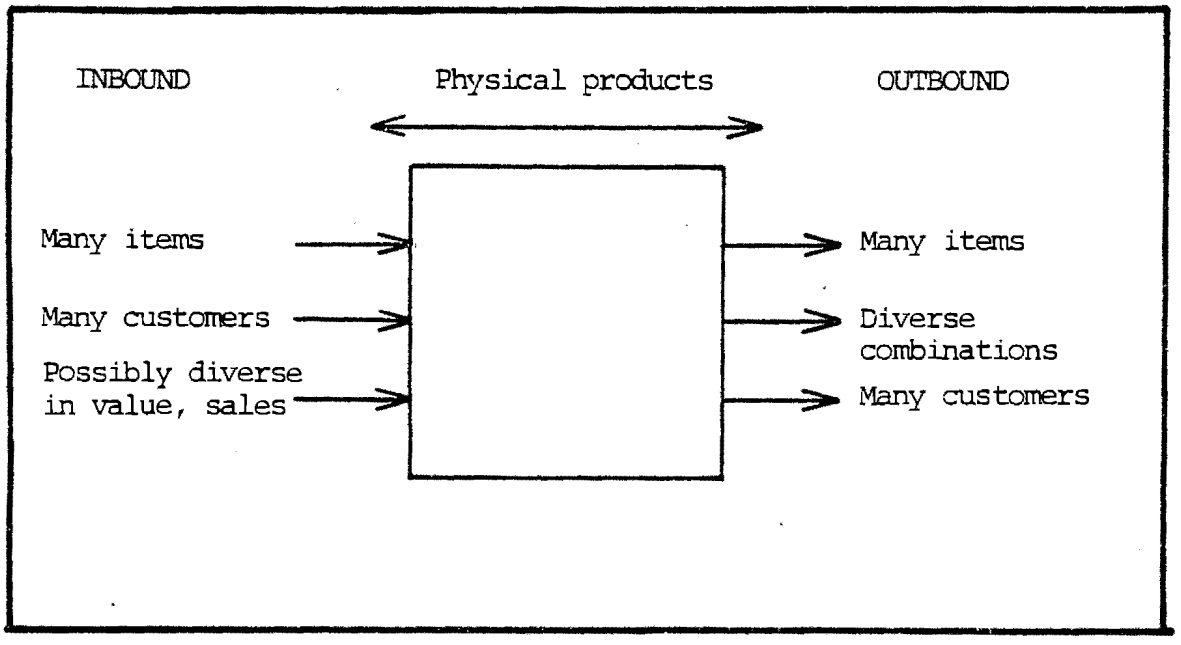


Figure 2.9 : Distribution activities of marketing organisations

c) Marketing organisation, including retailers and wholesalers. A key factor with these organisations is that the inbound and outbound products are physically unchanged, except for possible operations such as repacking and marking. In most cases, all the physical distribution activities are included and important in the firm's distribution function. The characteristics are illustrated in Figure 2.9 below (21,Fig. 7.3).

d) Manufacturing organisations. There are a number of distinguishing characteristics of these organisations, as shown in Figure 2.10 (21, Fig. 7.4). There is a major flow of materials in and out of the organisation, as well as a substantial amount of internal physical distribution within the organisation. The materials physically change form through a conversion process requiring substantial investments in time, capital and effort. In most manufacturing organisations the distribution is subordinate to the conversion and marketing functions.

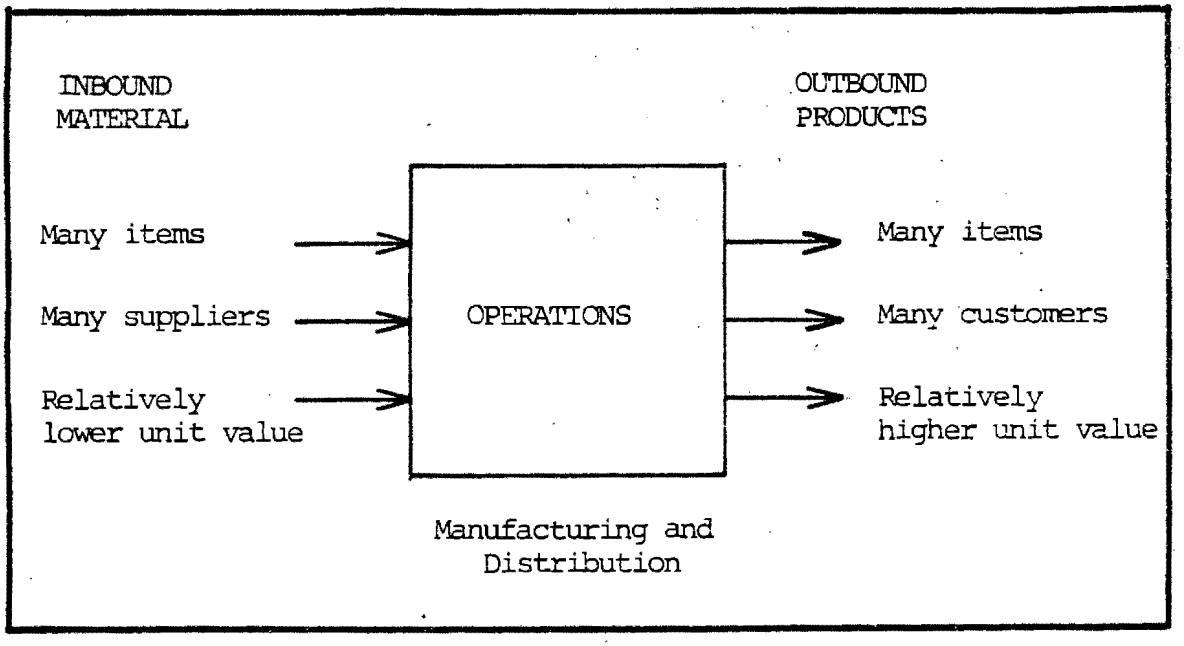


Figure 2.10 : Distribution activities of manufacturing organisations

2.7 SUMMARY

The total concept of physical distribution is that of a system encompassing all materials flow, from raw materials procurement through to end-product consumption. It does not simply involve the transport of finished goods. Distribution interacts strongly with other business functions, especially marketing and production. It is important to examine the total costs of the entire distribution system, and to identify trade-offs in order to avoid suboptimisations and to reduce the total costs. These trade-offs can be carried out both internally and externally to an organisation. A total systems view of distribution also cuts across traditional organisation boundaries. The concept of physical distribution, though, can apply to all organisations that define their own raw materials, products and customers. Materials management is the portion of physical distribution dealing with raw materials and work-in-progress.

Marketing aims and objectives govern distribution strategies, although the costs and feasibility of these may force revisions in marketing policies. Distribution provides products mainly with place utility. Many areas are jointly affected by both marketing and distribution which depend principally on the selection of target market segments. Distribution channels are carefully selected to achieve marketing aims and to produce maximum profitability. The various stages of a product's life-cycle require different levels of support from the distribution function.

Customer service is the output of the distribution function, and is the interface with the demand creation portion of marketing. The cost of customer service equals the cost of lost sales, and its value lies in its contribution towards attracting future sales. Customer service can be divided into pre-transaction elements, transaction elements and post-transaction elements. Customer service is in itself a

product to be marketed and promoted. Customer service should be set to definite market requirements and not based on an organisation's perceptions. The important elements of service to customers are: timely dependability, communications and convenience.

Distribution also interacts with production, often with conflicting objectives. Sales forecasts should be set jointly with distribution and production, as well as marketing, since these affect both production schedules and distribution requirements. MRP mainly affects raw materials procurement and work-in-progress, while JIT ideals of eliminating inventories affect all aspects of distribution.

Distribution consists of 14 component activities, and their cost monitoring is of vital importance. The distribution function is a business function similar to production, marketing and finance. The entire function is dynamic and thus should be constantly monitored and re-evaluated. To be compatible with a total corporate systems approach, distribution should interact and work in conjunction with all other business functions at all levels. The emphasis and importance of certain distribution activities varies with different organisations, and depend to some extent on the nature and type of the business.

CHAPTER THREE

MANAGEMENT AND CONTROL ASPECTS OF PHYSICAL DISTRIBUTION OPERATIONS

This chapter deals with a number of basic aspects that are essential to consider if an integrated physical distribution system is to be managed in any organisation. Section 3.1 analyses the costs of physical distribution. It sets out the nature of the costs to be collected and the reasons for doing so. A part of this section attempts to identify the major cost centres of distribution operations and various methods of allocating costs to them. Notes are also included to propose some ideas on means of controlling costs, and to point out some differences between traditional, accounting cost data and that required for the effective operation of distribution.

Section 3.2 highlights the importance of information and communications in physical distribution management. After a discussion on the uses of distribution information, the gathering of control information and the types of information required are analysed. Short notes are also included on the importance of having correct and timely information through the order cycle for the rest of the distribution process, as well as on some types of computerised order-processing and other information systems under development.

Having noted the information requirements of the distribution process, the Section 3.3 discusses its use for controlling and monitoring distribution performance. The use of a survey or audit is noted to ensure a uniform perception of distribution and service level performance between member organisations of a distribution channel. Some commonly used key measures and ratios are also highlighted to illustrate the nature and detail of monitoring to be considered.

Some comments are made in Section 3.4 about the structure of a distribution department. It is noted, though, that these are mainly for guidance and information. The actual structure of an organisation's distribution department, as well as the number and type of staff employed, all depend very much on its own characteristics. No single solution is correct in this respect, and nor will a solution successfully implemented in one organisation necessarily work for any other.

3.1 THE COSTS OF DISTRIBUTION

3.1.1 A Total Cost System is Necessary

In the previous chapter, emphasis was placed on the evaluation of cost - value trade-off analyses in order to improve the total distribution system. It was stressed that physical distribution interfaced with many other business activities which all contributed towards overall corporate profitability. However, in order to identify the possible improvement areas of any distribution system, and to objectively compare alternatives, it is necessary to have sufficient information on the relevant costs of the distribution function in an organisation. The definition, gathering and analysis of 'sufficient' and 'relevant' costs is of paramount importance, and is also the major problem in distribution costing.

The first decision to be taken in the area of distribution costing is to establish the entire physical distribution system itself as an autonomous and cost accountable unit. Ball(3) regards this as the single most important step to be taken in order to avoid fragmentation of the costs into useless classifications. For example, it is normal for the administration costs of distribution to be sunk into general overheads. In establishing distribution costs in this way, all its costs have to be taken into account, including the

less obvious ones such as staff and computer costs, the costs of forecasting, the costs of planning factory loading, materials procurement costs and the costs of processing and despatching orders.

It is important to note that most firms will have their own, unique way of identifying and relating costs in certain areas. Ray(9, Ch. 27) also notes that: "... without a total costing system, attempts to optimise the distribution function are near to impossible". The establishment of a total cost system to evaluate the costs of distribution is not a quick or easy task to undertake. Nevertheless, it is vital that detailed cost information about the distribution system of an organisation be available, for the comparison and design of any changes in this function.

3.1.2 The Reasons for Gathering Cost Data

Buxton(13) points out that physical distribution costs are normally scattered among many and varied traditional cost centres of an organisation. These should be collected into a total distribution cost system. Sometimes certain costs, or costs which are not physical distribution costs but which are affected by the distribution system, are not even recognised. These should also be determined and included. Examples of these are the effects of stockholding size and order processing on production scheduling, and the effect of delivery frequency on the costs of customer service levels. Information is necessary on individual costs if distribution efficiency is to be improved. Lambert and Stock(2) emphasise that costs must be fully identified, effectively measured, quickly and accurately reported and readily accessible so that they can be used by management both for routine operations and for long-range plans.

Ratnatunga(16), quoting Longman and Schiff, classifies distribution cost accounting into 'cost analysis' and 'cost control'. Distribution costing data should therefore be collected to satisfy the following aims of cost analysis:

a) To analyse the costs of distributing and promoting products,

b) To analyse the costs of marketing individual products,

c) To analyse the costs involved in serving different classes of customers in different areas,

d) To compute figures such as: the cost per call, the cost per order and the cost of accepting a new customer,

e) To evaluate managers according to their actual controllable cost responsibilities, and

f) To evaluate alternative strategies or plans with a full knowledge of cost behaviour.

Cost control, on the other hand, measures the performance of a specific function against a predetermined goal.

3.1.3 Defining Distribution Costs

Distribution costs include all costs, as defined by Magee(21), which are subject to three essential principles:

a) The costs are either paid out costs or opportunity costs, but are out-of-pocket.

b) They include any costs that are affected by changes in the distribution system.

c) It is more important to accurately define cost factors than to measure them precisely.This is because it is sometimes useful enough to know an order of magnitude rather than a precise value. In such cases, a knowledge of the typical cost variation characteristics - curves plotted of the cost behaviour against some variable, is more useful than accurate values.

3.1.4 The Cost of Lost Sales

The most important cost to be attributed to the distribution function is the cost of lost sales. In the case of distribution, lost sales are caused by a failure to deliver. This does not mean, though, that every failure to deliver results in a lost sale. It also does not mean that because a sale is lost, all future sales to a customer will be lost. However, these possibilities depend on a large number of factors, including: the nature of the goods, whether custom-built or standard goods; the level of competition; the ease of substitution and the urgency of the order.

The cost of lost sales is thus very difficult to estimate and is always subjective to some degree, but every business should attempt to quantify it, based on its own past experience and objective common sense. The cost of lost sales can then be traded-off against the costs to distribute when setting distribution service levels.

3.1.5 Allocating Costs to Cost Centres

When considering the costs of distribution, Buxton(13) specifies relevant cost centres as discrete areas in which costs are incurred in the fulfilment of order requests. He lists seven major cost centres as: Order processing; Materials handling; Packaging; Storage; Inventory maintenance; Transportation and Administration (costs unallocable to the other six).

He also suggests the use of 'account groups' for the allocation of costs. Each account group consists of a major node in the distribution system or a major flow link between nodes. For example, an account group can be identified for a factory, its warehouse and the flow link between them, factory - warehouse. Each account group will then have some or all of the seven cost centres identified above. The type of cost then has to be specified for each cost centre of each account group. The warehouse, for example, will incur

expenses such as salaries, heating, lighting, stationery and telephones to be placed under its administration cost centre. In this way costs are clearly related to functional accounts.

Ray (9, Ch. 10) for example, identified the costs of stockholding and listed them in their basic categories:

a) Finance: Cost of Working Capital

b) Storage:
- Storemen's wages
- Materials handling equipment
- Storage, racking
- Heating, lighting, water
- Insurance of stock and building
- Rent
- Rates
- Repairs and maintenance

c) Stock Losses:
- Shrinkage
- Deterioration
- Depreciation
- Obsolescence

Each of these could be allocated on the basis of Buxton's account groups described above. Another example is shown in Figure 3.1 illustrating a model proposed by Lambert and Stock(2) for determining inventory holding costs.

The results of a survey carried out by Constantin et al.(22) in the U.S. showed that when allocating costs, distribution managers desired:

a) Standard cost systems for distribution activities,

b) The reporting of interest costs on inventory,

c) That freight costs incurred be reported as functional costs, and not deducted from sales, and

d) That physical distribution costs be deducted when determining the profit contribution of marketing and sales personnel.

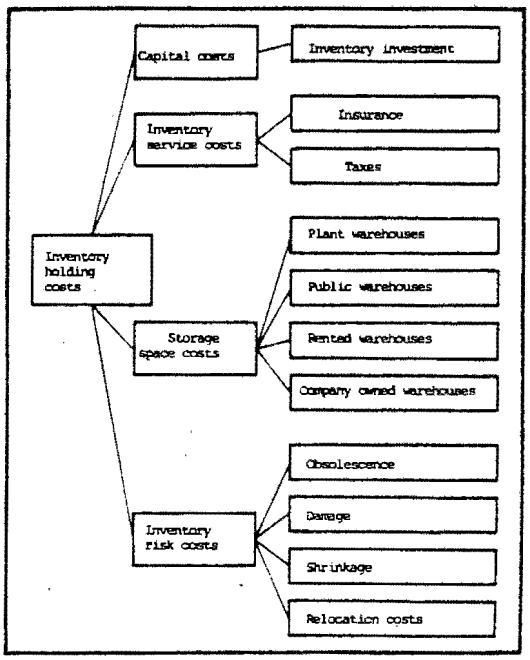


Figure 3.1 : A model for determining inventory holding costs

3.1.6 The Use and Control of Physical Distribution Costs

Regulations and incentives can be used in order to control and maintain distribution costs at a reasonable level. An example is the discount given for purchasing exact units of palletised loads. Ray(9, Ch. 27) gives another example of fixing a distribution charge system geared to the service level provided. The price-drop size curve that he suggests, as shown in Figure 3.3, shows three characteristics:

a) A minimum price for large drops,

b) A flat part around the budget drop size, and

c) A rapidly rising curve to discourage very small drops.

Distribution costs can then be used to balance out the cost of providing a given service level with the opportunity costs of losing a sale. Sharman(4) also suggests to balance out the cost to a firm of providing a service level, with the value of that service to the customer. Consider, for example,the value of a rush order of printing ink to a daily newspaper or to a monthly magazine. This could be used as a basis for deciding on the allocation of discounts or price premiums. It is also often necessary to compare and choose between alternatives. In these cases differential or incremental costs are required.

Further, costs can also be split by product and by market segment. This would enable analyses to determine whether it is profitable to service a particular market segment, or customer, with a particular product.

Four major areas identified by Ratnatunga(16) where the knowledge of costs is of great importance for analysis and control purposes, are: customer profitability, transportation, stock location and inventory control.

Some potentially confusing areas should be noted when analysing distribution costs. Distribution costs are in no way related to sales revenue and these two should not be compared. Ray(9, Ch. 27) points out that distribution costs precede sales, and include such factors as the movement of goods from plant to warehouses, packaging of goods and storage expenses. Buxton(13) warns about attempting to draw conclusions from a comparative analysis with static conditions, as for example with constant throughput volumes. However, a dynamic approach creates the need to break down costs into fixed and variable components.

It also becomes important, when distribution costs are to be continually monitored, to have a single person, having reasonable authority and an understanding of the whole system, responsible for surveying the distribution costs.

This is to prevent the possibility that absolute costs will be examined without considering the effects of one cost on another.

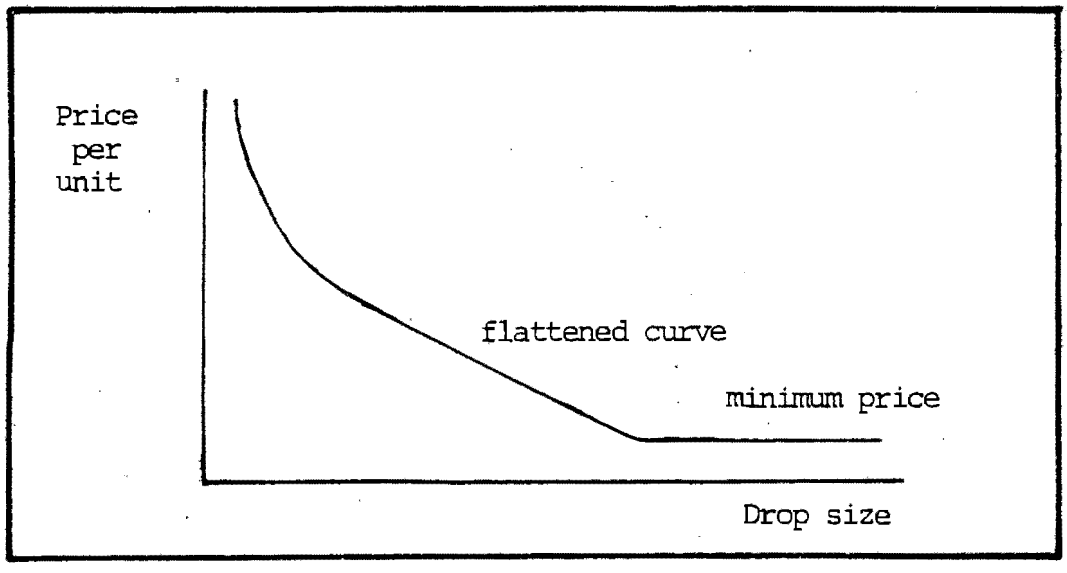


Figure 3.2: Recommended price curve

3.1.7 The Unsuitability of Financial Accounting Data

Financial accounting data is used for historical and financial purposes. It is not geared towards distribution costing. The nature and application of financial accounting data makes it unsuitable for use as reliable distribution costing data. Examples of this unreliable data are the changing of stock valuations, the varying of depreciation charges or the carrying over of sales in order to smooth out variations in the year-end results of an organisation.

According to Sawdy(23) the lack of distribution costing data can be attributed to two reasons:

a) Conventional accounting systems do not isolate the costs of distribution, which tend to be placed into a general expenses category.
b) Even if distribution costs are classified separately, they often do not provide information of economic

significance. For example, detailed information may be kept on transportation costs but not on the costs of delivery.

This obscuring of costs by the traditional financial accounts can lead to two results. Either some costs are lost completely and cannot be recovered for analysis, or product and personal profitability may be incorrectly stated. It is therefore important that the correct information, of costs and other data, be collected and arranged properly in order to permit meaningful evaluation and monitoring.

3.2 INFORMATION AND COMMUNICATIONS REQUIREMENTS IN PHYSICAL DISTRIBUTION

3.2.1 The Types of Information Required

Information and communications flow through a distribution system even more densely than the materials flow, and provide vital links that bind the operations together to allow them to behave as a total system. The total information requirements of modern organisations are vast and complex, and have led to developments such as the establishment of specialised Management Information Services. Sir Daniel Pettit(11) believes that the essential information required for the planning and running of distribution is a knowledge of: the origins, destinations, characteristics and qualities of the goods to be transported; the differences between the timing of supply and demand which lead to the need for storage; and the requirements for supporting services such as order processing.

