ONLINE RESOURCES

ALAN RUSHTON | PHIL CROUCHER | PETER BAKER

THE HANDBOOK OF LOGISTICS AND DISTRIBUTION MANAGEMENT

7TH EDITION

UNDERSTANDING THE SUPPLY CHAIN

The Chartered Institute of Logistics and Transport

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The Handbook of Logistics and Distribution Management

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Seventh edition

The Handbook of Logistics and Distribution Management

Understanding the supply chain

Alan Rushton, Phil Croucher and Peter Baker

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ABOUT THE AUTHORS

Alan Rushton

After graduating from the University of Warwick with a degree in Economics, Alan spent several years in industry as Raw Materials Controller with the International Synthetic Rubber Company and as a distribution executive with Rio Tinto Zinc based in London.

He studied for an MSc in Transport Studies at Cranfield University and then joined the National Materials Handling Centre, initially to carry out research into urban delivery problems and goods consolidation. He was a senior consultant with the Centre for many years, undertaking a variety of consultancy projects, specializing in transport and logistics systems and strategies. After helping to create the Distribution Studies Unit (DSU) at Cranfield, he became the Director of Studies for the MSc in Distribution Technology and Management, and Head of the DSU.

With the creation of the Cranfield Centre for Logistics and Transportation (later the Cranfield Centre for Logistics and Supply Chain Management, CLSCM) he became the Director of Graduate Programmes for the new Centre where he set up and, for many years, ran the Executive MSc in Logistics and Supply Chain Management. He became the Director of eLearning for CLSCM and chaired the eLearning Committee for the Cranfield School of Management.

As well as his research and consultancy experience in transport, distribution, logistics and the supply chain, he has lectured in Europe, the Far East, the Middle East, North America, South America and Africa. He has published widely and co-wrote the original and subsequent editions of *The Handbook of Logistics and Distribution Management*, which was first published in 1989. He is also co-author of *International Logistics and Supply Chain Outsourcing*. He has continued to undertake consultancy, both nationally and internationally, and is the Director of Dialog Consultants Ltd, a consultancy specializing in distribution, logistics and supply chain management. Alan is a Fellow of the Chartered Institute of Logistics and Transport.

Phil Croucher

Phil Croucher is an independent supply chain consultant and trainer. He has 44 years' experience in the field of logistics and supply chain management, the last 20 years at senior management or board level, working, travelling and living in many different countries.

He has worked in many different industries, countries and functions within those industries. On the third-party logistics side he has worked in express parcels in the UK, as Managing Director of a freight forwarder in Oman, as General Manager of a desert trucking company in Oman, and as Regional Manager for the Middle East responsible for land transport based in Jordan and Dubai. In addition, he has held the post of Group Logistics Director in the paper merchant business in the UK, National Distribution Manager in the food industry and Vice President-Supply Chain, responsible for worldwide procurement and logistics movements for a land drilling contractor in the oil and gas industry with operations in Algeria, Qatar, Kingdom of Saudi Arabia, India and Oman.

Although at heart a practitioner, it has not stopped him developing a parallel career in training and academia. He has worked for the Chartered Institute of Logistics and Transport (UK) (CILT) on many projects. In 2002 CILT chose him to represent them in China at the inception of a prestigious training contract with the Chinese Government. This was followed by four further two-week trips delivering training in Beijing, Shanghai, Shenzhen and Dalian. He has also delivered training in Taiwan for CILT.

More recently (2011) CILT sent him to Somaliland to train United Nations International Children's Emergency Fund (UNICEF) staff, in 2012 he was sent to Bangkok to train Plan International staff and in 2013 he was sent to Qatar four times for Maersk Oil.

He has taught Masters courses in procurement, supply chain management and operations management.

He has also published several articles, most notably 'Insourcing'.

His qualifications include an MSc in Logistics and Distribution Management from Cranfield University, Chartered Fellow of the CILT (UK) and a Professional Diploma in Management from the Open University. He also holds a NEBOSH National General Certificate in Occupational Health and Safety.

Peter Baker

Peter Baker spent the early part of his career in international freight forwarding, conducting export and import freight movements and ship's agency work. He became an office manager prior to taking an MSc degree in Distribution Technology and Management at Cranfield University.