As an example, Wilson(9) lists some of the types of information required for the control of certain specific activities:

a) Vehicles utilisation: lost time due to operator absence, excessive terminal times, repairs, accidents, lack of work or period of high and low utilisation.

b) Repairs: the incidence of repairs of vehicles and equipment such as repair costs, type of repair, mileage and age. This category should include planned maintenance information.

c) Personnel: the keeping of personal employee records as well as numbers and grades of employees, hours of work, efficiency of working, productivity, lost time or overtime and staff turnover information.

d) Product group: the product mix, work standards, the spread of deliveries by location and time, the number of deliveries, the size of drops, the number of packs and their sizes, losses and damages, revenues and costs of each cost centre, traffic peaks and troughs and the seasonality of sales.

e) Cash: elements of cash flow, credit control operations and comparisons to budget.

Sometimes information is required that is difficult or even impossible to measure directly. Examples of these are: the cost savings that can occur from changing the loading and routing of trucks, or the effects on inventory holding of altering delivery schedules. A great deal of work has gone into operations research and simulation techniques to try and answer such queries. To date, the use of simulation seems to have achieved a greater acceptance and better successes.

The type of information necessary for certain activities, though, such as customer service monitoring, requires a knowledge of market needs. Internal and external audits should then be conducted when setting information

requirements specifications for the design of new information systems, or for the updating of old ones. A survey should be made of customer needs, and should then be examined in order to identify areas that require monitoring

Distribution information is thus collected and communicated in many forms and often needs sorting before being used. Buxton(13) classifies distribution information according to four requirements: its presentation requirement, such as reports, written or verbal; its regularity requirement, such as a one-off, infrequent or frequent; its time reference, as reporting past events or forecasting future ones; and its urgency, as requiring immediate action or not.

3.2.2 Reasons for Gathering Information

A primary reason for gathering distribution cost and other information, is for the monitoring and control of specific activities. Skjott-Larsen(9, Ch. 21) highlights three purposes for the collection of information by a firm:

a) Strategic planning. To address long-range plans, information needs to be summarised and company-wide in scope. Often, the sources for this type of information are external to the company, such as market and financial indicators. Slater(10) believes that the key factors to be considered for this purpose are: government legislation; key suppliers, their activities and plans; general economic and political conditions; and new technological developments.

b) Management control. This information concerns the efficiency and effectiveness of a system and its component parts. An emphasis here should be on producing exception reports to trigger off corrective action or modifications.

c) Operational control. Here, the information needs to be very detailed, accurate and up to date in order to carry out operational activities. The information gathered for this purpose also serves as a data base for the requirements of higher levels of management.

Skjott-Larsen states that the information flows specifically related to distribution must be timely and accurate in order to allow the system to respond efficiently and in a co-ordinated manner. He distinguishes four specific roles of distribution information:

a) It serves to trigger off actions in other components of the business,

b) It monitors and controls the distribution system performance against previously established cost and customer service objectives,

c) It co-ordinates the distribution function with other business functions, as well as the elements of the distribution function among each other, and

d) It links the firm's internal system to related external systems.

3.2.3 The Information Required for Control Purposes

An important use of much of the information collected is for the monitoring and control of distribution operations. It is thus appropriate to first examine aspects of operational control and the information this requires.

Buxton(13) describes in detail four basic control concepts as follows:

a) The 'control cycle' consists of a set of actions taken in controlling an operation. These consist of: collecting the information relevant to the performance of a particular management unit; comparing the

information with the standards or targets; and taking corrective action or adjusting the standard in the light of the variations.

b) 'Control loops' are feedback systems whereby corrective action is triggered by the information collected. Closed-loops occur when corrective action is taken automatically by the system and do not require human intervention, except when the standard needs to be adjusted. Open-loops highlight the need for corrective action but require human intervention for it to occur. Most control systems work on a combination of these two.

c) 'Tolerance levels' specify a range of performance levels within which actual performance should lie. However, these levels should be set carefully so that only random deviations are covered, and so that shifts in behaviour or efficiency are not obscured.

d) 'Management by exception' is a method of management that makes use of only exception reports. Here, activities that are performing satisfactorily are left to continue, while only those exhibiting variations are attended to. This ensures that corrective action is first directed where it is needed the most.

In most organisations, some management control is held through the allocation of operating budgets. Budgets are a source of information to managers and department heads about the costs associated with the activities under their control, and are often used as a standard of comparison for actual results. In such cases, the information included in budgets must be compatible to that collected for the purposes of comparison.

Skjott-Larsen (9, Ch.21), though, warns that a trade-off is necessary between the degree of integration required of a

firm's distribution control information and its cost. A high degree of integration results in close co-ordination between interacting activities and a greater and more consistent efficiency. However, the information system will be more costly, more complex and less flexible.

3.2.4 The Importance of Communications to the Order-Cycle

Skjott (9, Ch. 21) defines the total order-cycle as: "... the time that elapses between the moment a customer places an order and the moment the goods are physically delivered to the customer". Order processing triggers the order-cycle, and is the core activity of physical distribution information systems. Its inputs are the customer orders and its outputs are the signals that trigger off the rest of the distribution process.

The most important factors of the order cycle that can be improved by better communications are its average speed, its consistency or variability, its costs and its accuracy. A faster order cycle reduces the required inventory levels, thereby releasing capital and can sometimes result in a faster cash flow. Its reliability affects the levels of safety stocks. Any time lags or delays in the information flow between subsequent channel members will hinder the entire process and cause increases in the levels of safety stocks. The possibility of a trade-off thus arises between the costs of using a high-speed computerised order-processing system and the costs of high inventories and safety stocks, long lead-times and inconsistent order-filling accuracies.

3.2.5 The Use of Distribution Information Systems

Computerised systems are used mainly for the order-receipt and order-processing activities. Orders can usually be placed manually by using order forms, telephonically, or by using portable data terminals. These orders are normally loaded into the computer, and it then generates the necessary information, documentation and instructions to initiate the next set of activities in the distribution process. The latest systems used by major supermarkets and retailers involve using point-of-sale terminals to record sales data. Replenishment orders are automatically generated when a pre-set re-order point is reached.

The information systems that are used have been greatly affected by technical developments such as increased computer power, greater memory capacities, faster, more dependable and cheaper communications links and greater availablity of software. Any information system that is installed should be capable of performing four functions: data retrieval, data processing, data analysis and report generation. It must be remembered, though, as Buxton(13) points out, that the output of any computer-aided analysis depends on the accuracy and quality of its input data.

Killeen and Lauer(13) report that at present two primary paperless systems are under development:

a) To communicate information electronically from vendors to carriers to stores and to central warehouses.

b) The processing of inbound and outbound transactions at the warehouse.

3.3 THE CONTROL AND PERFORMANCE MONITORING OF PHYSICAL DISTRIBUTION

3.3.1 Reasons for Monitoring Distribution Performance

Costs, customer service levels and other distribution information that is used for controlling and monitoring distribution activities, also serve as a basis for further analysis and decision making by higher levels of management. The costs of the distribution function, and the potential increases in revenue and profits that it can generate make it an important area to monitor. However, it is important to remember that when an organisation reviews its distribution system, and controls and monitors it for its own profitability, it nevertheless forms only one part of a larger, total system.

Christopher(7) also points out that it does not always necessarily follow that an increase in customer service levels will lead to improved profits. Instead, a distribution system should be monitored with regard to certain stated goals and objectives. These goals may require the use of such measures as: return on investment, utilization of assets, system flexibility or some other measures of effectiveness. The information that is gathered for measuring the performance and controlling physical distribution, is also collected in order to: avoid suboptimisation of the total system, identify leads and lags in the system and evaluate system alternatives.

3.3.2 Using Distribution Performance Monitoring

Ackerman and La Londe(25) believe that the monitoring of distribution activities can be used as an effective and positive incentive to improve performance: "As long as the measurement is not used for disciplinary purposes, workers will co-operate in providing the input needed to measure their performance against a standard. When they become interested in statistics, they will improve their performance in their effort to compete for better scores."

Grouping products and customers by market segments and by geographical location to determine customer revenue profiles, will often reveal that there are only relatively few totally profitable accounts. A substantial number will make some contribution but will not meet the required overhead recovery rates. Often, an even larger proportion do not even meet the variable costs of delivery, thereby using up some contribution generated by more profitable accounts.

A survey carried out by Constantin et al.(22) in the U.S. showed that distribution managers overwhelmingly supported the use of variance analysis reports. However, they displayed some uncertainty about the uses of linear programming, regression analysis and simulation. This could be due to a lack of familiarity with these techniques.

3.3.3 The Importance of Auditing Distribution Performance

An internal and external audit of distribution and customer service performance should be carried out periodically by firms, within the span of their long-range planning horizon. They become necessary due to changes in the operating environment of an organisation. Sabath(19) suggests some important environmental changes as: a decline in market share, the rapid growth of a competitor, an increase in customer service complaints, shifts in demand patterns and an increase in complaints about product quality, freshness, packaging and order accuracy. Martin Christopher(7) describes an audit as: "The appraisal of the existing situation or position, both in terms of the external environment and the internal operating environment of the company. The audit is essentially a device for monitoring these environments."

Pearson(6) believes that there are three key decisions to be made when measuring distribution and service level performance:

a) A target market must be selected. All efficiency measurements are then based on how well that target market is served. This will allow definite measurements to be made of a tangible number of end users.

b) Set, as a policy decision, service level objectives. These objectives should determine a firm's distribution strategy, and not vice versa. Performance is then measured with respect to these objectives.

c) Make comparisons of the measurements with the firm's own established standards of efficiency. Industry averages or competitors' standards should not be used for comparison, but they can be used as a reference when setting the firm's own standards.

3.3.4 The Information Required from Audits

The information obtained from audits can be used to establish corporate macro distribution standards, as La Londe and Headen(26) point out, and then micro standards can be set compatible to the overall objectives for all the activity centres involved in the distribution task. These micro standards are usually set in terms of either activity levels or costs. A good audit should also point out potential improvement areas. An example is to reveal whether the demand for high service levels comes mainly from smaller, less profitable customers forced to make frequent emergency demands. Another example is to reveal which products, marketed as 'options', should be treated as special or custom-built to allow selective costing and pricing. Wilson(9, Ch. 21) suggests that some more outputs that can be obtained from an audit are: the varying costs of servicing accounts; the comparison of the firm's service levels with that of competitors and with industry expectations; the setting of minimum order and drop size policies; and the costs and response time of the spares and repairs service activity.

Perreault and Russ(18) suggest three criteria for selecting those customer service and distribution areas or elements that have the greatest potential impact for a firm, from all the areas identified by an audit. They rate on a scale of one to three: the stated importance of the particular element to the customer; the competitive potential of the element to the firm; and the relative costs of making changes to that element. In this way, a form of decision matrix is drawn up to score the total benefits to the firm of each identified area.

3.3.5 Some Key Performance Measures and Ratios

Most firms will have some of their own unique set of measures and ratios in order to determine specific aspects of certain activities. However, many measures are common to most activities. Knowing these may help a firm to improve its own performance monitoring, as well as to know the measures chiefly used by its customers and competitors to monitor performance.

The recent survey carried out by Killeen and Lauer(24) identified three types of productivity measures commonly used in the U.S. for measuring and managing distribution performance:

a) Units per labour hour expended. These are measures such as the number of units received per labour hour, or the number of units put away, ticketed, selected or packed per hour of labour.

b) Units per total function cost incurred. These are measures of performance with respect to the total cost of each distribution function: units received/total receiving costs, and also units put away, ticketed and shipped per total function cost.

c) Selected quantitative measures. These are used to assess the overall effectiveness of the distribution

function and to pinpoint potential problems for management attention. Some examples are: percent out of stock, inventory turns, percent selection errors, demurrage costs or number of emergency replenishments per day.

Wilson(9, Ch. 22) also suggests some key ratios. All of these are based on measuring: the activity level, or the potential or standard hours, or deviations from the norm such as lost time, or physical quantities such as occupied storage space and truck mileage; and comparing these to factors such as costs, revenues, available space or time, salaries, or consumables such as fuel or tyres. For more detailed information Vangermeersch and Brosnan(27) published a paper in which they identified 16 key units of analysis for which cost control data could be gathered. These are specifically geared towards enhancing the revenues of a firm generated through distribution.

3.4 THE ORGANISATION AND MANAGEMENT STRUCTURE OF PHYSICAL DISTRIBUTION

3.4.1 The Position of Distribution as a Business Function

Traditionally, the distribution activities and management responsibility have been split up and dispersed among various departments. For example, production was in charge of traffic, packaging and materials handling; marketing and sales supervised depot locations and their stocks, customer service levels and sales forecasts; and finance controlled order processing and investments in inventory. However, the trend now is towards grouping and centralising the physical distribution systems management.

The distribution function need not be the central function of an organisation. In the past it has been successfully managed under many of the other business functions, but in

such cases there is some risk of suboptimising the total system by the inclusion of bias towards the governing function. Physical distribution must be considered in decision-making in all other business functions. Conversely, almost all of the other departments in a firm have an input which influences the administration of physical distribution.

Distribution, like other business functions, can also be centralised on a company-wide basis, or decentralised according to divisions or departments.

3.4.2 Distribution Personnel and their Seniority Level

Distribution personnel can be employed in either line or staff function positions. Lancioni(28) quotes Bowersox and defines a line function as: "... one concerned with performing day to day operational duties related to the firm's product or service offering." Similarly, he defines a staff activity as one that exists for: "... developing new techniques and providing assistance to the line organisation so that operational objectives can be achieved."

Placing distribution personnel in staff function positions is therefore for advisory purposes. Such a department would concentrate on planning and measuring activities. In establishing such a system, as Wentworth(9, Ch.4) notes, there is no need to reassign people or relocate lines of authority, but it may be necessary to create positions. This structure is easy to implement and is frequently found as the initial form of a distribution department in an organisation. However, because of their advisory position, distribution personnel may find opposition or resistance to their work.

As a line function, distribution managers are directly in the operations' line of control. Wentworth describes this structure as more difficult to set up, and probably

requiring a transfer of personnel. In this case, there is a manager and personnel carrying out each activity of the distribution process. This creates a strong unity of purpose, but still requires an input of staff activity to help with planning and analysis. This would suggest using a combined structure, where staff personnel would act as consultants to the line personnel. In such a structure, Magee(21) suggests that the physical distribution manager should be in charge of: traffic and transportation, inventory control and overall production plans, sales order administration, customer service, warehouse management and physical distribution systems research and development.

However, the position of the physical distribution manager in the firm's hierarchy depends very much on the firm itself. The nature of the business may naturally lean towards marketing or production, and distribution may have to assume second place. Wentworth(9, Ch. 4) points out that physical distribution managers are on a par with production and marketing managers. Distribution connects these two functions, it has equal importance as a cost or profit centre, it serves the interests of both and it requires a similar degree of specialised skills. Some companies have appointed a distribution director at corporate director level. This, however, is not always possible or desirable. There may be enough functional directors already, there may be no suitable candidate, or for political reasons,in order to prevent opposition, it may be desirable to place the distribution manager under another function. In all cases, a high degree of integration is needed between all departments in order to prevent conflicts and breakdowns in communications.

3.4.3 Some Alternative Ideas

The solution that is finally implemented for the management of the distribution process depends very much on the organisation, the importance it places on the distribution function and its flexibility. There are also other ways of

introducing physical distribution management into a company. Christopher(7) suggests using a 'task force' that works on specific projects without regard to the function boundaries, but which draws on them for inputs to the sub-system the task force is managing. Some companies group production and distribution together into an 'operations' function which may also include purchasing. Irrespective of the solution implemented, physical distribution must be a well-defined management area with straightforward responsibilities and sufficient authority to carry them out.

3.5 SUMMARY

This chapter examined some basic considerations necessary to manage and control distribution operations in an integrated system. The distribution system must be established as an autonomous, cost accountable unit and its total costs must be examined. Cost information is required for planning purposes, for measuring effectiveness and for comparing alternatives by trade-off analyses. The cost of lost sales must be determined, to be used in setting service levels. Distribution costs should be allocated according to functional accounts, and not according to financial accounting classifications. The costs of distribution should then be used to set pricing policies, distribution incentives and selective service levels that are favourable to the firm.

Distribution costs and other information are required for planning, for the monitoring and control of activities and for co-ordinating distribution with other functions. The control of operations requires the setting of standards and tolerance levels for comparison with the performance measurements. One method of control is by setting budgets. The performance monitoring of activities and the transmittal of communications are especially vital in determining the

speed, reliability and accuracy of the order-cycle. Computerised systems are thus mainly used for order-receipt, order-processing and for other activities included in the order-cycle.

Distribution activities must be monitored to avoid suboptimisation, to identify problem areas and to evaluate alternatives to the system. The monitoring information should be used as incentives, and for determining the profitability of products and accounts. Performance measures should be based on audits of market requirements. Some productivity measures commonly used in the U.S. are: units per labour hour expended, units per total function cost and other measures.

Distribution should be integrated into one function and fit into an organisation as any other business function. Distribution personnel should be employed both as line and staff functions. The management of the distribution process can vary from middle-management to top corporate executive level, but should have well-defined and straightforward responsibilities.

CHAPTER FOUR

PHYSICAL DISTRIBUTION IN A SOUTH AFRICAN CONTEXT

Having discussed general aspects on the theory and management of physical distribution, and how these apply to U.S. and U.K. conditions, a closer look is now taken at South African characteristics. Section 4.1 looks at some trends evident in South African firms. South African 'big business' and its impact on physical distribution is discussed, as well as comment being made on the effect of technological change on distribution.

Some comments are made in Section 4.2 about South African markets and their obvious impact on physical distribution processes. Section 4.3 discusses transportation in South Africa, which is a reasonably well developed function of South African business. The recent past performance of, and trends in, the rail, road, air and sea transport sectors are examined. Notes are also included on certain aspects of a new 'National Transport Policy' currently under Parliamentary review. All the statistics used in this chapter were obtained from the volume: "South African Statistics 1986" published in Pretoria by the Central Statistical Services. Selected statistics are illustrated graphically in Appendix B.

4.1 CHARACTERISTICS OF BUSINESS OPERATIONS IN SOUTH AFRICA

4.1.1 The Balance of Power In South African Distribution Channels

South African business is characterised by some very big organisations in the industrial, manufacturing and retail fields. In the distribution of grocery, consumer and luxury goods, the channels are typically controlled by some large and powerful retail groups such as Pick 'n Pay, Checkers and

Woolworths. This is especially noticeable in the retailing of foods. These large retailers tend to act more as the consumers' buying agents than as the channels' selling agents. They often dictate the terms of distribution and the availability of goods to their suppliers, sometimes producing a situation similar to vertical integration where the suppliers may not be owned by the retailers, but are still totally dependent on them. In some cases, these retailers support their suppliers financially and otherwise for new ventures and major capital outlays.

In the engineering production and manufacturing industries, and in some areas of food processing, it is often the organisation that carries out the conversion process that is strongest in distribution terms. Some examples from various industries are, amongst many others: Hullets, Coca-Cola, South African Breweries, South African Nylon Spinners, the PG group of companies, SAPPI, South African Allied Newspapers, AECI, Hoechst and the motor industry in general. The heavy industrial and engineering components industry normally control their distribution channels by appointing agents to retail their finished goods. Some suppliers of raw material such as iron and steel, or coal and other mining products, are also large organisations but tend not to be viewed as part of the distribution channel. They use their own channels to distribute their raw materials to industry in general.

4.1.2 Present Trends in South African Business Operations

In certain areas of the engineering, manufacturing and food processing industries, monopolies or cartels exist. These are normally based in the large market areas. Although they often have a number of production and manufacturing facilities in various centres, these concerns effectively stifle the development of similar, localised industries in other parts of the country. Examples of such organisations are the breweries and the deep-sea fishing companies. Nevertheless, statistics from 1960 to 1979 show that the

total numbers of manufacturing establishments are increasing. This is a result of government policy to decentralise and to encourage the development of small businesses. No statistics were available since 1977 on numbers of wholesalers, but it is their suspected that these are decreasing due to retail stores increasingly managing their own warehouses.

In the production and manufacturing fields, there are not many current technological developments significantly affecting physical distribution. Foods and other consumer and luxury goods are increasingly being prepacked and prepriced at the manufacturing stage. The recent emphasis placed on the JIT philosophy of manufacture mainly influences the handling of work-in-progress and the distribution of smaller, more frequent batches of finished goods.

4.2 SOUTH AFRICAN MARKET CONSIDERATIONS

South Africa possesses relatively few, but concentrated, market areas. An analysis of retail sales statistics by economic regions identifies the main areas to be: the Western Cape area; the Eastern Cape area; the Transvaal PWV area; and the Durban-Pinetown area. Geographically, these areas are situated far apart with little business activity carried out in the areas separating them. Although demand is concentrated in these markets, sales volumes for consumer and luxury items are relatively small in comparison with U.S. and U.K. standards. There is, however, a great potential for large volumes of sales in so-called 'black' markets where the demand for such items is growing steadily.

Another factor is that the majority of industries and industrial areas are situated around the larger markets. However, not all industries are represented in all markets.

This has a tendency to segment and complicate the distribution of both raw materials supplies as well as that of finished goods. There is, at present, also a government policy to decentralise both industrial and residential areas. However, statistics of the percentage population in urban areas show trends of increased urbanisation. The main factor affecting distribution, though, is the geographic distances separating market areas.

4.3 TRANSPORTATION

The large distances separating markets in South Africa place a great importance on the long-distance haulage of goods. The use of bulk transportation, however, is not always possible due to: sales volumes being relatively small; the location of certain suppliers and manufacturers in certain areas only, causing delivery destinations to be segmented and scattered; and the flow of goods from an organisation to a particular market area often being in one direction only. There also only exists a limited number of routes to arrive at a particular destination, which complicates the routing and scheduling of deliveries. Despatches to decentralised areas are often routed through major centres, and thus increase the transport load between these centres. The location of industries generally into industrial 'parks' surrounding the larger centres affects local deliveries as well.