After a period with a specialist materials handling and distribution consultancy, he worked for 12 years with Deloitte Consulting in their Supply Chain and Consumer Business divisions. During his period in consultancy, he has conducted over 100 supply chain projects across a wide range of industries and public sector organizations. He has undertaken projects in many European countries, as well as in North America, the Far East, Central Asia, West Africa and the Middle East. These projects have included supply chain strategy, procurement, international logistics, distribution centre design, inventory control, transport operations and supporting computer systems.

He became a lecturer, senior lecturer and then visiting fellow, at the Centre for Logistics and Supply Chain Management at Cranfield School of Management, where he completed his PhD on the subject of the role, design and operation of distribution centres in agile supply chains. He has continued his consultancy work during this period. He is a Fellow of both the CILT (UK) and the Higher Education Academy. He has published regularly in books, trade journals and academic journals.

PREFACE

The scope of logistics continues to change and grow, and covers a wide range of different topics. In this book, we discuss key aspects of supply chain philosophy and practice, but also focus on the detailed elements of distribution and logistics. The objectives of the original book remain unchanged: to provide a text with both simplicity of style and relevance of context. In addition, we have attempted to reflect the general principles of logistics and distribution that can be applied in any country throughout the world, recognizing that in some instances there are practical differences that cannot be generalized effectively. As before, we have included a substantial and detailed Index, which we know makes the book very attractive to students and practitioners who wish to identify specific subjects for reference.

We hope, once again, that this book will help in logistics managers' quest to improve service and reduce cost while reducing the environmental impact, as well as keeping them aware of the many different facets of logistics and the supply chain. It should be of interest and use to practising managers and supervisors, to candidates undertaking examinations for the various professional institutes, and to undergraduate and graduate students who are reading for degrees in logistics, distribution, transport and supply chain management or where these subjects are an integral part of their course. It should also provide major support for those participating in web-based training in logistics.

The book is divided into seven distinct parts, each covering a broad subject area in logistics. Each part is made up of a series of interlinking chapters. The main topics in each chapter can be seen in the list of contents at the beginning of this book.

In Part One the key **concepts of logistics and distribution** are considered. After an introduction to logistics and distribution, the integrated nature of logistics and the supply chain is discussed. The important aspects of customer service within logistics are covered in some detail and the use of different channels of distribution is examined. Finally, the key issues and challenges for logistics and the supply chain are outlined.

Part Two covers the ways and means of **planning for logistics**. An overview of logistics planning is provided including a specific logistics design framework. This is followed by a discussion of the key logistics processes. The important area of supply chain segmentation is reviewed. The various costs of the key logistics elements are outlined and the concept of logistics trade-off analysis is described. A particular approach to logistics network planning is developed and then the key elements of logistics management and organization are examined. The various issues concerning

omnichannel fulfilment are investigated and this part of the book concludes with a consideration of manufacturing logistics.

Part Three concentrates on those issues that are involved with **procurement, inventory and demand forecasting** decisions. The main principles concerned with the procurement and supply of raw materials and other goods are explored. The basic concepts behind the inventory-holding decision are investigated, including the reasons for holding stock and the different types of stock. Key developments in inventory planning are reviewed, particularly the way that inventory is viewed across the supply chain as a whole. Finally, there is a discussion of the use of demand forecasting to help determine the amount of inventory that should be held in the logistics network to meet customer service needs.

Part Four covers **warehousing and storage**. The main warehousing principles are introduced and an outline of the main warehouse operations is provided. Palletized and non-palletized storage and handling systems are considered, including descriptions of the various types of equipment that are available. Then, order picking, replenishment and packing are reviewed in some detail, in particular, the main order picking concepts, and the various order picking methods. The major factors related to receiving and dispatch are outlined. A step-by-step approach to warehouse and distribution centre (DC) design is described. Finally, there is a review of the key elements involved in warehouse management, together with the supporting information systems, for both automated and conventional operations.

Part Five concentrates on those areas of logistics and supply chain management specifically related to **freight transport**. International logistics and the choice of transport mode are considered, including a simple approach for modal choice. An overview and description of the major modes of international transport – maritime, air and rail – are given. For each of these, the basic infrastructure of the industry is reviewed, together with a variety of other aspects such as equipment, safety, pricing, security and documentation. Intermodal transport is also discussed. There are several chapters concerned with aspects of road freight transport. Vehicle selection factors are described, including the main types of vehicle and vehicle body, different types of operation, load types and characteristics. Vehicle and fleet costing is explained. Methods for the planning and resourcing of road freight transport operations are outlined. Following from this, the routeing and scheduling of vehicles within this process is described, including examples of both manual and computer routeing and scheduling. Finally, in this section, the key aspects of international freight forwarding are considered.