4.3.1 Trends in South African Transport Modes

Statistics of the South African Railways route kilometres show that the rail infrastructure is expanding very slowly, and is unlikely to change much. The emphasis here will be on achieving greater transport speeds. The total amount of goods traffic in terms of tonne-kilometres carried by the railways has decreased slightly since the early 1980s. However, the introduction of new services such as

'Fastfreight' and the mini containers may affect this. The total kilometre distance of roads in South Africa has also remained almost constant since the early 1970s. But, the relative ratio of tarred roads to other roads has been slowly increasing. This shows that the total road network is not expanding significantly, but that existing roads are being upgraded and improved. Recent developments of private toll roads may have an effect on the total network, though, particularly if these increase the access to certain decentralised areas. An analysis of statistics of road and rail transport of goods shows a slight increase in the volume of goods transported by the SATS rail and road services, and a correspondingly large increase in the volumes transported by private transport contractors. Holz (29) reports that the railways' market share of the total goods transported dropped from around 62% in 1952 to 40% by 1972. The figure for 1985 was still around 40%, having dropped as low as 33% during 1984.

However, the amount of air freight tonne-kilometres carried by SAA has risen considerably. The international overseas services increased more than eight times, and the internal services more than three times, between 1970 and 1985. Only the relatively small amount of tonne-kilometres of freight carried on regional services to neighbouring Southern African countries have decreased since the late 1970s. The amount of shipping cargo handled by South African ports has also grown, with the total amount of overseas harbour tonnes handled almost tripled in the ten years between 1975 and 1985. However, the amount of coastwise cargo has decreased by almost 30% in the same period.

4.3.2 The Effect of the National Transport Policy Study

The single most important factor that will affect distribution transportation in South Africa in the immediate and long-term future is the draft White Paper on National Transport Policy submitted to Parliament by the Minister of Transport Affairs on April 4, 1986. It is based on the

recommendations of the National Transport Policy Study (NTPS). Some of the basic recommendations are: that the transport of freight in South Africa should be deregulated, and that the permit system for the transport of certain goods by private carriers should be abolished; that SATS should be allowed to negotiate the transport and price of the goods it wishes to carry; that cross-subsidisation within and between the various modes of transport by SATS be eliminated; and that all carriers should contribute fully to the maintenance and development of their respective modes of transport infrastructures. Various other recommendations were also made, including some concerning SATS fares and their alignment to true costs, the payment of uneconomic services and public safety regulations to be applied to all carriers. A number of legislative changes were also listed, including the creation of three new statutory bodies to replace five other organisations. The integration of SATS into a national organisation offering a transport service, as opposed to being a collection of separate road, rail, air and sea transporters, is seen as being a development similar to the creation of the National Freight Corporation in the U.K. The aim of the new legislation is to: "...ensure total free competition in the freight transport market by entrenching equitable compensation", as described by Holz (29).

4.4 SUMMARY

General environmental conditions affecting distribution activities in South Africa were reviewed in this chapter. Some large retail groups control the supply and distribution of foods, consumer and luxury goods. Similarly, in the engineering production and manufacturing industries, the organisation carrying out the conversion process is often dominant.

Monopolies or cartels exist in certain business fields. This stifles competition and promotes the location of multiple production facilities in large market areas. However, total numbers of manufacturing establishments are increasing. South African markets are relatively small and scattered over large distances. Major industries and businesses are also situated in the large market areas, but are not all represented in all markets. This segments the distribution of goods and services.

The rail infrastructure in South Africa is expanding very slowly, with more emphasis placed on increasing transport speeds. Total rail traffic is increasing, but the SATS market share of combined road and rail traffic is dropping in favour of private carriers. The road infrastructure has remained almost constant, but may change with the introduction of toll roads. Air freight has increased considerably, except to neighbouring Southern African countries. Overseas shipping cargo has also increased, but coastwise cargo has decreased.

The main recommendations of the National Transport Policy Study that affect distribution are: the deregulation of freight transport, allowing SATS to negotiate transport rates competitively, the payment by carriers for their transport infrastructure and the establishment of more stringent public safety regulations.

CHAPTER FIVE

POTENTIAL IMPROVEMENT AREAS IN PHYSICAL DISTRIBUTION

This chapter highlights some of the areas in the physical distribution function where there exists the greatest potential for improvements and savings. A general discussion is given in the Section 5.1 on the implementation of changes in distribution. Implementation of a differential service level policy, according to customer profitability and product, is discussed. The importance of recognising functional and operational inter-relationships, and of recognising the effect on them of changes in the distribution process is noted. Some capabilities and criteria necessary for setting up a distribution information system are examined. A note is also included on the sequential development of distribution departments.

Sections 5.2, 5.3 and 5.4 deal with the activities of warehousing and materials handling, inventory management and transportation management respectively. The various types of warehouses, their location and materials handling systems and equipment are reviewed. The management of inventory is discussed with a view to reducing investments and costs. The various modes of transport are compared, as well as their appropriate selection.

The chapter concludes with a short discussion on customer service, means of improving it and ways of reducing costs. It should be noted that although the subject of customer service is treated last, it is the output of the distribution process, and is the factor that sets the overall objectives of the physical distribution function. The levels of customer service should first be set then the distribution function should be organised to meet these requirements and its performance monitored with respect to the chosen goals.

5.1 IMPLEMENTING CHANGES IN PHYSICAL DISTRIBUTION

5.1.1 Setting Distribution Objectives

Based on the strengths and weaknesses of an organisation's current operations, as well as on the available market opportunities, distribution objectives or standards should be formulated. These 'macro' objectives of the distribution function must also be compatible with the overall corporate goals, and these together identify the 'micro' objectives that deal with specific standards for the various components of the distribution process.

An important method of setting distribution standards is by the use of flexible service policies differentiated by products and by customers or market segments. La Londe and Headen(26) describe the macro distribution standards applied by the U.S. army. The system is adapted and summarised below. The market segments, groups of customers or military units are given a 'Force Activity Designator', which ranks their importance according to their contribution to desired objectives. Similarly, products or items are grouped and given an 'Urgency of Need Designator' in relation to their importance and the role they play in maintaining operational effectiveness. This is similar in concept to an ABC-type classification. The customers and items are then arranged in a block matrix format and the matrix coefficients are allocated according to their priority level in distribution. These priority levels are then split into groups and used to define the maximum allowable order-processing time and order-cycle time. The system is illustrated in Fig. 5.1(a), (b) and (c)

(Product)	Urgency of Need	Designator			
		A	B	C	D
	I	01	04	11	16
Force Activity	II	02	05	12	17
Designator	III	03	06	13	18
(Customer)	IV	07	09	14	19
	V	08	10	15	20

From: U.S. Army Logistics Management Manual (FM38-1)

Figure 5.1(a) : Military procedure for determining distribution priority level

Priority Group	Priority Designator Range	Maximum processing, from receipt of requisition to availability for shipment
One	01-03	1 Day
Two	04-08	3 Days
Three	09-15	10 Days
Four	16-20	12 Days

From: U.S. Army Logistics Management Manual (FM38-1)

Figure 5.1(b) : Determining allowable processing time based on distribution priority level

Priority Group	CONUS PDD from date of requisition to receipt of material	Overseas PDD from date of requisition to receipt of material
One	5 Days	7 Days
Two	8 Days	15 Days
Three	20 Days	45 Days
Four	30 Days	60 Days

CONUS - Continental United States
PDD - Priority Delivery Date

From: U.S. Army Logistics Management Manual (FM38-1)

Figure 5.1(c) : Order-cycle standards, based on distribution priority level, for evaluating distribution system performance

This description of the system is very simplified, but the basic concepts apply and can be used to determine very effective macro standards. There also are many other factors, such as information flow and monitoring systems, that must be considered when applying such an approach. Once such macro standards or objectives have been established, though, the various alternative strategies to achieve them can be examined.

5.1.2 Some General Suggestions for Improvements

To evaluate alternatives, Metz(30) introduces the concept of the 'break-even sales increase'. He defines it as the increase in sales necessary to just compensate for the increase in delivery costs incurred by introducing the new system. He suggests an overall approach when evaluating alternatives. Firstly, to subdivide the overall system into sub-activities such as: quantifying the firm's market share, the percentage of urgent orders, the marginal profit on the various products and the transportation costs of the

various alternatives. Secondly, to determine the accuracy of the various factors that are known, and to make maximum use of the available data to eliminate possible alternatives as early as possible. The key sensitivity points, then, are normally areas of maximum potential trade-offs.

The customer or market segments account groups, described in 5.1.1 above, should also be analysed and monitored for profitability. Gordon Hill, reported by Cox(31), suggests that the number of unprofitable accounts can be reduced by: improving the product mix, increasing sales volumes, reducing delivery frequency, lengthening the order-cycle time, applying a minimum-order limit, charging a premium on small accounts, intensifying the business in the vicinity, encouraging the use of wholesalers, reducing the level of service, using less costly ways of obtaining orders or using non-returnable packaging. External factors that will influence the decision to be taken are: the customer service standards, the pattern of demand, the way in which the orders were obtained, the frequency of delivery and the trading terms.

Killeen and Lauer(24) also identified in their survey some areas between merchandising and distribution that could be better co-ordinated: the available capacities of the various distribution facilities, the storage capacities of the retail stores, alternate means and costs of transport, alternate means and costs of storage, the timing of distribution and the transfer of merchandise between stores. Marketing can also combine with distribution to provide incentives to customers through the sales discount structure, that will benefit the distribution system. Annan(32) believes that a financial budget: should identify areas of expenditure and activities in distribution; should be presented in terms of varying levels of sales; and should identify various channels of distribution and their costs and profitability. Computer services should also introduce a computerised parcel monitoring system to enable

instant information availability on the whereabouts of consignments.

As Aspinall and Chadwick(33) point out, a firm should always be striving to obtain the correct balance between product quality, the service offered and the price demanded. They distinguish those companies in the distribution industry that can charge higher prices as being extremely speedy and reliable, having very few breakages and offering extra services such as: the storage of goods, the picking of specific orders, remedial facilities for damages and even computer services.

5.1.3 Notes on Information Requirements

When designing information systems for distribution, certain steps and procedures are recommended to be followed: interview customers, set performance standards, identify critical areas to be monitored and interview management about their information requirements. The most significant sources of data for the data base are the order-processing system, the company records, industry data and management data. A data base is needed that is capable of aggregating data so that information on specific sectors such as customers, salespeople, products, territories or channels of distribution can be obtained. In order to carry out incremental cost and revenue analyses, data in the form of fixed and variable components must also be available.

To minimise total costs, and to evaluate trade-offs, the costs associated with each individual component must be known and how changes in each contribute to the total. Killeen and Lauer(24) have identified network cost modelling as being an important area of future development. Therefore, it must be remembered that such models also require detailed data inputs.

It is also very important to ensure that the right information is being collected, otherwise very precise but

irrelevant records will be kept. For example, detailed data on transport costs will be kept but none on the costs of delivery. Another point to consider is that it is often less costly to achieve a time saving through the information flow rather than the physical flow through an organisation. A relatively new development is to consider key suppliers as other departments of the same company in order to provide a direct link and flow of certain information.

5.1.4 Developing a Physical Distribution Structure

Lambert and Stock(2) list a number of steps to be followed when starting or reorganising a distribution organisational unit, including: research the corporate strategy and objectives, organise the function in a manner compatible with the corporate structure, define functional accountabilities, identify the support systems, determine system flexibility and understand and plan the allocation of human resources.

A study by Lancioni(28) has identified the typical sequential development of a new physical distribution function established by a firm. Line positions were incorporated first in a definite sequential pattern: warehousing, was first; order processing was second; the traffic function, was third; fourth was purchasing; inventory management was fifth; and after that came tracing and expediting, production scheduling, inventory control and value analysis as relatively new activities. Later, staff positions were created to support and assist the line personnel, also in a definite sequence: first was customer service; finance and budgeting was second; then came systems and procedures, forecasting, personnel and training and operations research. This sequence should be approximately followed when establishing a new distribution department. The biggest problem encountered was the lack of communication between line and staff personnel. Other difficulties arose in defining the responsibilities of distribution staff personnel, in understanding the positions

of staff personnel by line personnel and in recruiting qualified personnel. Some of these problems could possibly be overcome by initially implementing a staff function oriented structure, as described in Chapter Three.

The effectiveness of the distribution department should also be monitored. It is important, therefore, to identify, measure and prioritise the basis upon which this will be done, for example considering flexibility, reliability, results or productivity.

5.2 WAREHOUSING AND MATERIALS HANDLING

5.2.1 The Purposes of Warehousing

Warehouses are necessary for many reasons. The demand for any product or item is normally not matched to its production. Demand patterns are erratic or variable, and sometimes seasonal, while production tends to be constant and regular. Therefore, goods need to be stored in the interim period between the time they are produced and the time they are consumed. Warehousing of goods also allows for economies to be made on bulk transportation, materials handling, unitisation and order assembling. When a variety of goods are obtained from a number of sources, some facility is also required in order to carry out the break-bulk, order-picking and assembling activities. Warehouses or depots are thus required as facilities to provide working and safety stocks, as merchandise transfer points and as break-bulk and order-assembly points. Walker(9, Ch. 5) points out that over and above these functions, warehouses also provide for merchandise security.

Locket and Westwood(34) differentiate between a warehouse, linked to points of production or import, and a depot, which is regional and close to the market. They identify warehouses as being a buffer between fluctuations in demand

and in production. Depots are close to the market and provide the required service levels. While warehouses and depots also both perform a storage function, 'distribution centres' can be defined as facilities where the primary aim is merchandise movement.

5.2.2 Activities Included in Warehousing

Therefore, a warehouse has two basic functions: movement and storage. Lambert and Stock(2) believe that movement in a warehouse is made up of four handling activities:

a) Receiving. This means unloading the products, inspecting the quality, verifying counts and updating records.

b) Transfer. This includes all movements into the warehouse for storage, movement into consolidation areas and movement to loading docks for shipment.

c) Order selection. This is the major movement activity in a warehouse, the regrouping of goods as per orders and the drawing up of packing slips.

d) Shipping. The goods are loaded and the records are adjusted.

The storage function can be either 'temporary' or 'permanent'. Bowersox, as quoted by Buxton(13), defines permanent storage as: "Storage in excess of the inventory required for normal replenishments." Storage in a warehouse may also be required for 'conditioning'. This is where a transformation occurs in the nature or quality of the goods, as in the fermentation of wine.

Lambert and Stock(2) also identify and list 15 activities included in warehousing: inventory control, purchasing, order entry, receiving, inspection, redistribution, put away, storage, replenishment, order selection, checking,

packing and marking, staging and consolidation, shipping and clerical/administration.

5.2.3 Planning Warehousing Facilities

In the planning of warehousing operations, Waller(9, Ch. 5) distinguishes related decisions according to their various planning horizons:

a) Strategic decisions. These involve questions such as: the level of technology and the amount of its use; and the size, location and types of facilities. These types of decisions should typically be reviewed every three to five years.

b) Tactical decisions such as methods of transport, product location in the warehouse, direct delivery policies and inventory levels. These should be reviewed yearly.

c) Operational decisions. These are decisions taken for the day-to-day running of warehouse operations: vehicle routing, load planning, overtime levels and depot replenishments.

It is the strategic decisions involved in warehousing and materials handling that need careful consideration, for they typically involve a large capital outlay and long-term commitments. Waller(9, Ch. 5) identifies some considerations to be taken in long-range planning:

a) The current and likely future demands on the system: in terms of quantities, nature of sales and customer service requirements.

b) The network of facilities, including depots, that would be best suited to adequately satisfy such demands.

c) The resources and costs necessary to operate such facilities and transport operations, as well as the capital required to develop current facilities to such an extent.

An analysis of these factors can then be carried out in order to determine the optimum number of depots, their optimum locations and the optimum flow of goods through each. The decisions regarding depots are often taken in this order. Computer studies can also be undertaken to help this decision making. The layout of warehouses depends very much on the products to be handled. Their storage methods and the equipment used can vary considerably: palletised systems or various types of racking such as 'drive-in' or 'drive-through' or narrow-aisle high-rise racking. McKibbin(8, Ch. 11) identifies two basic planning requirements. Firstly, an efficient plan of materials flow must be developed. Secondly, the materials flow pattern become the basis for the correct arrangement of facilities and of the work area. According to Firth(9, Ch. 8), the three main areas of warehouse design are the goods receiving and despatch area, the storage area and the order-picking area.

5.2.4 Costs Involved in Warehousing Facilities

The costs of warehousing are normally substantial. They have a fixed investment component and a variable component dependent on the volume and nature of the throughput and also on the storage and handling methods. The total warehousing costs of any organisation vary significantly with the number of its facilities.

The warehousing structure can also significantly affect the inventory costs of a firm. Waller(9, Ch. 5) describes how the fixed warehousing costs such as rent, rates or administration can be reduced by contracting, leasing or mechanising facilities. He shows, as in Fig. 5.2(9,Fig. 5.10), the relationship between depot costs and throughput,

illustrating first the economies of scale and then the 'diseconomies of scale'. The warehousing and distribution centre facilities of an organisation can be centralised or decentralised, and they can be company-owned, rented, leased or contracted out or any combination of these. However, aspects such as security and constraints on the layout and the materials handling equipment used should not be ignored.

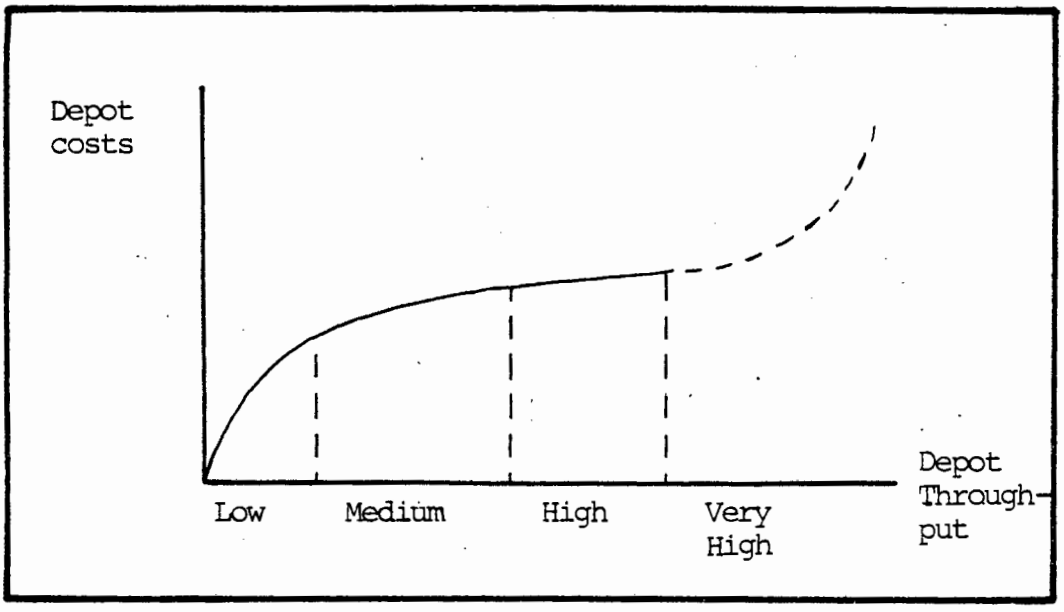


Figure 5.2 : The relation between depot costs and throughput, showing economies of scale and diseconomies of scale

As McKibbin(8, Ch. C.11) points out: "The slow moving items, essentially of a static nature, incur substantial costs in storage but only nominal costs in handling. The exact reverse holds for the fast moving items." Since both types of items are usually found in warehousing operations, there is justification in trying to improve the efficiencies of both storage and handling activities. The present day emphasis on increased speeds of inventory turnover is thus possibly reflected in the rapid development of materials handling equipment.

5.2.5 Warehouse Location

The location chosen for a warehouse or distribution centre often depends on a trade-off between the warehousing and transport costs of the flow of goods through the warehouse, and on the customers and factories allocated to that warehouse. Waller(9, Ch. 5) describes that customers and factories can be allocated to a warehouse on the basis of proximity, costs, or customer service requirements. The desirability of having a local control on operations may also influence the depot siting.

Lambert and Stock(2) identify three types of depot location strategies from a macro perspective:

a) Market-positioned. These are warehouses nearest to the final customer. Factors that should be considered in such a strategy include: transport costs, order-cycle times, the perishability of the product, the order size, local transport capabilities and required service levels.

b) Production-positioned. These are closest to production facilities or sources of supply. Factors to be considered: the perishability of the raw materials, the number of products in the mix, the assortment of products ordered, transport consolidation possibilities and rates.

c) Intermediately positioned at the midpoint between sources of supply and demand. This strategy is often pursued when there are varied products made at several plant locations, and high customer service levels must be provided.

From a micro perspective, they also list a number of factors to be considered when choosing an exact site: the quality and variety of transportation carriers serving the site, the quality and quantity of labour, labour rates, the

cost and quality of the industrial land, the potential for expansion, the local tax structure, the building codes, the nature of the community environment, the costs of construction and the cost and availability of utilities.

5.2.6 Methods of Facilities Location

The optimal locations for warehousing facilities can be found by a number of analytical methods, heuristics, computer techniques and packages and, more recently, by the use of simulation studies. Almost all methods of finding optimal facilities locations use one of two approaches. The 'infinite-set' approach allows an optimal location to be found anywhere. This is very flexible as the actual implemented solution can be in the near vicinity of the optimal location without significantly altering any variables. However, in this method the costs are not known and are usually assumed to be proportional to distance. In the 'feasible-set' approach, a finite number of known, available sites are used. In this case, costs can be accurately determined, but the distance of the final solution from a theoretical optimum is not known. It is also restrictive in not considering potential future developments and changes in availabilities. In all cases, though, it is vitally important to carry out a sensitivity analysis to determine the stability of the solution to the critical parameters.

5.2.7 Some Basic Principles of Materials Handling

In order to select the desired materials handling capabilities of various facilities, it may be useful to review some principles of materials handling. Firth(9, Ch. 7) has identified five, which are summarised below:

a) The use of unit loads. The idea being to form as large a unit as possible, preferably to ISO standards, and to retain it as long as possible. The principal advantages are the ease and speed of handling, better

use of space, product protection and a reduction in the use of labour.

b) The use of cube space. The equipment costs are initially higher and it is more expensive to operate. The use fork-lift trucks or stacker cranes are required here, but the advantages are better land utilisation and reduced building costs.

c) Minimisation of movement by considering, for example, the stock location, the batching of orders and the zoning and departmentalization of the warehouse. It should be noted that storing in height also requires movement.

d) The control of flow direction. Cross-over points and areas of high traffic density should be avoided. Possibilities here include the use of 'U-flow' or 'through-flow'. Parking areas should be carefully located.

e) Safety and security aspects. This involves sound design, safe operation and adequate operator training, as well as paying attention to gangway widths, racking tolerances, adequate stacking and congestion areas. The awareness of fire hazards and the proper maintenance of alarm and sprinkler systems is also important.

5.2.8 Types of Storage Systems

The final design and selection of materials handling systems and equipment will be dependent on many factors, notably three important ones identified by Buxton(13): the characteristics of the products, the volume of movement and the distance and dimensions of movement. The handling equipment could be manual, power-assisted or fully mechanised. Firth(9, Ch. 7) classifies most storage systems under three headings:

a) Palletised unit-load systems. This can be done by stacking like products in rows two or more pallets deep, called block-stacking, or by making each pallet individually accessible, called individual pallet access.

b) Small components systems. These normally use bins or shelving to hold stocks. However, these often allocate excessive space on the basis of maximum stock for every item.

c) Long-load systems. These often use bar-rack techniques of the pigeon hole or cantilever type.

5.2.9 The Design of Facilities and Equipment

When reviewing warehousing facilities, systems and equipment, most firms are constrained by their existing facilities. The ideal method of designing a warehouse or distribution centre is to determine the flow of goods through it, design its layout, select the materials handling equipment and only then design the building structure around it. Some warehousing facilities are designed such that the racking and storage equipment is the building support itself. However, in many cases, firms will be reviewing the materials handling equipment requirements for already established facilities, and will thus be constrained in their choice.

For new establishments, the use of raised or level load/unload docks must be decided. Operations research or simulation studies can be used to decide on the number of bays. The areas of the docks and their marshalling space also have to be allocated. Buxton(13) describes four inventory location methods: by popularity, measured in orders per day or week; by unit size; by total space requirement, measured in cube volume; or by the cube/order index. This last index, obtained by dividing the volumetric space required by the order frequency, gives a measure of

the space and popularity of a product, with the lower indices closest to the door. This measure always gives a good location method, if not optimal, and is probably the most consistently accurate technique available.

Warehouses, depots and distribution centres are also ideal areas for computer applications. They are currently used especially for rapid recording of received and despatched merchandise, and for identification coding at load/unload areas. However, computers can be used to such an extent that some facilities have become fully automated. Buxton(13) distinguishes between automation and mechanisation: automation implies some form of computer control, while mechanisation implies the replacement of manual labour by machinery. There is a high degree of correlation between the two, though, since automated facilities usually involve a high degree of mechanisation.

The characteristics required for automated systems are: a minimal variety of products, especially with respect to size and shape; the use of large unit loads helps to keep costs down; and a high speed of flow. But, the advantages of automation include: a reduction in labour costs, increased efficiency by reducing order-picking times, and a reduction in warehouse size due to improved space utilisation.

Locket and Westwood(34), though, argue that the only essential function of a regional depot is that of product transfer. This leads to the idea that the depot is unnecessary and that only a 'transit point' is required. This transit point or changeover location is simply a meeting of two vehicles. The goods are then transferred from the trunking vehicle onto the local delivery vehicles without requiring any of the other depot operations. While the authors describe a number of U.K. companies that have adopted the concept, it may not be feasible in all cases.

A different application of a similar concept is reported in the survey by Killeen and Lauer(24), where a substantial number of U.S. companies, especially larger ones, are applying a 'cross-docking' technique as much as possible. Cross-docking occurs when an inbound shipment is taken to a staging area for immediate processing and direct outbound shipment to stores.

5.3 INVENTORY MANAGEMENT

5.3.1 The Purpose of Inventory

As was discussed in Section 5.2 above, inventories are necessary to make up for the differences and variabilities between production and demand. However, in recent times of high interest and inflation rates, the emphasis has been on reducing inventories in many organisations. In many cases, retailers and other organisations have successfully reduced their inventories at the expense of producers and suppliers. This has been achieved by ordering smaller quantities more frequently, coupled with higher customer service expectations. There has also been an increase in the demands for varieties of models, styles, colours and other variations, leading to a decrease in the movement of each variety.

As Sharman(4) points out, stocks can also deteriorate, become damaged or obsolete and serve to delay the recognition of quality problems. However, stocks are not altogether negative. Sawdy(23) believes that: "Stock is not a liability; it is a vital tool in the determination of long-term profits." Lambert and Stock(2) identify six types of inventories: cycle stock, required to meet the normal demand; in-transit inventories; safety or buffer stocks to account for the variability in demand; speculative stock held in anticipation of, for example, a price-rise; seasonal stock; and dead stock.

5.3.2 Methods for Reducing Inventory Investments

Lambert and Stock also cite six areas to be reviewed when attempting to reduce the amount of stock held by a firm: multiechelon inventory planning, as in an ABC-analysis of inventory; lead-times analysis; delivery times analysis; elimination of low-turnover items; analysis of pack-size and discount structure; and examination of returned-goods procedures. It should be remembered that inventory is a typical area where the 80/20 rule applies, and thus centralising slow-moving and low-volume items can significantly reduce a firm's stockholding. Since the amount of inventory increases geometrically with the number of stockholding points, the remaining products that account for the bulk of a firm's sales and profits could be consolidated at fewer locations. However, it must be noted that centralisation and consolidation of stock will normally increase transport costs, especially if customer service levels are to be maintained. A cost-value trade-off analysis will thus be required for these decisions.

Improved forecasting will also reduce inventory by preventing the unnecessary deployment of goods. Reducing the replenishment-cycle time for depots or distribution centres will reduce stocks, and reducing the order-cycle time variability will reduce safety stocks required to cover uncertainties. Lambert and Stock show, as in Fig. 5.3(2, Fig. 9.10), how introducing a computerised system to increase the speed and accuracy of order processing can reduce the total order-cycle variability and increase the time available for planning.

Christopher(7) warns about the 'accelerator effect' unnecessarily raising and lowering buffer stock levels in a distribution channel. These variations in stock levels are triggered off by changes in demand, but lag the demand fluctuations, and are amplified in magnitude. This is illustrated graphically in Fig. 5.4 overleaf, where a manufacturer, a wholesaler and a retailer hold 8 weeks, 12

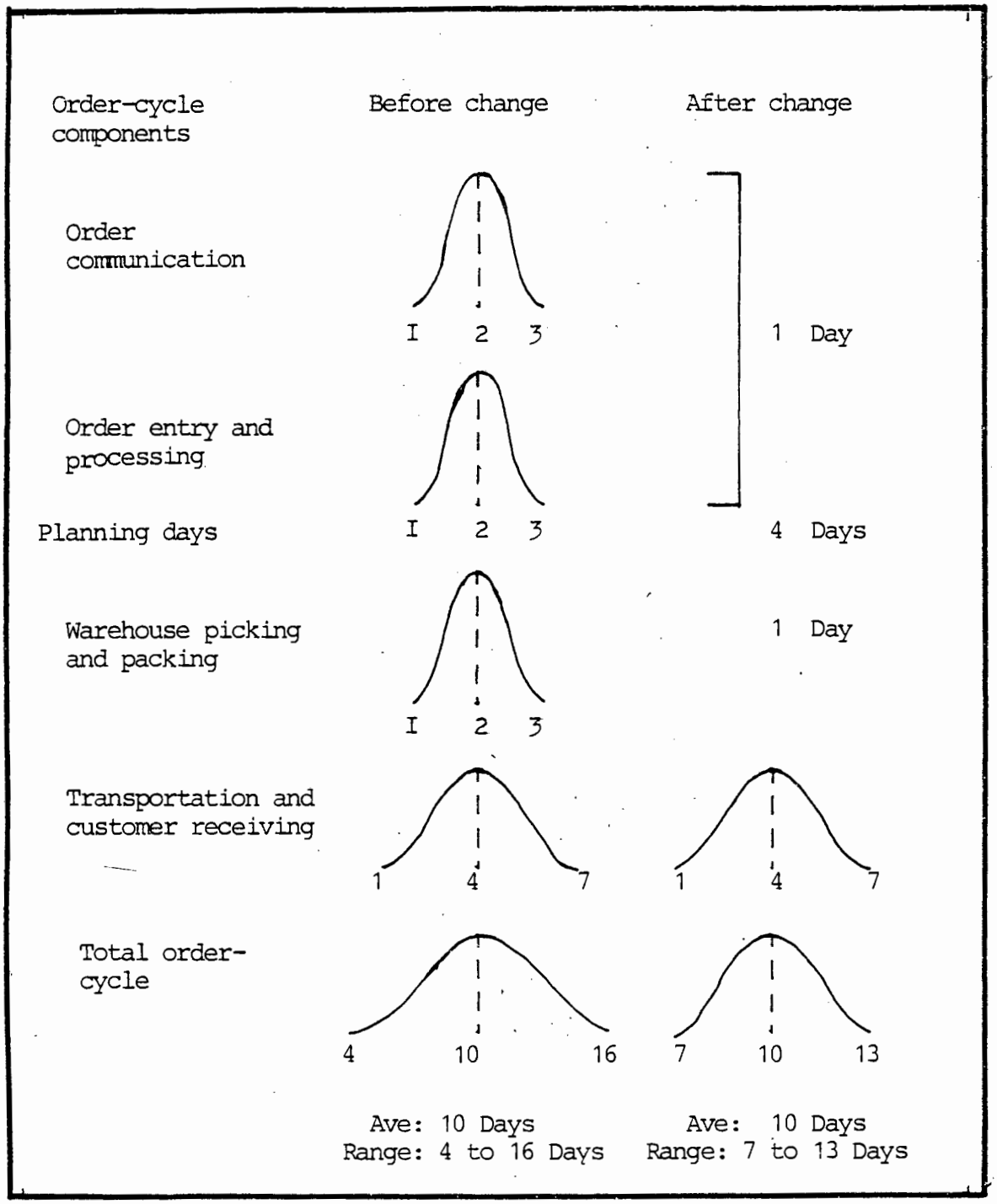


Figure 5.3 : Introducing a computerised order-processing system to increase available planning time and decrease order-cycle variability

weeks and 3 weeks of buffer stocks respectively for customer service purposes. An increase in consumer demand of 20% causes: a 21% increase (20% + 20% of 3/52) in stocks at the retailer; a 26% increase (21% + 21% of 12/52) in stocks at

the wholesaler; and a 30% increase (26% + 26% of 8/52) in stocks at the manufacturer. The reverse process occurs when consumer demand drops.

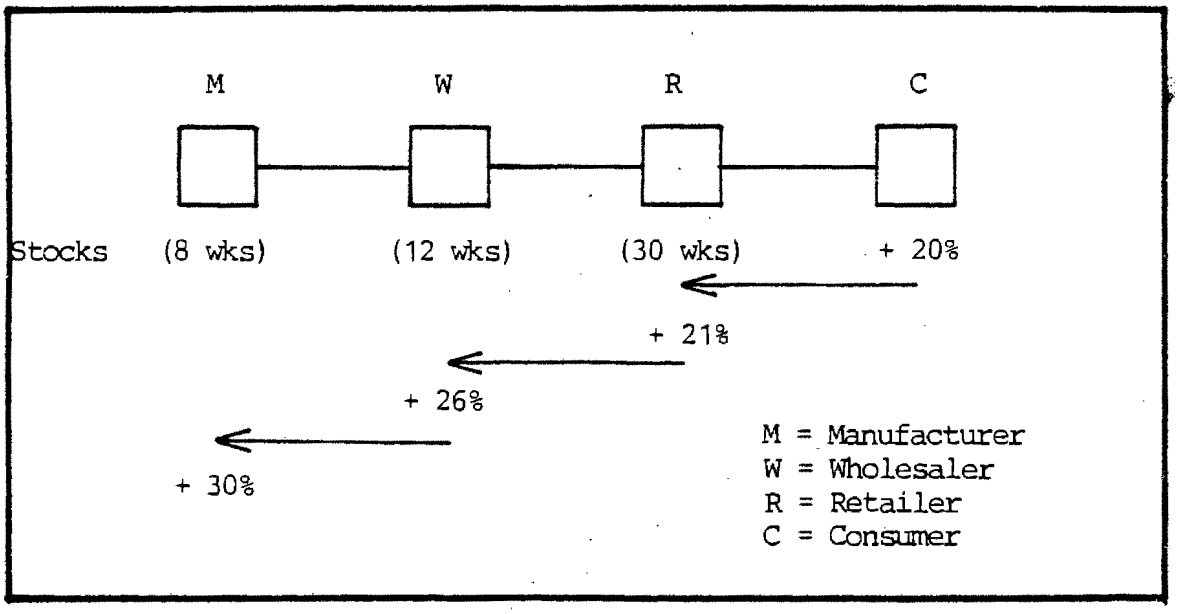


Figure 5.4 : The accelerator effect in a distribution Channel

Lambert and Stock(2) show that inventory levels increase disproportionately as service levels approach 100%, implying that customer service cannot be improved solely by adding inventory. They also illustrate how increased inventory turnover substantially reduces carrying costs. However, a trade-off is required here with the effect of increased turnover on transportation and on customer service levels. It should also be noted that inventory policies such as increased turnover, reduced safety stock levels and stockholding consolidation can greatly affect costs of production.

Ray(9, Ch. 10) believes that any review of a firm's inventory should include decisions on: the range of the trading stock, with a view to eliminating dead stock; the range of items that need to be kept at decentralised points

and the items to be centralised; the number of field depots to maintain; and the target service levels required. He also lists a number of criteria to be used when making an ABC-type analysis of inventory:

a) Sales value. To be used when the whole range of items sells at reasonably similar speeds and mark-ups and sales value.

b) Profit contribution. To be used when the whole range sells at similar speed, but mark-ups vary widely.

c) Sales frequency. When the range sells at widely different turnover rates, but similar gross margins.

d) Sales frequency/profit contribution. When the stock range sells at varied speeds and mark-ups.

e) Sales frequency/sales value. To be used when the range sells at widely different frequency and large variations in sales price per item.

5.3.3 The Costs of Inventory

Stocks tie up capital and produce high interest costs. Sawdy(23) identifies two other important costs of inventory that are proportional to the amount of stock held, and that must not be overlooked: the costs of product deterioration and the costs of product obsolescence. He defines stock as: "investment in unsold goods", and points out that it does not have to be in a warehouse. He believes that, at any one time, a firm's inventory consists of: goods paid for and stored in a warehouse, goods ordered and paid for but not yet received,as well as goods despatched but not yet paid for. To this list should also be added work-in-progress.

5.4 TRANSPORTATION MANAGEMENT

5.4.1 The Effects of Transportation

Transportation is an important aspect of the distribution process, involving the physical movement of goods. It also contributes significantly to the total distribution costs. A number of conventional forms of transport are readily available to firms for the transportation of their goods to the following member of the distribution channel. When managing the transport activity, the total distribution concept should be remembered at all times, since this is an area that can easily be suboptimised to the detriment of the entire function. The transportation area is also constantly undergoing changes. As Ratnatunga(16) describes: "... it is not static; the whole question of transportation must be kept under constant review to ensure that it kept efficient." Any improvements or changes in the transport activity impact mainly on the inventory management and materials management functions.

Due to the high costs of transportation, there is an increasing interest in improving efficiencies and existing equipment, and in using more efficient forms of transport in terms of energy consumption and pollution. Backler, reported by Cox(31), identified transport costs into three areas where they are incurred. Product-related costs are associated with volumes and the product mix, as well as with matching the transport requirements with the availability. Customer-related costs refer to the distance between the despatch point and the customer, and the time spent at the unloading point. Network-related costs are a function of the routings and schedules used and the third parties involved. These network-related costs and some product-related costs have been the subject of studies in order to minimise them using operations research and simulation techniques. Gordon Hill, reported by Cox(31), reported on a 1979 survey carried out in the U.K. on ways of achieving productivity improvements: in trunking operations, by

improving fuel economies, matching vehicles to loads and strategically introducing distribution centres; in local deliveries, by re-organising routes and aiming for 'nameday' deliveries.

According to Annan(32), the statistics to be collected for the management of transportation should be related to: despatch patterns, either daily or weekly; the methods of delivery used, such as own vehicles, hired transport or railage; vehicle routes; vehicle efficiencies, usage and utilisation; vehicle accidents; lost time and breakdown time; average vehicle mileages per engine or set of tyres; vehicle running hours and costs; cost comparisons between different types of vehicles; and different forms of fuels used, such as diesel, petrol or electric. All this information can then be used to monitor performance, to select the correct type of transport and to make improvements in the vehicle routings and fuels used. Planned maintenance programmes, which include items such as tyres, can then also be evaluated and monitored.

Another aspect which should be considered in transport management is the use of unitisation and containerisation and the 'through-transport' concept. This concept was developed in order to achieve a faster, smoother flow of goods with reduced handling and greater security. Goods are packed and sealed in a container and, passing though one or more modes of transport and various parties, are only unpacked at their final destination. Where suitable, it can be a very efficient means of transport. The pipeline as a means of transport has not been discussed as it is relatively specialised and has limited applications.

5.4.2 Rail Transport

The railing of freight is often a relatively cheap mode of transportation. Its disadvantages are mainly its slowness, due to low travelling speeds and delays at terminals, and its lack of flexibility. A competitive environment often

helps to improve the former, and seems to be presently occurring in this country through the introduction of new services. The lack of flexibility can be partly overcome by the railways collecting and delivering goods by road to customers in main centres and railing the intercity long distance haulage.

The nature of the goods and the travel distance are important factors when considering rail transport. Detmold(8, Ch. B.3) describes that on shorter routes, rail is normally only advantageous for a regular flow of heavy goods such as coal. The ideals for longer hauls are: bulk commodities, long distances, great consignment sizes and frequent and regular shipment. These same characteristics apply to the transport of manufactured goods, with the added advantage of being able to use containerisation. The best solution for bulk goods is, where feasible, to use a unit 'company train' directly between private sidings. These company trains carry items such as: coal, aggregates, petroleum products and chemicals, raw materials and products such as those from the iron and steel industry and motor vehicles and their components.

The attraction of rail transport for other types of freight lies mainly in the use of containers and the link it affords to road and sea transport. The more recent developments in the use of rail transport include the establishment of computerised systems to speed up the transport cycle of individual containers and to enable progress reports to be given to customers on individual containers.

5.4.3 Road Transport

Road transportation is of enormous importance in physical distribution due to its great flexibility. A transport system comprising of motor vehicles is easy to control, its routes and its loading are easily changed, requires a relatively low capital investment to establish, can use purpose-made vehicles on convenient schedules, is adaptable

to changing demands and customer service levels and is relatively fast. However, it is constrained in its vehicle size, the available road network and legal considerations such as driving hours restrictions.

When using road transport, either private transportation or a public transport company can be used. However, for most firms, a combination of both is often the best solution. These three possibilities are discussed below with respect to distribution, although financial implications should also be considered.

a) Private transport. The vehicles can be owned, leased or hired. A private operation affords greater control, flexibility and a reduction in administration. The disadvantages include dealing with fluctuations in demand and having to manage and control a further business activity. Extra investments in maintenance and repair facilities are sometimes also required.

b) Public transport. The use of public transporters is often less costly in trunking operations, because they can consolidate loads for round-trips. Public transporters can often also combine deliveries to an area from several producers and in this way be cheaper for local deliveries. However, a firm may wish to have personal contact with its customers and may thus prefer to carry out its own local deliveries. Safety and security aspects should also be considered when using public transporters.

c) Mixed transport. Using a combination of private and public transport may be desirable for a number of reasons. It affords flexibility in dealing with variations in demand, it may be required that some customers be serviced direct, and certain products may require special transport arrangements such as refrigerated trucks. For economic reasons it may also

be decided to only deliver to customers within a certain distance from a despatch point, and to use public transporters to deliver to others.

Woodward(9, Ch. 11) points out that certain industries are most suited to using road transport. The food and horticultural industries usually require a combination of speed and refrigeration not normally provided by rail or air operations. In the transport of fragile goods, the least damage usually occurs when door-to-door road transport is used. Some industries rely on interplant road freight, for example in the clothing and shoe industries where certain goods are transferred from one factory to be further processed at another.

Road transport has become the most used means of carrying freight, both in the U.K. and in the U.S. Developments that have increased its flexibility have been the use of demountable bodies, articulated vehicles and detachable semi-trailers. The composite loads can then be left at various areas for use, or for transfer to waiting vehicles for further distribution, while the main transport vehicle does not have to remain idle. In the distribution of most goods, a part of the transport activity will be carried out by road transport. This is simply because, due to its flexibility, it is used as a link between other forms of transport, for example to transport freight between an airport and a rail terminal. The flexibility of road transport has also been increased even more by using it in conjunction with other modes of transport, as in the 'trailer-on-flat-car' (TOFC) or 'piggyback' concept, and on Ro-Ro ferries.

5.4.4 Air Transport

The speed of air transport is its greatest advantage, but its impact can be reduced by delays at the terminals. This makes air transport usually uneconomic over short distances but it becomes very much more positive over longer distances

where the ratio of transport time/delay time becomes larger. Air transport is also normally very reliable, since airlines are, by necessity, very conscious of serviceability. Freight damage is usually minimal because airline containers are less subject to bad handling, and are often loaded under cover. The high cost of air freight should be traded-off against reductions in lead time and the associated reductions in inventory and warehousing.

Jackson(8, Ch. B.6) lists nine factors to consider when selecting goods to be transported by air: rate of turnover, levels of service, age of product, value/weight ratio, physical shape, size and fragility, commercial importance, technical importance, transportation costs and order quantity. Ross(9, Ch. 13) suggests plotting the freight rate per cubic metre against consignment volume for the various modes of transport: rail, road, sea and air. This will point out the breakeven density point at which air freight becomes cheaper, if at all. Normally, sea and rail rates are very cheap for very dense merchandise, but escalate rapidly as the density reduces. The value of the goods must also be considered, as well as the capital tied up by the duration that the goods are in transit. The insurance on air freight is often cheaper as well.

Ross also classifies the present demand for air freight into three broad categories: with immediate arrival date, where the items are required immediately and the price is insignificantly small in comparison to the loss incurred if the goods are not available; with an arrival date within four days, as required by rush orders; and with an arrival date of 5-14 days, as for reasonably urgent orders, that cannot go by surface transportation. The restriction of air transport to major air terminals can be overcome by combining with another transport mode, especially road.