Part Six of the book covers the **outsourcing of logistics**, when the key decision of whether to use an own-account (in-house) operation or whether to outsource to a third-party logistics (3PL) service must be made. This begins with a review of the different outsourcing operations, activities and services that are available. The key decision criteria for outsourcing are then reviewed. The actual process of selecting a

service provider is described, including a step-by-step guide from the initial scoping of outsourcing requirements through to final negotiation and contract agreement. The all-important question of contractor management provides the finale to this section. The need to manage an outsourced contract is explained and the key factors required in managing a successful relationship are examined.

The final part of the book, Part Seven, considers a number of aspects related to the **operational management** of logistics and the supply chain. The cost and performance monitoring of logistics and distribution operations is discussed, together with the use of benchmarking as a major technique for identifying best practice in logistics. The different information and communication systems that can be used in the supply chain are outlined, indicating how the development of the digital supply chain has evolved from the many different threads of technological development. Key factors concerning security and safety, a very important area of responsibility in logistics, are discussed. Another important aspect that is considered is the impact of logistics operations on the environment, as well as the environmental regulations that may impose on logistics operations. The final chapter of the book provides an overview of humanitarian logistics and compares this with commercial logistics.

Once again, we hope that this new edition of *The Handbook of Logistics and Distribution Management* will continue to serve as an essential aid to understanding this wide-ranging and increasingly important business area.

Alan Rushton

PART ONE
Concepts of logistics and distribution

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Introduction to logistics and distribution 01

Introduction

The key components of logistics – transport, inventory, warehousing – have been fundamental elements of industrial and economic life for countless years. However, these components and their sub-functions were treated as individual elements and rarely as part of a bigger and broader concept whereby they are connected together to provide the means to an end. That end is the satisfactory supply of goods or products to a customer at an acceptable time and an acceptable cost. Thus, in those early years, logistics was not recognized as a major business function in its own right. The main reason for this is the nature of logistics itself. It is a function made up of many sub-functions and many subsystems, each of which has been, and may still be, treated as a distinct management operation. Both the academic and the business world accept that there is a need to adopt a more holistic view of these different operations in order to take into account how they interrelate and interact with one another and to ensure that the overall operation, whatever it may be, is optimized.

The appreciation of the scope and importance of logistics and the supply chain has led to a more scientific approach being adopted towards the subject. This approach has been aimed at the overall concept of the logistics function as a whole but, importantly, also includes the interrelationship of the individual subsystems. Much of this approach has addressed the need for, and means of, planning logistics and the supply chain, but has necessarily included the consideration of the major operational issues as well.

Continuous advances in technology and the development of new ideas and concepts, however, mean that there is a constant change in thinking with regard to the most effective approaches that should be adopted for logistics and the supply chain. Some of these key ideas and issues are described in Chapter 5. This first chapter of the book provides an introduction to the very basic aspects of distribution, logistics and the supply chain. Initially there is a review of the scope and definition of

distribution, logistics and the supply chain. Next is a discussion of the key elements that are fundamental to the logistic function. A brief description of the historical growth of distribution and logistics is followed by an assessment of its importance throughout the world. Finally, a typical distribution and logistics structure is described and discussed.

Scope and definition

Parallel to the growth in the importance of distribution, logistics and the supply chain has been the growth in the number of associated names and different definitions that are used. Among the many different names can be found:

- physical distribution
- logistics
- business logistics
- materials management
- procurement and supply
- product flow
- marketing logistics
- supply chain management
- demand chain management

and there are several more.

There is, realistically, no 'true' name or 'true' definition that can be pedantically applied to these different terms because the elements that are covered can be so variable. Every industry has its own characteristics, and for each company in that industry there can be major variations in strategy, size, range of product, market coverage, etc. Logistics is, therefore, a diverse and dynamic function that has to be flexible and has to change according to the various constraints and demands imposed upon it and with respect to the environment in which it works.