5.4.5 Water Transport

The inland waterways of South Africa are not very suitable for use as a transport mode, but the expanse of its coastline and the number of existing harbours offer great potential for sea transport. Some of the more recent developments in sea cargo transport include the Ro-Ro carriers, and the development of barge carriers, such as the LASH system, where entire barges are loaded into a 'mother' vessel for discharge to smaller ports. The main competitor of sea transport is air, but air is more suited to high-value and low-weight products, while sea is suited to bulky or heavy products.

Churcher(8, Ch. B.5) lists some of the main types of equipment used in sea transport for carrying goods: semi-trailers, articulated vehicles with their drivers, lorry and trailers with their drivers, containers, flats and pallets are used on short-duration voyages of up to 36 hours; and the shipowner normally provides his own equipment for longer voyages. He suggests that for short-duration voyages, it is best to deal with freight forwarding agents who provide the equipment, the land transport and the customs clearance. The advantages of using containers with sea transport are very significant and allow for linking up with other transport modes.

5.4.6 Choosing the Transport Mode

One of the first activities that is required when considering transport modes, is to identify the parts of the distribution channel where transport or movement take place. Some may require different transport methods and the effect on the channel should be determined. It must also be remembered that the alternative transport modes do not necessarily compete, but rather complement each other. Slater(9, Ch. 14) believes that: "Subject to the basic constraints of customer service level requirements and labour preference, the choice of the transport mode should

be a financial one either minimising the operating cost or maximising the after-tax return on capital."

Buxton(13) identifies three criteria on which to base the selection of the transport mode:

a) Operating costs. The volume of the product and the distance travelled must be considered, since the distance influences the ratio of fixed/variable costs. For all modes of transport, the total costs per kilometre decrease as the distance increases, but at different rates. For road transport, the costs remain almost constant.

b) Service performance. The main performance criteria are: speed, reliability, frequency, availability, safety, versatility and costs. Water transport is not usually considered from a speed point of view. Air is probably the most reliable. Road is the best in terms of frequency and availability as the road network is more extensive than either rail or air terminal networks. Rails and water are the most versatile in terms of the loads they can carry. Road is also better to use when markets are dispersed.

c) Product suitability. Rail is the most suitable for long-haul bulk traffic. Water is also suited to transporting heavy, bulk goods such as raw materials. Low-value items cannot support a high distribution cost. Goods such as perishable foodstuffs also require specialised transportation.

Slater (9, Ch. 14) identifies the selection to be based on operational factors, the characteristics of the alternative transport modes and the channel strategy, as illustrated in Fig. 5.5 below. An environmental analysis should be carried out to identify the operating characteristics, and four specific areas studied: the customer characteristics, to

give an idea of total annual sales volumes, trends in the sales and services expected; environmental characteristics, such as transport and communications infra-structures, local laws and tax considerations; product characteristics, in order to identify the important distribution characteristics of various products; and the company characteristics, to

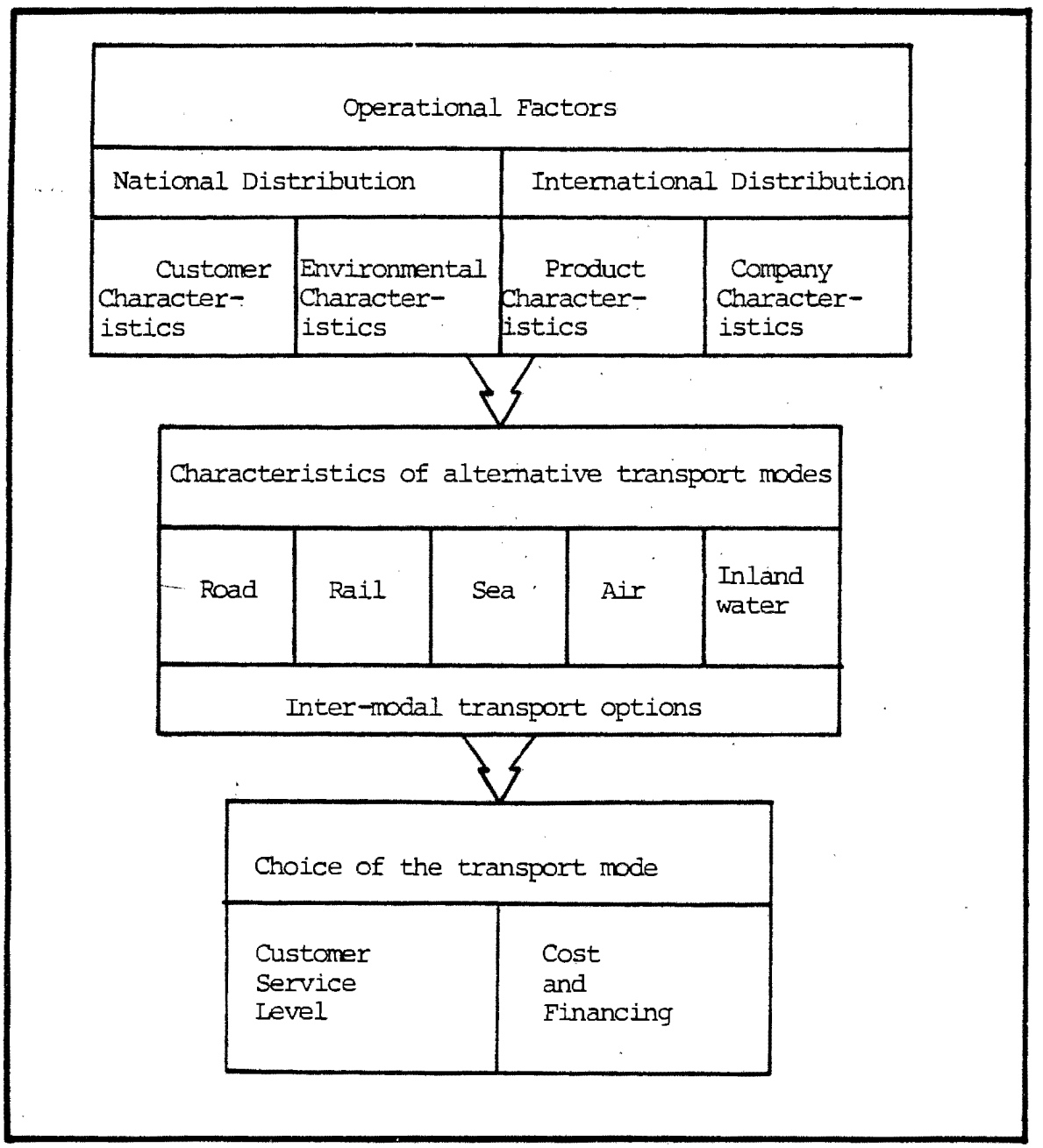


Figure 5.5 : Factors affecting the choice of the transport mode

identify objectives as well as existing and planned facilities. The various modes of transport are then analysed in terms of suitability. Once a transport mode has been chosen, the main areas to be monitored are: technological developments; the environmental trends, to comply to legal requirements and to take available opportunities; the volumes carried, to identify trend changes; and competitors, to ensure customer service levels advantage.

5.5 CUSTOMER SERVICE

5.5.1 Developing a Customer Service Package

The emphasis that a firm places on customer service and the service level objectives it sets, are vitally important since these form the basis for the entire organisation of its distribution function. A knowledge is required of the behaviour of competitive and environmental factors in the political and legal, social and economic and technological fields. Lambert and Stock(2) believe that the specific information about service levels to be obtained from a general customer audit is: the corporate statement of customer service objectives, the information that a firm should provide its customers with in regard to customer service standards, the elements of customer service, the internal customer service reporting system and the distribution performance measures to be used.

Perreault and Russ(18) describe that developing a competitive customer service package involves six major steps: defining the important customer service elements, determining the customers' perceptions, designing a competitive customer service package, developing a promotional programme to 'sell' the customer service offered, market testing the service package and promotional programme and establishing performance controls. In order

to develop such a package, a firm must identify: the elements of customer service and the levels that the firm and its competitors provide, the costs to the firm of providing the current service and those of any other proposed service packages, and the potential benefits of any possible changes such as increased demand, higher prices or more loyal customers.

5.5.2 Setting Distribution Activities

Once customer service level policies and objectives have been decided, the other distribution activities can be adapted to suit. An example would be to decide on an inventory policy of segmented stockholding at various locations based on product profitability. Another possibility is to segment markets, to provide differential service levels at different prices. An example of this is given by Morehouse(35) where a firm in eastern Canada transporting freight to the west, contracts for delivery in three, four or five days with a difference in price of five or ten percent. The shipper must consider what the extra service means in terms of costs, market impact, customer relations and other factors. It should be pointed out, though, that the top service performance of the distribution function should not be misused as a sales incentive. Expedited shipments increase costs and should therefore be charged a premium.

Advanced order-processing systems help to save time and reduce the total order-cycle time. However, it is not always necessary to pass on these time savings to the customer, and they can be used internally for planning the distribution process and thus maintain the order-cycle time but reduce its variability.

Other costs of distribution can also be decreased while maintaining service levels, although this must be subject to thorough analysis. For example, when dealing with a large number of variations or customised products, it may be

economical to use bulk transportation of the basic or blank item to field depots, and to have local facilities to fit trimmings or customise it. Conversely, it may sometimes be possible to reduce total inventory and distribution costs by substituting with last-minute, high-cost shipments of customised items from a centralised factory. However, whichever decisions are taken, Annan(32) warns that: "... a policy of cost reduction should in no way affect the quality ... true reductions will not be attained by lowering the business's standards of performance."

It is also important that a firm should regularly examine possible internal and external changes that could affect its distribution process. For example, a number of surveys have indicated that the largest portion of the total order-cycle time occurs prior to the order being received and after the order has been shipped. Should any changes occur in these areas, they will affect the firm's customer service levels. Implementing an advanced, computerised system to speed up order receipt and order processing can lead to substantial gains in time and productivity. Killeen and Lauer (24) suggest looking at certain activities, such as ticketing merchandise or hanging garments on hangers, that add value and cost to the items. These can be moved up or down the various members of the distribution channel to increase effectiveness and reduce overall costs.

It may be worth remembering that the improvement by an organisation of its customer service levels may stimulate and trigger off a similar response from its competitors. On the other hand, Metz(30) points out that an improvement in delivery services has a tendency to lead customers into reducing their own safety stocks, and hence make them more dependent than previously on the availability of service. It may also be necessary to examine the emphasis and the direction placed on customer service by other members of the distribution channel. They are normally all independent companies primarily interested in maximising their own

profits, and having their own particular combination of prime products and best customers. However, the deciding service level is the one that influences the behaviour of the final consumer of the goods or services.

5.6 SUMMARY

This chapter examined some specific areas where improvements would have the greatest impact on a firm's distribution process. Service policies should first be set, based on customer and product profitabilities, that determine the standards and objectives of the distribution function and all its component activities. The correct information must be collected from the individual components, and collated into a data base. In order to minimise difficulties, the development of a distribution structure should follow established sequential trends.

Warehouses are necessary to act as a buffer between variations in supply and demand. All the activities in warehouses, depots or distribution centres revolve around their primary functions of merchandise storage and movement. Careful strategic planning is required for warehousing facilities, since they normally involve large capital outlays and long-term commitments. The costs of warehousing activities should be monitored and controlled. The location of facilities should also be carefully considered. The use of proper materials handling equipment can help to reduce warehousing costs.

Investments in inventory can also be reduced by careful monitoring and management. Stocks should be analysed by type, centralisation of stocks can be increased, forecasting accuracy can be increased, the accelerator effect should be minimised and stock turnover can be increased. Inventory is

money invested in merchandise, but it does not have to be in a warehouse.

The transportation activity is central to the distribution process. It is constantly changing and should be managed to avoid suboptimisation. Rail transport is best suited for: transporting bulk commodities, long distances, large consignments and regular shipments. Road transport is very flexible but is constrained by size and legal considerations. It is the most common mode of transport used. Air transport is very rapid and is best suited to high-value, low-weight products. The transport mode should be chosen subject to the customer, the environment, the product and the company characteristics.

A customer service package should be developed based on market needs, environmental factors and business requirements. Specific distribution activities decisions can then be taken, but cost reductions must not be allowed to affect the quality of the service offered.

CHAPTER SIX

WOOLWORTHS CASE STUDY : A SYSTEM DESIGN FOR HANGING TEXTILE MERCHANDISE

This chapter reviews a project carried out at Woolworths concerning the distribution of their textile apparel from various suppliers to their stores. Woolworths, being a retailer, is the last member of the distribution channel before consumers. However, they deal directly with garment manufacturers as their suppliers and do not use the services of wholesalers. The entire process of distribution in the Woolworths case, therefore, entails the distribution of incoming garments from their suppliers to their stores located country-wide. The origins and destinations of the merchandise are thus fixed, the service levels to be maintained by physical distribution are those required by the stores and the distribution process is concerned solely with finished goods at all times. Woolworths wished to review their physical distribution of garments with a view to developing a system to distribute garments in a totally hanging mode.

The project initially began in October 1985 with the author visiting Woolworths, at the request of their Physical Distribution Department, in order to discuss the project, examine their current distribution process and carry out an initial feasibility study of a hanging garment distribution system. The project aims and objectives are discussed in Section 6.1 and the current production and distribution system used by Woolworths at the time is described in Section 6.2. These factors had been established by an initial two-week stay at Woolworths. A further period of three months was then spent by the author at Woolworths gathering information, examining their current systems and procedures, analysing alternative proposals and their implications, and finally culminating in the initial trials that were run at the end of February, 1986. All this work

was carried out in conjunction with the Physical Distribution Manager at Woolworths, Mr Brian Marr, and is briefly reported in Section 6.3.

The study was continued, using the basic ideas and concepts that had been previously established, between Woolworths and a third party nominated carrier. This resulted in the decisions and trials described in Section 6.4, with the author once again being involved for a two-week period in July, 1986, during the co-ordinated distribution and promotion trial that is described. A further review of the project in November, 1986, provided the information for the final Section 6.5 on future developments.

Having discussed the concept, theory and management of physical distribution, as well as potential improvement areas and specific South African conditions, the Woolworths project is included as a case study to demonstrate a practical application of the discussion so far. It is an interesting piece of work, combining innovative concepts with a total systems approach and meaningful cost trade-off analyses.

6.1 INTRODUCTION

6.1.1 Reasons for the Study

Woolworths wished to review its textiles distribution system in order to investigate the feasibility of transporting garments in a hanging mode. Marks and Spencer in the U.K., a company with which Woolworths has very strong ties, have a hanging garment distribution system and use the services of an independent contracted carrier, Transcare. The ideal situation towards which Woolworths is aiming, is to have garments remaining hanging from the manufacturer's production line all the way through to the shopfloor display.

There were a number of reasons why Woolworths wished to distribute its textile merchandise hanging. Chiefly, it will improve the quality and the presentation of the merchandise. It will allow the elimination of cardboard boxes, and the associated labour, time and expense to pack and unpack the boxes, as well as to bale and dispose of the empty cartons. The disposal of cartons at stores is a major and costly activity. Some other reasons are: for ease of identification and handling, to promote a more ordered flow of merchandise, and to review and establish a new and improved system in order to gain greater control of the distribution function and its costs.

However, in considering a hanging textile distribution system, some important facts about Woolworths should not be overlooked: approximately 60% of Woolworths' market share is situated in the Rand - PWV area; about 50% of Woolworths' suppliers, producing almost 80% of their merchandise, are situated in the Western Cape; Woolworths sell in excess of 60 million garments per year; and their textile sales turnover is in excess of R450 million per year. Of course, not all garments are always suited to a totally hanging distribution. But the implications of any such moves are enormous, not only for Woolworths, but also for its customers, suppliers, transporters and packaging suppliers. However, the distribution of hanging garments does also lead to a more complex, unique and specific materials handling and distribution system. A project was therefore undertaken by the distribution department of Woolworths to analyse the feasibility of implementing a distribution system for hanging textile merchandise.

6.1.2 The Project Aims and Objectives

It first had to be established whether it was worthwhile changing the current distribution system. Currently, garments were mostly distributed in cardboard cartons or boxes. Although the study was divided into a number of

different stages, the aims and objectives of the entire project were to:

a) Determine the costs of the current methods of distributing in cartons,

b) Develop and propose conceptual systems and methods for hanging distribution,

c) Estimate the costs of these proposals,

d) Determine the modifications and improvements in equipment required by any methods alterations,

e) Determine the advantages and disadvantages, and the general impact on Woolworths, its suppliers and its transporters, and

f) Improve the service provided to Woolworths' customers.

On a longer term plan, Woolworths also intend to implement a point-of-sale recording system to record sales on the basis of garment style, colour and size. This will enable the gathering of detailed sales data and accurate store replenishment requirements. A hanging garment distribution system will help to implement this system by being designed to allow the fast identification and picking of store orders and short order-cycle times.

6.2 INITIAL PRODUCTION AND DISTRIBUTION SYSTEM AT WOOLWORTHS

6.2.1 Description of the System

The current distribution of textile merchandise at Woolworths is bound to its organisational structure. Woolworths categorise all their textiles into one of six

groups. Examples of these are: Ladies Outerwear, Lingerie and Boyswear. Each of these groups consists of a number of departments. Some of the departments falling under the Boyswear group, for example, are leisurewear, sleepwear and outerwear and schoolwear. These departments are then further subdivided into a number of different levels, as is illustrated in Appendix B.

The most detailed description of any garment in the present system is by its 'stroke' number. This code identifies garments according to their cut-style and pattern, but not according to their colour or size. The entire production, distribution and retail of all textiles in the present system is divided up and controlled on the basis of strokes. The production of any particular stroke is carried out according to a predetermined budget. Approximately seven to eight months before releasing a stroke to stores for sale, its production schedule, the manufacturers to be selected and its final distribution are all planned. The garment style and fabrics are then selected. The fabrics are first tested and, if approved, they are purchased and allocated to the selected manufacturers. Here, sample garments are made. If these are accepted, the budgeted production is contracted to the manufacturer. Once in progress, both production and sales are reviewed every two weeks against budget. Manufacturers supply the various departments weekly with lists of the 'availabilities' of the various garments. The distribution of garments according to store requirements is thus based on the available merchandise.

6.2.2 Current Distribution and Packaging Practices

The total production of any particular stroke is divided up by percentages into the various colours desired. Within each colour, the various sizes are listed as a percentage of the total. The packaging of garments is specified by Woolworths, as is the size of the pack, normally comprising 12 or 24 garments. Within each stroke, various packs are specified, normally one or two per colour. Each pack thus

has the set number of garments of the set colour, but contains garments of different sizes according to the specified ratios, and is called a 'ratio pack'.

Each department receives weekly 'checking lists' from the stores that detail the store requirements and their sales. Knowing the merchandise availability, the departments fill out and issue 'Delivery Instructions' (D.I.s) to manufacturers. These outline the number of packs to be sent to each store. Manufacturers must despatch cartons within five days to the respective stores.

Some garments are packed flat in their cardboard cartons, but where possible, many are packed hanging in the cartons. A pilot study had also been undertaken with a transporter where a limited number of garments from certain larger suppliers were transported by road, hanging in a truck. The packaging department at Woolworths specifies to manufacturers the type and method of packaging required for each stroke. All garments that can be hung are packed with a hanger, even if flat-packed. Also, all tags and labels are placed on each garment, and each is individually placed in a plastic-film overbag. This packaging is integral to all garments whether they are boxed flat, boxed hanging or not boxed at all, and is called 'primary packaging'. 'Secondary packaging' includes the cardboard carton and its tape, staples and labels.

Under the present system of distribution, Woolworths pays its suppliers for the garments that are delivered to its stores. Each manufacturer despatches his goods independently to the various stores using the transport arrangements and the packaging specified by Woolworths. The costs of packaging and of rail or road transport are included into the manufacturers' costs and are worked into the price per garment charged to Woolworths by them.

APPENDIX A

APPENDIX A : SELECTED SOUTH AFRICAN STATISTICS

Some national statistics were extracted from the latest "South African Statistics 1986" published by the Central Statistical services. These were plotted in the following seven figures by way of illustration of certain comments in Chapter Four.

Fig.A–1: SALES BY ECONOMIC REGIONS

% OF TOTAL 1980

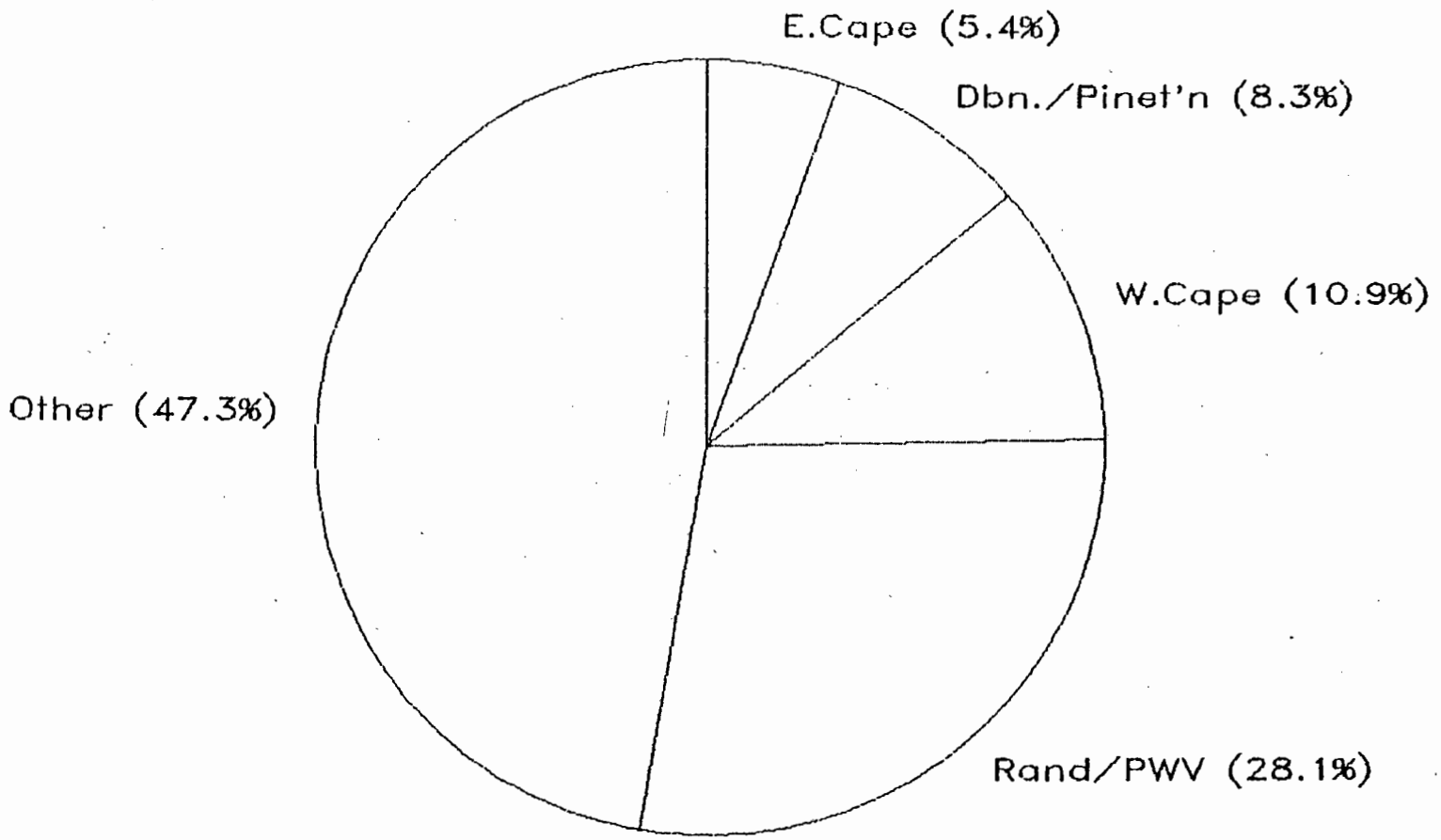
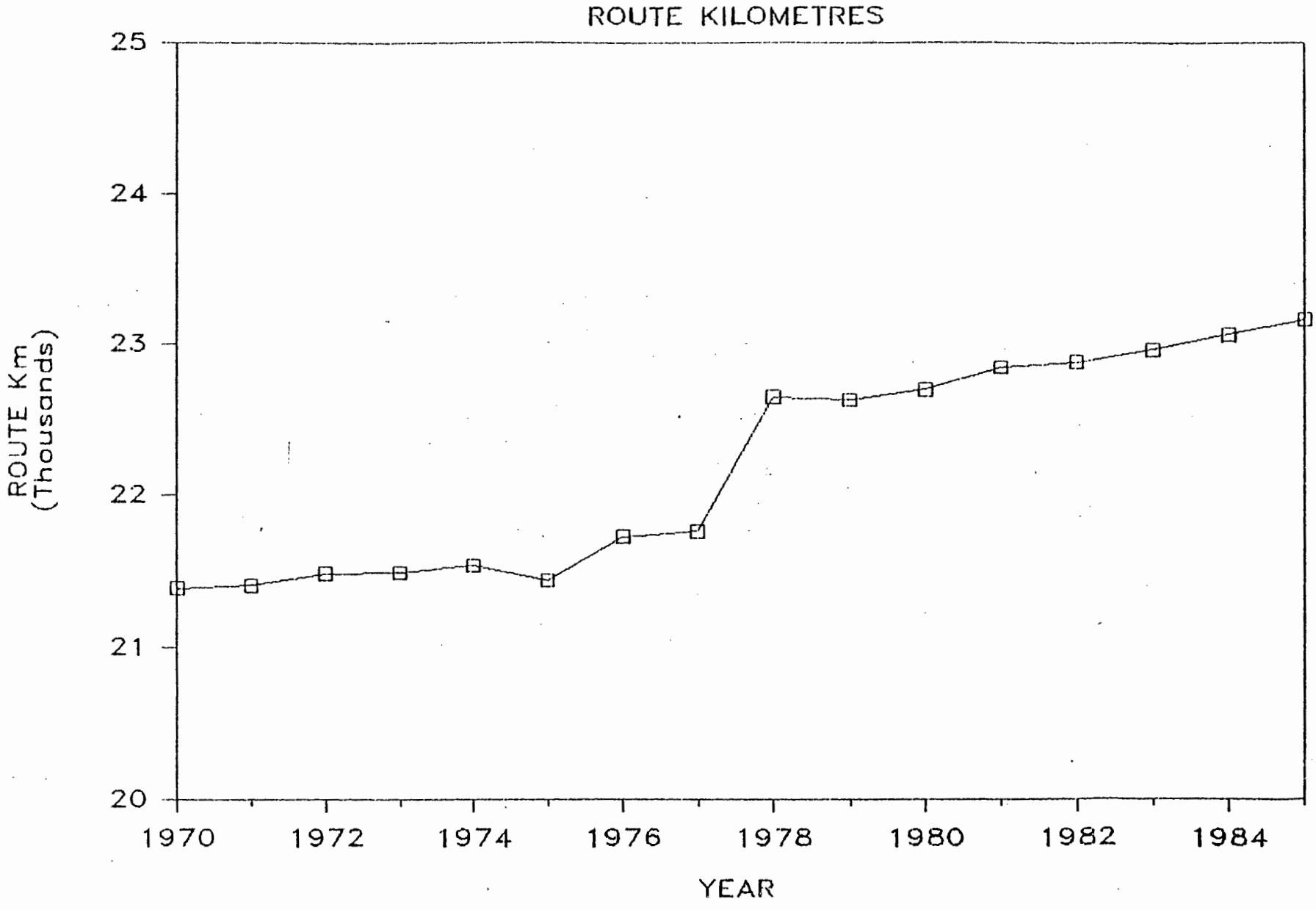


Fig.A—2:RAILWAYS : OPEN LINES



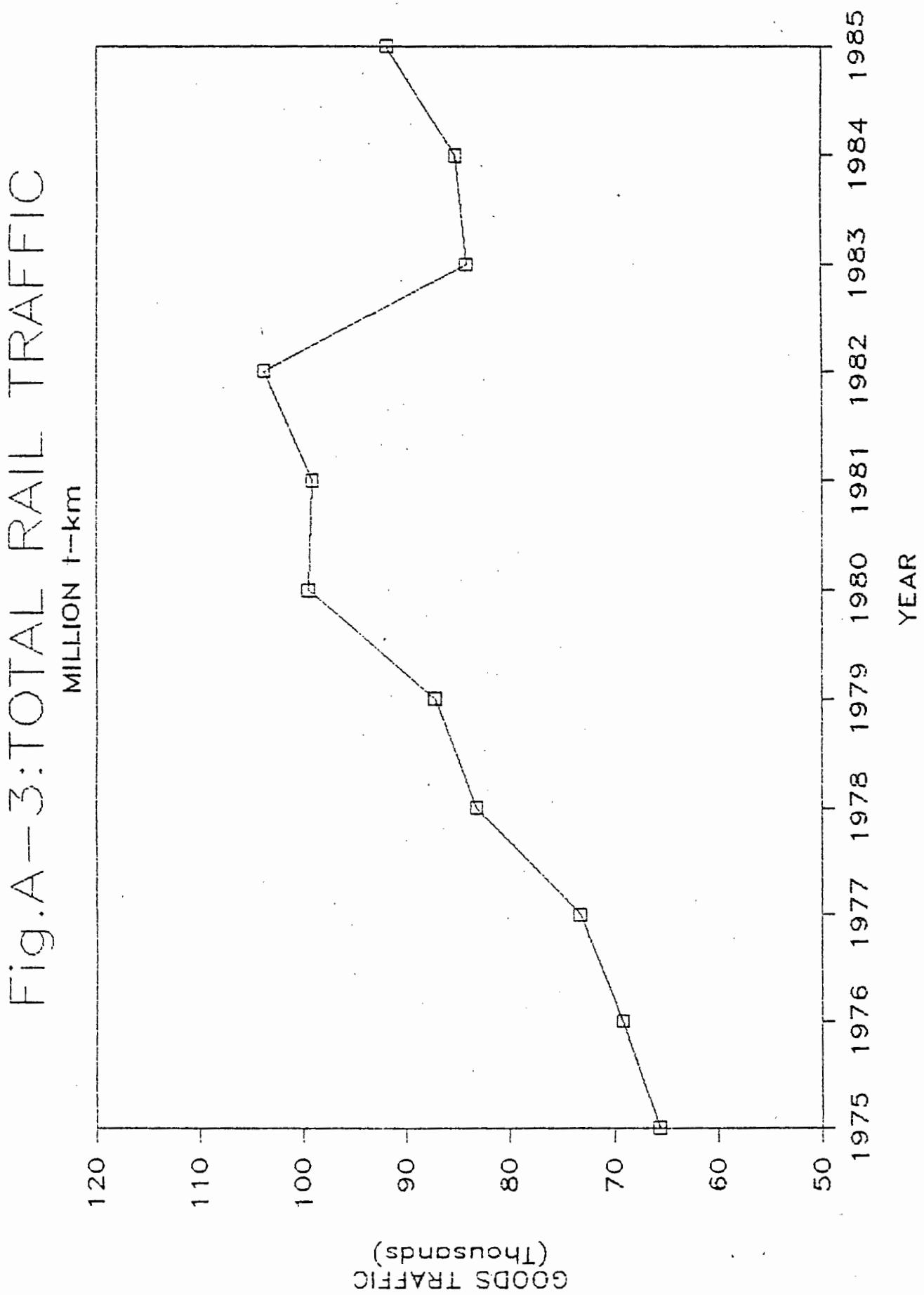


Fig.A-3:TOTAL RAIL TRAFFIC
MILLION t-km
GOODS TRAFFIC
(Thousands)
120
110
100
90
80
70
60
50
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
YEAR

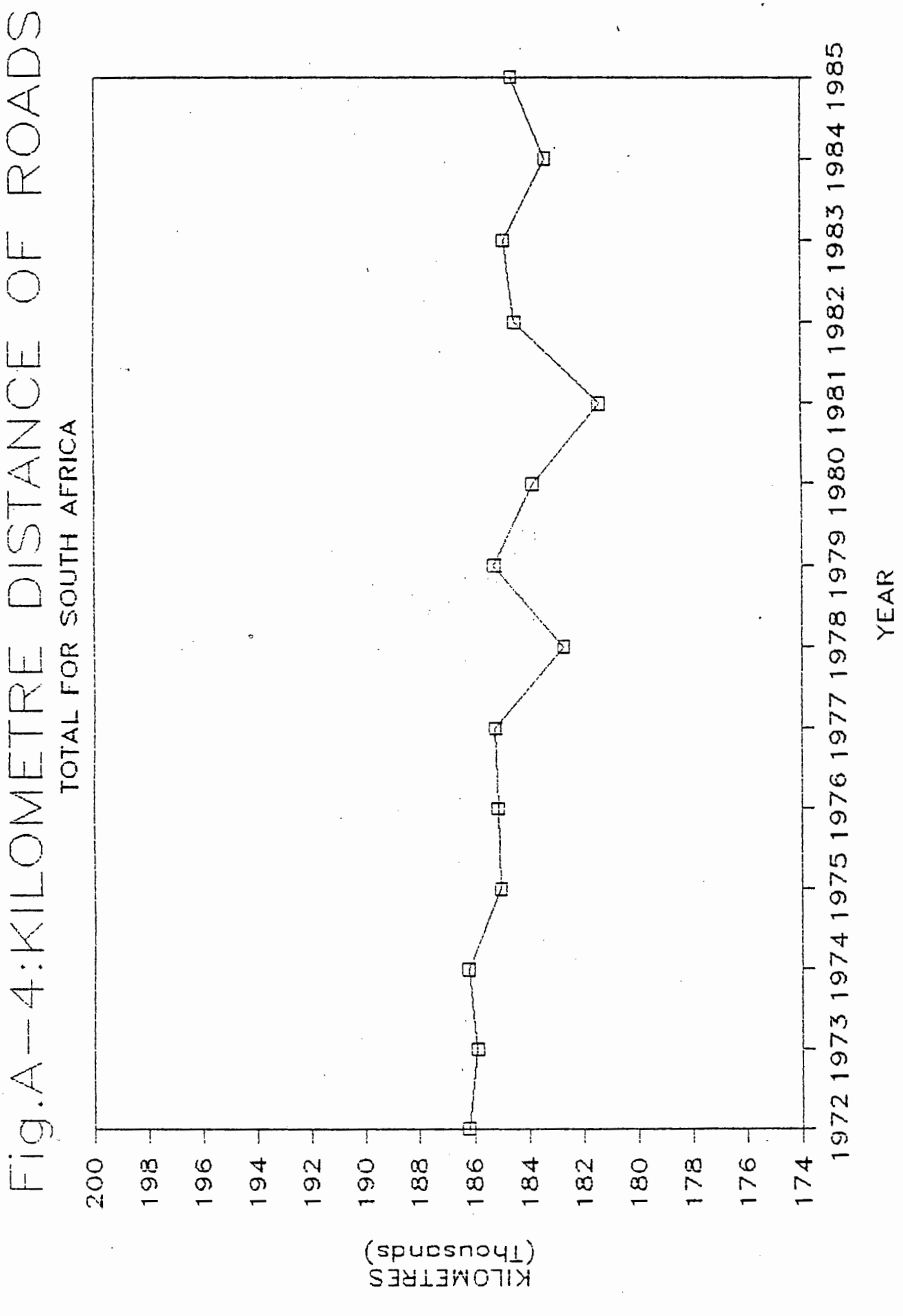
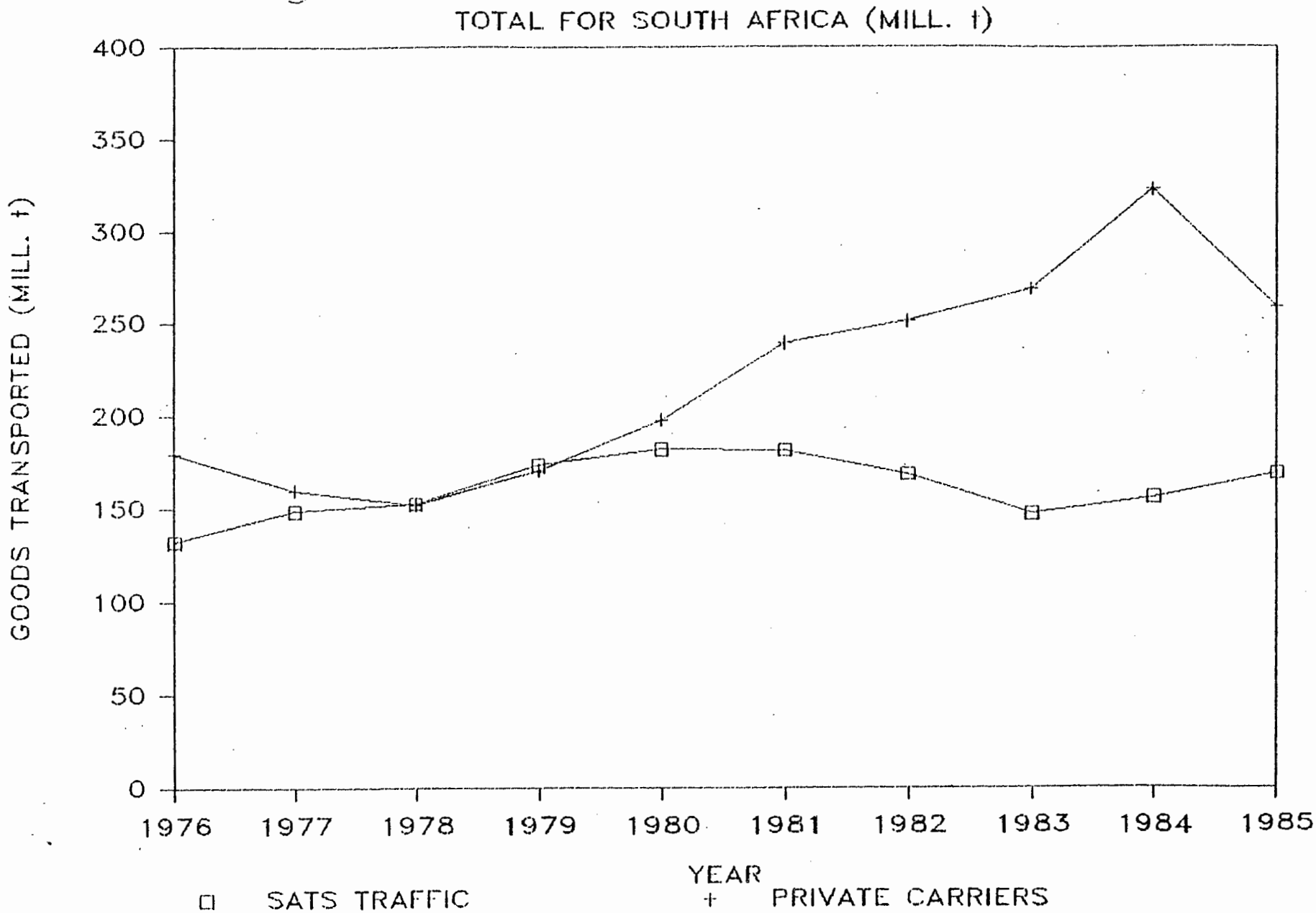


Fig.A-4:KILOMETRE DISTANCE OF ROADS
TOTAL FOR SOUTH AFRICA
KILOMETRES
(Thousands)
200
198
196
194
192
190
188
186
184
182
180
178
176
174
1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985
YEAR

Fig.A–5:RAIL AND ROAD TRAFFIC



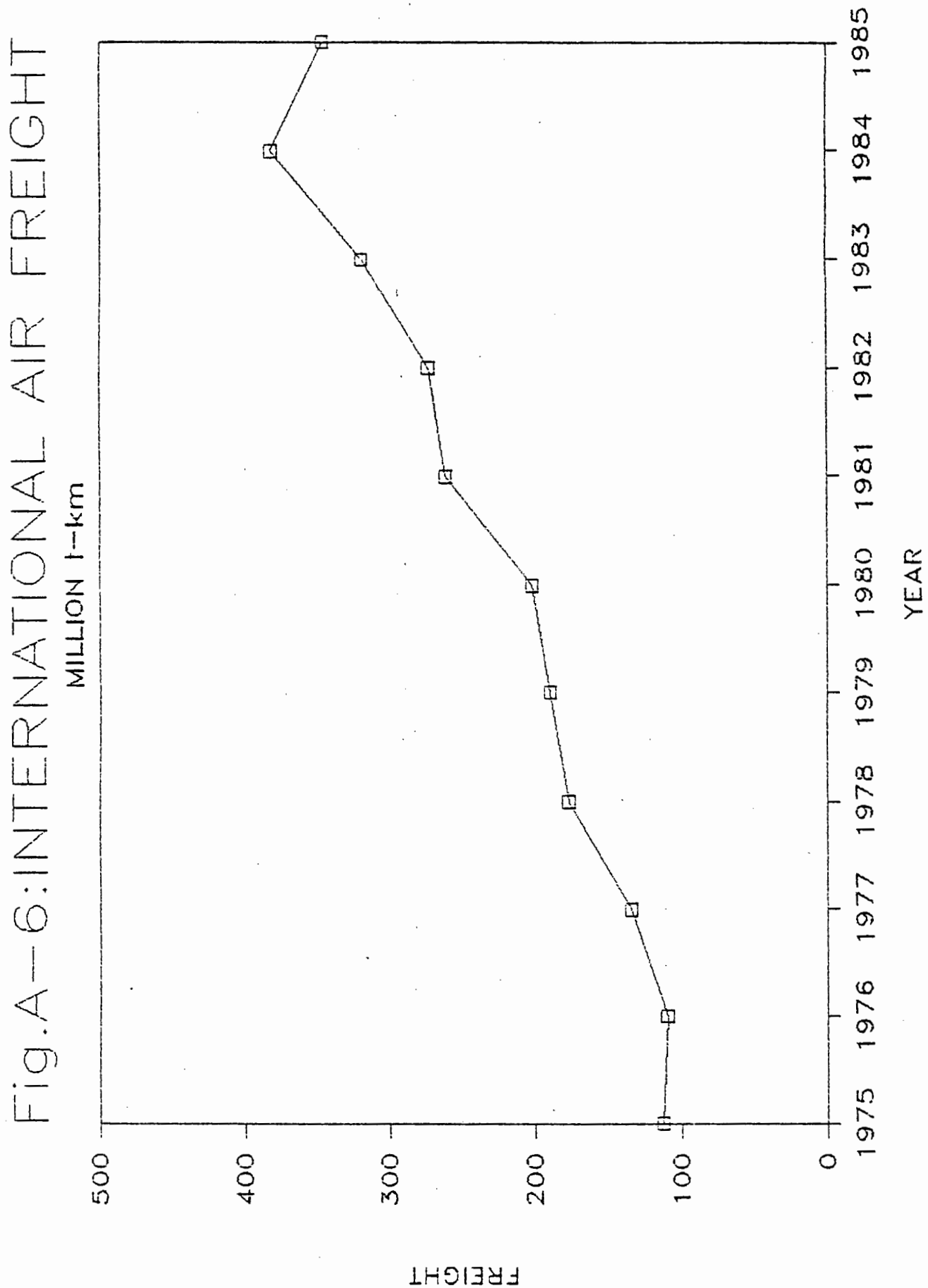
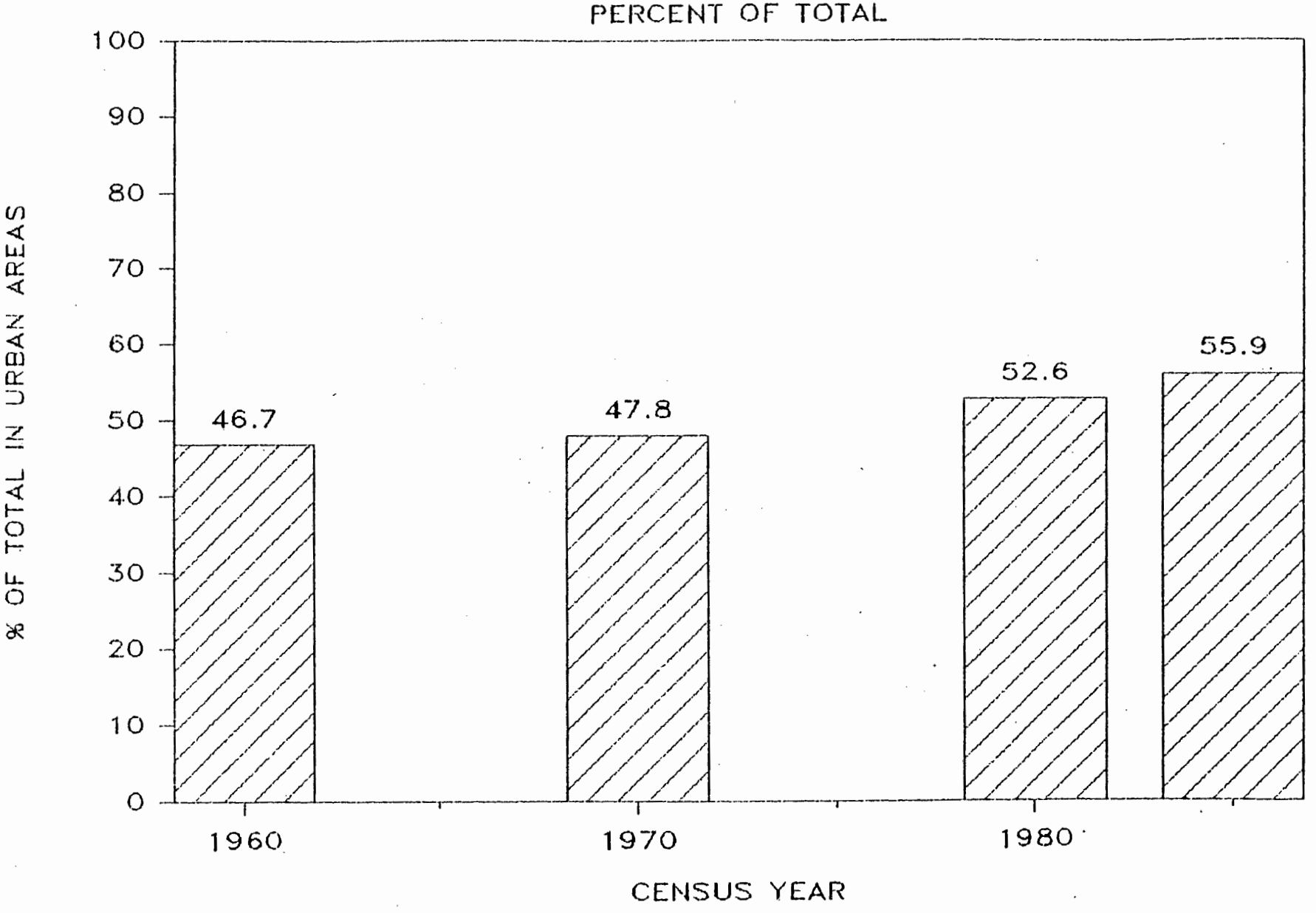


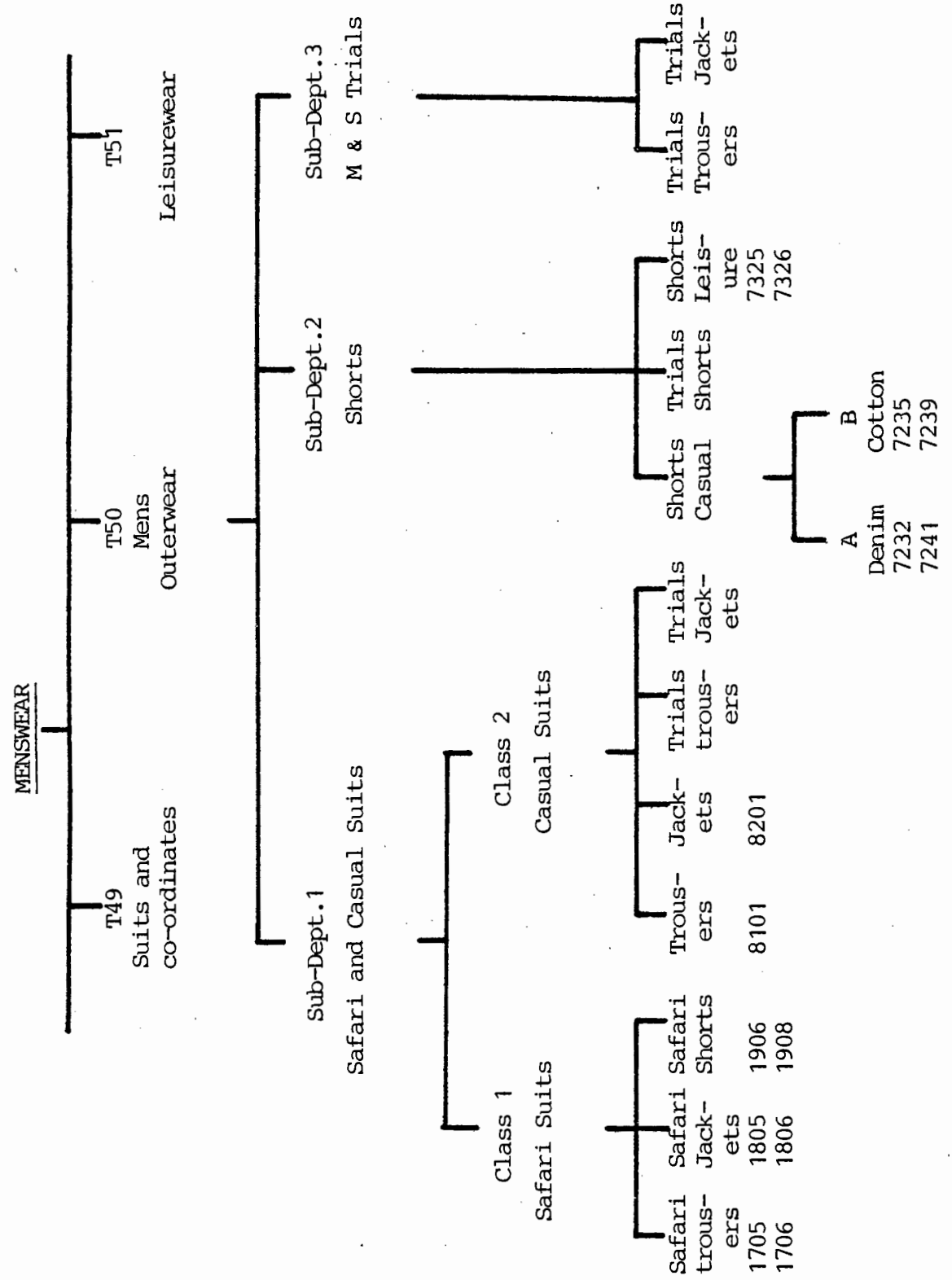
Fig.A—6:INTERNATIONAL AIR FREIGHT
MILLION t-km
FREIGHT
500
400
300
200
100
0
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
YEAR

Fig.A-7:URBAN POPULATION



APPENDIX B

B-1 : WOOLWORTHS TEXTILE GROUP AND DEPARTMENTAL STRUCTURE (EXAMPLE)



B-2 : GARMENT RANGE

The range of garments, and suppliers, that was analysed for the initial trials is given below. These were garments either flat-packed in cartons, hanging in cartons or hanging and transported by road. A breakdown of the direct distribution costs was obtained from the suppliers for all these garments. These were also the garments used in the initial trials.

Supplier	Garment
Bibette	Ladies Dresses
	Children's Dresses
	Ladies Blouses
	Ladies Skirts
	Ladies Tailored Separates
	Ladies Pants
	Ladies Jackets (lined)
	Ladies Jackets (unlined)
	Ladies Styled Tops
	Ladies Styled Shorts
Rex Trueform	Men's Trousers (x 2)
	Men's Jackets
	Ladies Skirts
	Ladies Blouses
	Men's Shorts
Aldenro	Ladies Jackets
	Ladies Pants
	Ladies Blouses
	Ladies Skirts

B-3 : ILLUSTRATIONS OF THE FREIGHTBIN AND HANGING GARMENTS

The following illustrations were taken during trials of hanging garments distribution. They show the freightbin, the framework that was designed for transporting hanging garments, the set and the loading of the garments.

Figure B-1 : The 1,5m mini-container used for the intercity transport of hanging garments. Note the stainless steel structure and the glass-fibre reinforced body

Figure B-2 : The framework inside the container. A frame erected inside a container, showing the vertical corner-legs and the horizontal supporting-beams for cross bars. Note the space available for carrying other goods on return-trips

Figure B-3 : The framework with cross-bars. A frame erected inside a container with cross-bars on which the sets will be hung with the hanging garments. The horizontal support-beams are fully adjustable for height and so is the pitch between cross-bars

Figure B-4 : Corner detail of framework. The vertical corner-leg is wedged against the steel structure. The pitch along the horizontal support-beams for adjusting cross-bars is equal to the diameter of the cross-bars

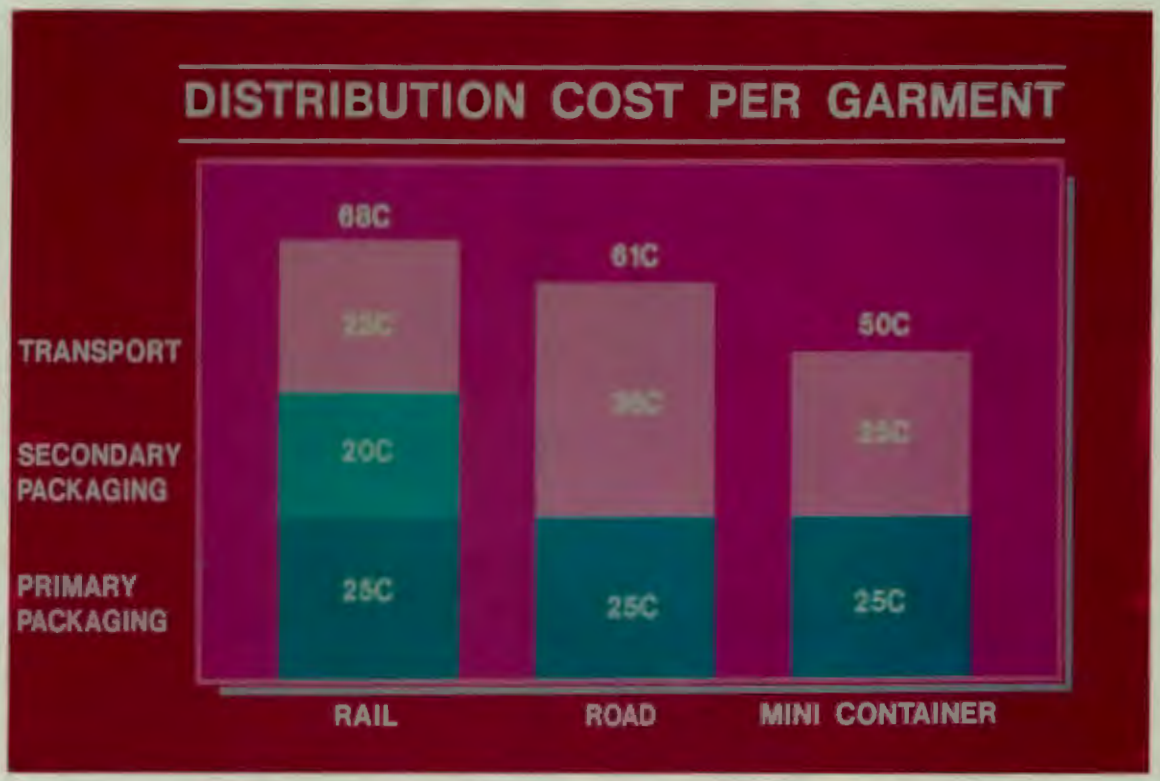


Figure B-5 : Cost comparisons after initial trials. A comparison of the distribution costs for the same mix of garments distributed by the different methods

Figure B-6 : Detail of the set. An illustration of a set as a convenient handling unit, showing the extended hooks. The number of garments per set is specified, and they are overbagged and sealed as a unit

Figure B-7 : The collection and delivery truck. The truck that was used to collect and deliver 'Z-racks' of hanging garments, showing roll-up door and tail lift

Figure B-8 : 'Z-racks' of hanging garments. Complete sets of hanging garments were collected from local suppliers and delivered to local stores on Z-racks. These were also used for order-picking and transferring the merchandise in the depots

Figure B-9 : Loading the first set into the freightbin. The freightbins were manually loaded, commencing from the top, rear

Figure B-10 : Partly loaded freightbin. Note the half-garments and full-garments. This freightbin is set-up for loading three layers of garments

6.3 INITIAL FEASIBILITY STUDY

Due to the multitude of suppliers as well as of garments, a representative sample had to be obtained for the purposes of the study, by grouping or picking out garments. Also, not all garments are suited to hanging. When considering suppliers, it was decided to concentrate on the larger suppliers to Woolworths for a number of reasons: they are more professionally organised and have a better and more reliable knowledge of costs and other information; their procedures are more flexible to enable the carrying out of novel trials; due to the volume of their business, they are more progressive and interested to be involved in any trials; and they produce sufficient volumes to enable reasonably 'life-size' trials for purposes of comparison. For garments, it was decided to concentrate on 'Ladies Outerwear' and on 'Menswear' since these were the most suited for an immediate conversion to hanging distribution. Many of these were already distributed hanging in cartons or by road. These two groups also account for almost 50% of the total textile sales turnover.

6.3.1 The Study of the Existing System

Therefore, a range of 20 garments was selected from three suppliers: Bibette, Rex Trueform and Aldenro, as shown in Appendix B. A breakdown of the direct distribution costs was obtained from these suppliers. It was decided to classify these costs into three categories: packaging, handling and transport costs. However, suppliers were not able to give sufficient information on their costs of handling. Only one supplier had some estimates of standard times for forming, packing and sealing cartons. Rough, order-of-magnitude estimates were made of the times required to handle hanging merchandise in comparison to boxed. There was insufficient time to determine these in any more detail, but it was felt unnecessary and not critical to the exercise. Subsequent rough measures during trials confirmed this. Intuitively, it was felt that eliminating cartons

would be beneficial overall. However, it was nevertheless suggested that the following costs may be useful to determine: at suppliers, the time and cost to assemble boxes, fold and pack garments into boxes, seal boxes, store boxes and to check and load boxes at despatch; at stores, the times and costs to receive and unload boxes, check in boxes, store boxes, transfer garments to the sales floor, place the garments on display and dispose of the boxes. Rates were also obtained for the transport of boxes by rail, the transport of garments by road and the costs of the cardboard cartons. The packaging and transport costs per garment were obtained from the suppliers.

Also under the present system, the transport of hanging garments by the road transporter was not acceptable. The trucks had not been designed nor converted for the transport of hanging garments, and as a result, the garments were hung from 'parachute strings'. The multiple handling of garments at the transporter's distribution centre and the fact that the trucks were not dedicated to the transport of hanging garments added an element of security risk. Many claims had been experienced against the transporters since launching the pilot study.

6.3.2 Analysis of Alternatives and Initial Trials

From the hanging garment distribution system carried out by Marks and Spencer in the U.K., a piece of equipment was obtained, called a 'set', on which garments hangers are hung. This set is a convenient handling unit and a means of unitisation of a load of hanging garments. The set itself consists of a wire structure of given width with two hooks for hanging from bars or racks, handles for manual handling purposes and a bottom rod on which to hang hangers. It also has another rod set slightly above the bottom one to prevent hangers from jumping off in transit.

The number of garments that are hung on a set is not universal, but is specified for different garments. This

concept is similar to specifying varying numbers of cartons for unit pallet loads of various products. The number of garments specified per set depends on the particular garment's characteristics: its fabric, weight and bulkiness. Standards were established empirically for the garments considered in the study - for example, eight men's suits per set, or twenty ladies' summer dresses per set. Subsequent handling, transport and transfer of all garments is then all carried out in units of full sets.

Various transporters used by Woolworths were then approached in order to discuss various alternatives for transporting hanging garments. The use of 6m and 12m containers as well as single and double pantechnicon trucks were ruled out because of the volumes required to fill them, even though they were all very cost-effective in theory. The continued use of the road transporter was not acceptable, as previously outlined. Air freight was discounted because of its high rates and the uncertainty of delivery. The use of a 1,5m mini-container, called a 'freightbin', suggested by the railways' marketing department seemed the most feasible alternative. In theory, it was not quite as cost-effective as some of the other proposals, but it could still be competitive with the costs of carton distribution. It was therefore decided to investigate the use of mini-containers more closely.

The S.A. Transport Services were, at the time, in the process of introducing the freightbin as part of their new 'Fastfreight' transport service that they were developing. They were planning to put large quantities into service and were agreeable in principle to have some mini-containers dedicated to firms which would use them extensively. They were also busy implementing a computerised tracking procedure to enable the tracking and return of the very same containers. Another positive factor was the railway's willingness to either drop off containers and collect them at a later stage, or to allow up to three collecting and/or

destination points per container with a wait of up to approximately 20 minutes per container to load/offload. Under this system, they guaranteed delivery to any destination covered by the system within four days.

The container consists of a steel base, with provision for handling with forklift trucks, a stainless steel structure frame and glass-fibre reinforced walls and roof. The freightbin is fully waterproof with doors at both ends that can be locked and sealed. It has a capacity of 7,9 cubic metres, approximately a quarter of a regular container. A framework then had to be designed and constructed to fit inside the mini-container for transporting the sets of hanging garments. Although the mini-containers could be dedicated for use by Woolworths, the railways would not allow any permanent fastenings or modifications to the container structure. The frame was constructed in the container with two layers to accommodate 'half-garments' or 'full-garments' depending on their length. Cross-bars were placed across the width of the container from which to hang the sets, and spaced according to the maximum width of hanger used by Woolworths.

For the purposes of the trial, traffic was chosen between Bibette, a large supplier to Woolworths, and City Deep, a depot in Johannesburg servicing three large local stores. This was done to ensure a sufficient volume of flow of goods. A total of 683 garments, consisting of blouses and dresses, were packed into the freightbin hanging on sets and were despatched to City Deep. Unfortunately, upon arrival, some of the cross-bars had worked loose in transit and many garments were lying upon the floor of the container. However, positive aspects of this first trial were that the garments that had remained hanging were in good condition and the delivery time of the load had been 36 hours.

Design modifications were then made to the set by lengthening its hooks, and to the frame which was made

structurally more rigid but more flexible in terms of loading configurations. A prototype was constructed and a second trial was undertaken between Bibette and City Deep. The increased flexibility enabled a mix of 1291 blouses, skirts and pants to be loaded. The mini-container was once again delivered 36 hours later in Johannesburg with all the goods in perfect condition. In a direct cost comparison including packaging and transport, the freightbin remained cheaper than sending the same mix of clothes in cartons or by road. It was thus concluded that the use of freightbins was overall a cheaper method of garment distribution in a hanging mode. In addition it was a fast means of transport and it maintained the quality of the merchandise.

The framework, being non-permanent, could be erected in a new container in approximately 20 to 30 minutes and dis-assembled in less. Also, once the frame was installed, the cross-bars could be stored at the top of the container along its roof and thus leave the inside of the container free for any loads required for return trips. A limitation on the use of the freightbins was the relatively large volume of garments required to fill it. This could be partly overcome by scheduling multiple collection/delivery points. However, this still required a large volume demand concentrated into a relatively small geographic area. The use of return loads was also considered in order to keep the mini-containers dedicated, to prevent the necessity of removing the frames and to help pay for the return trips. It was also necessary to fill the freightbins as much as possible if a flat 'box rate' per journey was used, in order to reduce the average costs per garment. Although delivery was fast, excessive turnaround times at terminals may have required the use of additional numbers of containers to maintain store service levels.

At a review of the results of the two trials, it was concluded that the use of mini-containers should be trialled more extensively on the bulk movement of garments. It was

also recommended that the practicality of direct deliveries to stores should be tested.

6.4 CONTINUED STUDY AND TRIALS

6.4.1 The Fashion Garments Promotion Trial

It was thus decided to expand and carry out further trials of a more practical nature on the distribution of hanging garments. Use of the freightbin was adopted for bulk, intercity transport. However, in order to do this, the use of distribution centres was considered necessary to co-ordinate and consolidate less-than-full loads. For the purposes of trials, it was also decided that two existing depot facilities in Cape Town and Johannesburg servicing selected stores could be extended to include all the required stores in their particular area. Road transport by truck was to be used, as well as wheeled, stackable racks called 'Z-racks' to transfer hanging garments. These would be used to collect merchandise from suppliers to the distribution depot, and to deliver garments from the depots to their local stores.

A specific fashion ladieswear clothing promotion was used to run the trial. This consisted of a number of various garments that were matched and marketed together as a theme, and displayed for sale as co-ordinated sets of clothes. The various items were manufactured by a number of suppliers. Under the existing system of carton distribution, each manufacturer would have sent the required number of packs of the particular garments under his responsibility to the individual stores. There are a number of disadvantages to this distribution method: each store receives multiple deliveries from many suppliers; the matched groups of various garments are not received simultaneously; delivery times are variable depending on store location; despatches from suppliers then have to be varied and staggered to ensure that all stores receive all the merchandise by the promotional launch date; and unco-ordinated deliveries of

the various components of the matched garment collections can cause either excess inventory holding at stores, or the display for sale of incomplete ranges.

Since all the garment suppliers for this promotion were in Cape Town, it was decided to route all supplier deliveries through the Cape Town depot. Loads would then be co-ordinated and consolidated and despatched either to stores or to the Johannesburg depot. Ten frameworks were ordered and assembled in freightbins to be used for bulk intercity transport. A third party transporter was used to collect the garments, hanging on Z-racks, from the suppliers and to bring them to the depot. A five tonne truck was used with a tail lift for loading/unloading, and horizontal shoring poles to secure the Z-racks. The same truck, and another at the Johannesburg depot, was used for the deliveries of items to the local stores with the transporter doing the routing and scheduling.

All garments were collected hanging on sets from the three suppliers in Cape Town and were brought to the depot for consolidation. The garments had been packed on the sets according to specifications previously laid down by Woolworths. Each set was overbagged and sealed at the hanger hook level in such a way that the seal had to be broken or the bag torn in order to reach the garments. Garments were loaded into the freightbins according to their geographic destination area. All the Johannesburg stores were serviced via the Johannesburg depot while the Durban stores were serviced by multiple deliveries and required careful packing. Due to a shortage of mini-containers, Eastern Cape stores were serviced by road trunker. In total, 18 full mini-containers were sent in two waves over a total period of five days, and 35 000 garments were transported.

6.4.2 Results and Discussion

A number of interesting results came out of carrying out such a trial in real working conditions, both for hanging distribution in general and for the distribution of complete garment themes. The co-ordinated delivery to a store of all the components in an entire garment range had never been attempted previously. In this way, all stores in a geographic area received all their merchandise on the same day, although there were some slight regional differences of about a day between various areas around the country.

The stores found the merchandise easy to handle and this method provided them with the opportunity of setting up immediate, powerful shopfloor displays. The immediate, on-the-spot availability to customers of large volumes of the entire range of garments helped to achieve a good sales impact and a high rate of sale. All goods were delivered in perfect condition, although some shortages in equipment had delayed despatches. The call-off of merchandise from suppliers by D.I.s from Woolworths head office could have been more co-ordinated, and the suppliers required longer lead times for order picking.

Apart from such minor problems, the entire trial was reviewed and considered a complete success. The collecting of goods, sorting at the depot, loading and intercity despatch had all been satisfactorily carried out, and so too the local deliveries. The response from stores had been good, their service levels improved and the sales impact positive. A total cost analysis indicated that the average total distribution costs had been approximately R6/set. A similar analysis of distributing in boxes showed an average total cost of around R9/carton.

Some other benefits had also been observed. The workload at stores had been reduced by eliminating cardboard boxes, by simpler and quicker receiving and checking-in procedures, by easier and quicker merchandise identification and by

reducing multiple handling. Delivery lead time variability had been reduced from a transit time of two to ten days, depending on store location, to a more consistent time of three to four days. The presentation of the merchandise was also improved. This important factor complemented recent developments in Woolworths to emphasise 'new concept' stores, whereby maximum use of hanging garments are made in modern and progressive display and layout techniques. This trial served as the basis for establishing future plans for developing a hanging garment distribution infrastructure.

6.5 FURTHER DEVELOPMENTS

6.5.1 Ongoing Operations

The basic procedures that had been established at the three suppliers for the promotion trial were then retained and used on an ongoing basis. All ladieswear supplied by these manufacturers that could be hung was then begun to be distributed using the new system. The depot facilities were more permanently established, and the services of the third party transporter were continued to collect completed sets daily from the manufacturers and to deliver to local stores. The freightbin pool was expanded to include twenty mini-containers in continuous service on an ongoing basis.

A further co-ordinated theme promotion of garments was also carried out using hanging distribution. In this case 20 000 garments were distributed nationwide from five suppliers in the Cape and one in the Transvaal, thus effectively testing the feasibility of return trips for the first time. The flexibility of using mini-containers was also established experimentally by using its distribution system to distribute approximately 1 000 cartons of a co-ordinated promotion of other goods such as toiletries, furnishings, towels, curtains and duvet covers. A commodity rate, by weight, has been negotiated with the railways for the

transportation of the freightbins, with an average of 90 sets being loaded per container. This means approximately 1 500 to 2 000 garments, depending on the number of garments per set. Holding rails have been developed for use in the transit depots to hold completed sets of garments in order to free available Z-racks for use by the stores and suppliers. Freightbins are also completely loaded in about 15 minutes, with the unloading of garments and the return of equipment to the containers taking about the same time.

6.5.2 Future Developments

A positive commitment has thus been made by Woolworths to a hanging distribution system. The strategic long-term plan that has been developed is to use a third party contracted distributor, that will own and operate the necessary equipment and facilities, to carry out Woolworths' textile distribution. This will mean substantial negotiations and considerations in the short-term concerning normal aspects of third party involvements, such as the tying-up of merchandise. However, in the long-term, this will mean the establishment of a specialised distribution organisation as well as variable distribution costs for Woolworths, depending solely on volumes. The hanging distribution system at the present stage is already cost-effective in comparison with the carton distribution system, and greater potential savings are expected by the introduction of larger volumes and more formal procedures.

The distribution system is to be expanded to accommodate all ladies outerwear garments from all suppliers early in 1987. This alone will affect five million garments per year. The addition of some menswear and childrenswear items at the same time will raise this figure to about eight million garments per year in the near future. Detailed costing studies based on the trials, and on which the distributor will base his rates, show that distribution savings on the ladies garments alone will be in the region of R840 000. Other potential benefits include faster store replenish-

ments, inventory reductions, less sell-outs and less breakdowns of lines caused by component shortages. Suppliers will also benefit by receiving more accurate orders, reduced distribution costs and reduced inventories due to more frequent and regular collections.

Since carrying out the trials, merchandise security had been improved by modifying the store labels and the overbags on sets, while shrinkage had remained minimal. Further studies are also at present underway on utilising the potential of return trips more effectively, and on using the versatility of the freightbin to distribute other goods such as toiletries, furnishings and certain foods. The advantages of the hanging garment distribution system for the future seem to lie mainly in the rapid, consistent and cheap distribution of goods while maintaining product quality; in the co-ordinated distribution of theme promotions; and in allowing the business to quickly respond to changes in a dynamic environment in order to 'keep ahead of fashion'.

CHAPTER SEVEN

CONCLUSIONS AND A LOOK AT THE FUTURE

This final chapter serves as a conclusion to this study and review of physical distribution. The subject has been treated from basic principles, and an attempt has been made throughout to discuss positive and negative aspects of distribution and their importance. The entire study has been treated in a positive, forward-looking way with emphasis placed on reviewing changes for improvements and better performance.

This final chapter thus looks at established trends and potential future developments. Section 7.1 examines these that have been identified in overseas businesses, in the U.S. and the U.K. Section 7.2 attempts to do the same for South African considerations. However, not much work has been published on this aspect in South Africa and this section is therefore a reasonably subjective discussion. Section 7.3 concludes the review and offers some personal thoughts by the author on important factors concerning the implementation of physical distribution changes.

7.1 ESTABLISHED OVERSEAS TRENDS AND FUTURE DEVELOPMENTS

7.1.1 General Considerations

The rising costs of distribution in all countries have forced companies to examine this aspect of their operations more closely. The substantial savings that can be achieved, as well as the potential business improvements made possible by a review of this activity have made physical distribution an important centre of attention. Sir Daniel Pettit(9, Ch. 25) gives the results of a survey showing a comparison of distribution costs in the U.S. and the U.K. These are shown

in fig. 7.1 (9, Fig. 25.1). He notes too that direct labour costs, not shown in the analysis, are also very expensive and ever-increasing. The use of computers is another factor that Pettit considers important in distribution, with trends showing that future use will be in the areas of operational control systems, in management information

PHYSICAL DISTRIBUTION COSTS BY FUNCTIONAL ACTIVITY

Functional Activity	Cost as % of sales U.S.A.		Cost as % of Sales U.K.	
Administration of distribution		2,4		2,0
Transportation:				
Inbound	2,1		1,5	
Outbound	4,3	6,4	4,0	5,5
Receiving and despatch		1,7		0,5
Packaging and protective packing		2,6		2,0
Warehousing:				
Factories	2,1		1,0	
Distribution depots	1,6	3,7	1,5	2,5
Stockholding:				
Interest on investment	2,2		2,0	
Taxes, insurance, losses, etc.	1,6	3,8	1,0	3,0
Order processing and related		1,2		0,5
Total Physical Distribution Costs		21,8		16,0

Fig. 7.1 : A comparison of the costs of physical distribution activities as a percentage of sales between the U.S.A. and the U.K.

retrieval techniques and in specialised systems for use by smaller companies.

In the field of distribution accounting, the development of distribution cost information systems will receive great attention. There are also formal training courses of physical distribution executives being laid down. According to Lambert and Stock(2), these include training in finance and accounting, general management, distribution planning and models, and marketing and data processing.

7.1.2 U.K. Trends

Pettit(9, Ch 25) indicates that in the U.K. system, road transportation has increasingly dominated the scene. Structural changes in retailing have also brought about changes in retail distribution and deliveries. There has been a growth of central warehouses under the control of large retail chains, that tend to isolate manufacturers from branch deliveries and restrict the distribution through wholesalers and other channels. There has also been a parallel development of cash-and-carry wholesale warehouses to cheaply supply small quantities to small retailers, hoteliers, restaurant and cafe proprietors that use their own transport. These wholesalers often operate on low stock levels of 6% to 10% with rapid turnover and low costs due to savings in handling, breakup, assembly and delivery.

Pettit also took note of: "... the wide discrepancy between hours per week the haulage industry is willing to work and the number of hours the customer will make available." This problem has been partly resolved by the use of delivery services that are linked to computer scheduling. Greater government intervention is also anticipated by the introduction of legislation, for example, to raise safety and maintenance standards, to contain size, noise and pollution levels and to control and regulate driver hours. Further, the development of specialist carriers is expected that service particular market areas. The present practise

of telephone-selling could develop into home-based, local computer-terminal purchasing of goods. The emergence of mail ordering and mobile shops to service scattered rural areas is also envisaged.

Other than these factors, Weeks(5) has identified that manufacturing companies have limited the personnel employed on any one site to between 1 000 and 2 000 as being a manageable unit. He also says that rising costs have forced many companies to review their maintenance and replacement policies. Apart from these considerations, there is a recent trend to favour third-party warehousing and distribution operations. This has been achieved by using equipment hiring contracts, third-party transport and delivery or by using a contracted distribution package whereby a third party manages and carries out the firm's distribution function using whichever service that circumstances dictate. In such cases, retailers then often nominate to their suppliers the carriers to be used. Hastings(36) describes such distribution packages and notes that establishing such agreements can be expensive and time-consuming with companies investing up to 1 million and negotiations lasting up to 12 to 15 months, with the first two-thirds of that time taken up with fact-finding and the development of ideas. He also identifies some further trends, other than those discussed above: the emergence of express services and door-to-door deliveries, the establishment of large-scale nationwide services as opposed to regional operations,a broadening of the range of traffic catered by transporters, an increase in the number of options of different service levels available and the development of U.K.-based services into EEC-wide operations.

In examining the future, Weeks(5) predicts a number of possible developments. Bulky manufactured products will be manufactured centrally but will be assembled close to main markets. Certain manufacturers will also produce duplicate product ranges in factories based in major markets. Rail and

water-borne traffic will increase, road traffic will be limited to shorter distances and will be more subject to available return loads and the use of whole or modular loads will increase. He also predicts the emergence of 'freight-interchange areas' on the outskirts of major markets where bulk loads will be broken down and delivered locally by small road vehicles. The management of in-house distribution activities will be limited to the very large companies, with other companies using third-party specialist organisations. Many of these trends, though, are expected to occur relatively fast due to the increased attention given to the physical distribution function by many firms.

7.1.3 U.S.A. Trends

In a survey carried out in 1980, quoted by Lambert and Stock(2), La Londe identified the major factors that will influence the growth and development of the corporate distribution function during the next decade as being: the costs of distribution, the costs and availability of energy, government regulations, customer service requirements, the state of the economy and the view of physical distribution taken by top management. Energy will assume increasing importance by becoming more costly and less available, by the shortages that are likely to occur in certain areas and by government legislation of energy conservation becoming increasingly stringent.

Lambert and Stock also identify trends in consumerism as resulting in increased pressures to improve physical distribution and its service. Some of the factors they cite are: the tendency for consumers to become more critical, and to become more concerned about the quality of life rather than quantities of things; the increased difficulty in making the purchasing decision, placing more emphasis on the delivery of the promised package of benefits; and the greater emphasis placed on product quality at reasonable prices in the face of recession and inflation.

There is also an increased tendency for American firms to expand into international markets. This has brought about some important implications: a trend towards owning foreign distribution-service firms; increasing vertical integration of distribution channels with members from several different countries, especially in acquiring foreign sources of supply for certain raw materials; and an increase in the sophistication and expertise of global physical distribution executives and departments.

Lambert and Stock(15) also consider environmental concern: "Individuals, businesses and governments are demanding efficient and productive distribution systems which move products with a minimum of pollution, the maximum in energy efficiency, and with a minimum of system delays such as those caused by transportation congestion." Issues related to this are the recycling and re-use of containers. Mossman and Maiers(37) have also noted the emergence of tactical pricing, for example load/unload allowances, dependent on certain activities being carried out by either the shipper or the carrier; multiple tender discounts for aggregating multiple shipments; volume discounts; constant or agreed pricing in return for a contracted service; and directional discounts quoted by carriers striving to develop markets or to create demand in the direction in which they are moving trailers empty.

Killeen and Lauer(24) report in their survey that retailers are making greater attempts at co-ordinating merchandising and distribution, since merchandise reaching stores too soon adds to the costs of holding inventory and merchandise arriving too late costs the retailer lost sales. Many other trends were highlighted by the survey. Large companies are mainly emphasising the use of their own carrier fleets, while others favour the opposite. However, the overriding factor is to find a method that suits the particular organisation best since there is no single right answer. Many retailers are also considering reducing the amount of

direct shipments to their stores and of using third-party consolidation services for merchandise receiving, processing and redistribution to stores. A related issue is the development of work standards and performance monitoring systems that will be given a high priority in the near future. They also noted that advanced materials handling equipment is mainly used by large retailers, but highlighted a substantial increase in their use by other companies in the near future: "Until now, investments in advanced materials handling equipment - such as conveyorised scanners, automatic sorters, and automatic guided vehicles - have primarily been limited to large retailers. However, the number and sophistication of such systems put into service by small and medium size retailers will rise dramatically in the next three to five years."

Information systems will be geared towards reducing order-cycle times, and labour management systems will receive high priority, as will the introduction of paperless communications and processing systems. They expect a dramatic increase in the use of software systems to monitor and evaluate transport and network costs and to model cost alternatives. They point out that training specifically geared towards physical distribution and related disciplines, such as quantitative methods, is now formally offered both at college level and at continuing education programmes. Another important factor that was uncovered was the lack of consistency between firms on their reporting and analysis of distribution costs. Killeen and Lauer(24) report that all the trends identified about retailing organisations and discussed above parallel those in other industries.

7.2 SOUTH AFRICAN TRENDS AND DEVELOPMENTS

7.2.1 General Business Response

All the trends and developments occurring overseas that were discussed in section 7.1 above, are relevant to distribution activities in South Africa. However, the interest and increased attention that has slowly been shown in physical distribution by overseas firms may become suddenly apparent to South African business, and consequently a rapid increase in awareness concerning the distribution function may be expected. Many South African organisations may first have to realise, though, that the total systems concept implies one that cuts across traditional functional boundaries.

There is currently a great emphasis being placed on inventories, and in the short-term at least, cash-flow considerations will induce firms to reduce their working capital by attempting to hold less stocks and have smaller and more frequent deliveries. This should be recognised as a basic change in service requirements. However, the establishment of new facilities and systems will require large investments and important financing, while many of the larger and more established firms will already have high, fixed investments in their own distribution systems. The situation here with facilities and systems is similar to that described by Murdoch(14): "Sunk costs in long-term warehouse leases or ownership of warehouses in less saleable locations often delay companies from moving to a more efficient warehouse location." A possible short-term tactic that may be attempted to partly overcome this problem is the use of incentives, such as tactical pricing described above, in order to encourage desired distribution trends, and this may well become entrenched in longer term operations.

7.2.2 Specific Areas of Developments

In South Africa, the application of computers and information systems will become more geared towards physical

distribution. Mathematical and statistical models available overseas will become used to aid management, and will include the use of linear programming and simulation models. The order-processing system will also assume greater importance, and this can help to improve the management information system. As pointed out by Lambert and Stock(2): "Implementation of the latest technology in order processing and communications systems can lead to significant improvements in physical distribution performance."

The relations and working arrangements between suppliers and retailers will also need to improve over the long term - organisations will need to work together in order to achieve a common goal, and not against each other to the detriment of that goal. Firms will also have to make meaningful use of cost/revenue analyses when evaluating carrier services in relation to their distribution system. And carriers must make tactical use of their service offerings to meet the shippers' needs. Pettit(11) describes the close links that will develop between users and providers of physical distribution services: "... users must have knowledge of all facilities and services that could be made available and providers must be able to take into account the future demands of his customers and potential customers in his own planning." Two factors emerged from the survey by Killeen and Lauer(24) that are also applicable in South Africa. Firstly, there is a need for organisations to investigate and determine the cost-effectiveness of pre-processing merchandise, such as attaching price-tags and labels at manufacturers. Secondly, there is also a need for organisations to look beyond their ranks if they wish to improve their distribution function and obtain the kind of people required to bring new technologies and equipment on stream.

It is also probable that South African firms wishing to expand and increase their sales and production volumes will increasingly turn to international markets. Distribution

characteristics may be significantly different in such cases, especially in dealings with developing countries. Lambert and Stock(2) compare the sophisticated distribution systems of highly developed countries with those of developing countries in Africa, South America or Asia. These are normally characterised by large numbers of intermediaries supplying large numbers of small retailers, inadequate transportation and storage facilities, a predominantly unskilled labour market and an absence of physical distribution support systems.

The pattern of use of sophisticated materials handling equipment is similar to that in the U.K. identified by Lockett and Westwood(34): "At present, sophisticated, high performance handling equipment is expensive and forces companies to centralise their storage to achieve the economies of scale. In a sense, the technology is dictating the system design, rather than the other way round. Implicit in the acquisition of an expensive handling system is the assumption of long term stability. This can also result in loss of flexibility."

7.2.3 The Effects of Deregulations

The National Transport Policy currently under Parliamentary review is expected to be accepted during 1987 and to be phased in within three to five years. The new legislation will increase competition, especially of price and services, both between modes of transport and between carriers within individual modes. It will allow SATS to negotiate prices to convey the goods it chooses to whatever destinations it chooses. They will not publish rates and tariffs anymore, and the transportation of goods to certain areas will cost premium prices. A more important factor is that SATS control all the various modes of transport and can thus guarantee given service levels for various prices, using whichever mode of transport may be suitable to fulfill requirements. An increase in the private sector distribution contracts service requirements may be expected.

Abolishing goods' transport restrictions and the permit system will remove entry restrictions to carriers in all fields and will lead to more competition between carriers, and to the establishment of distribution companies as opposed to transporters. This will also result in better communications systems between suppliers and users of transportation services in order to trace shipments. The emergence of toll-roads and the levies on all transport operators may boost further road systems development, as well as those of other transport modes.

More stringent energy and environmental regulations are likely to be enforced, including noise and emission standards, size and speed limits, limits on driver hours, limitations on times and access to commercial vehicles for transport and delivery and increased taxation of transport modes users. Holz(29) recommends the establishment of: a universal set of standards for vehicle care including the condition of the vehicle and its maintenance routine; a uniform compulsory training programme for professional drivers of heavy vehicles; compulsory rest periods for drivers off of their vehicles and in a place where resting and ablution facilities are provided; prescribed times when heavy vehicles are not allowed to travel; and two or more different types of drivers' licences to carry general goods and to carry dangerous and hazardous 'high-risk' goods.

7.3 CONCLUDING REMARKS AND THOUGHTS ON IMPLEMENTATION

Having discussed various aspects of physical distribution both theoretical and practical, as well as having attempted to place the subject in a practical context and to examine future possibilities, some remarks may be in order on an approach to adopt when considering changes. The systems approach has been emphasised throughout this study, and yet it must be noted that this should not be translated as a text-book approach. The function of physical distribution is highly dynamic and always changing, and is very dependent

on environmental conditions, for example fuel prices, transportation deregulations, energy costs, productivity rates variations and economic sanctions. An analytical view is recommended, together with a great deal of common sense, in examining such factors and their effects, whether temporary or long term, on the distribution process of a firm and its related distribution channel.

A high emphasis is placed on the planning of distribution functions, with an effective physical distribution plan depending upon decisions made in the marketing plan, the sales volumes plan, the manufacturing plan, the financial plan and the customer service plan. A number of authors have listed procedures for implementing the distribution planning process, and these may serve as useful reminders in some cases. It is always necessary to set business objectives first and then to allocate resources, particularly personnel and financial. It must be emphasised that it is necessary to consider all factors, even those that seem unrelated, when making distribution-related decisions, for example considering control and security aspects when deciding on a centralised or decentralised warehousing policy.

It is vitally important for any firm to study, evaluate and positively decide on a marketing and distribution channel strategy, including planned entries into international markets. It then becomes necessary and essential to collect and formally measure cost and other data to identify trends and variations from plans and to reinforce positive results. An effective system will be dynamic and responsive to feedback and will minimise hysteresis resulting in responses such as the accelerator effect. It must also be noted, as Campbell(1) warns, that physical distribution must not be allowed to become a totally general management discipline and lose any of its technical basis. Attempts at making improvements or changes in distribution should always be preceded by asking customers for their assessment of the

company's distribution service. This is the only way of determining existing customers' response and achieving market share improvements. However, the effects of competitive response by other firms should never be underestimated as this may lead to a more unfavourable position than initially desired.

Another important factor is that examining practical case studies of distribution reviews, such as that of Woolworths or other firms, may be beneficial in providing guidelines and ideas, but there is no substitute for innovative and deliberate thinking by a firm in order to arrive at a unique system which suits the particular organisation best, and to which it is totally committed and dedicated. There is no single right answer. Use should also be made, though, of the results of surveys and studies in order to be aware of potential errors and improvement areas. For example, the notes on the sequential evolvement of distribution activities in firms establishing a distribution department, could be used to formulate a plan for the similar establishment of a department in a particular company, while minimising resistance and opposition to such developments.

The important message is that any progressive firm reviewing its marketing, sales and other business plans may find it necessary to also review its physical distribution process. The benefits and other factors affecting such a decision have been outlined above. It is definitely important to note that while a successful physical distribution function may not solve all a firm's problems and lead it to a position of national or world leader, an ineffective and neglected distribution policy may easily play a major, if not dominant, part in any organisation's downfall.

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