Thus, these many different terms are used, often interchangeably, in literature and in the business world. One of the key relationships can be described as follows:

Logistics = Materials Management + Distribution

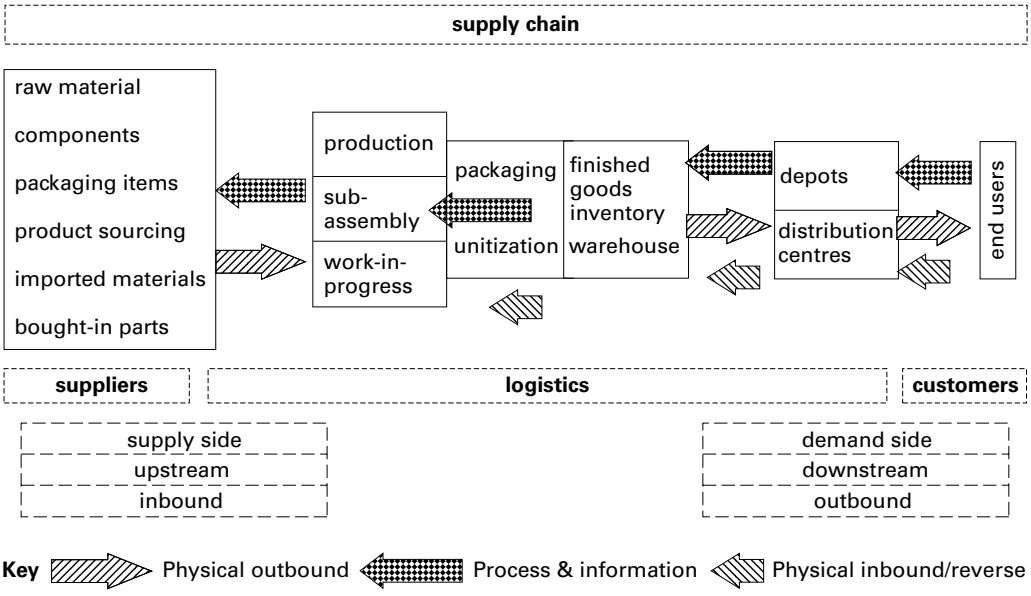
where 'materials management' represents the activities concerning materials going into and through the production process and 'distribution' represents the process of making a product available to the consumer or business that needs it.

An extension to this idea helps to illustrate that the supply chain covers an even broader scope of the business area. This includes the supply of raw materials and components as well as the delivery of products to the final customer. Thus:

Supply Chain = Suppliers + Logistics + Customers

It should also be noted that logistics and the supply chain are concerned not only with physical flows and storage from raw material through to the final distribution of the finished product, but also with information flows and storage. Indeed, major emphasis is now placed on the importance of information as well as physical flows and storage. This is reflected in the content throughout this book. An additional and very relevant factor is that of reverse logistics – the flow of used products and returnable packaging back through the system. Figure 1.1 illustrates these different elements and flows, as well as indicating how some of the associated logistics terminology can be applied.

Figure 1.1 A flow representation of logistics for a fast-moving consumer goods (FMCG) manufacturer. This shows the key components, the major flows and some of the different logistics terminology



Having indicated above that there is no 'true' definition of logistics that can be universally applied, it would be remiss not to consider some of the alternatives! The question of what is the most appropriate definition of logistics and its associated namesakes is always an interesting one. There is a multitude of definitions to be found in textbooks and on the internet. Several early definitions referred to the

ability of logistics to help create time and place utility for products in the marketplace. A selection of more recent definitions is:

> Logistics is the management of the flow of goods between point of origin and point of destination to meet customer and corporate requirements.
>
> Collins Dictionary

> Logistics management is that part of supply chain management that plans, implements and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements.
>
> Council of Supply Chain Management Professionals (USA), 2021

> Logistics is defined as the time-related positioning of resources. It is also described as the 'five rights'. Essentially, it is the process of ensuring that goods or a service is: in the right place, at the right time, in the right quantity, at the right quality, at the right price.
>
> Chartered Institute of Logistics and Transport (UK), 2021

For many definitions it is possible to detect the different biases – military, economic, academic… An appropriate modern definition that applies to most industries and that we might use for this book is that:

> logistics concerns the efficient transfer of goods from the source of supply through the place of manufacture to the point of consumption in a cost-effective way while providing an appropriate service to the customer.

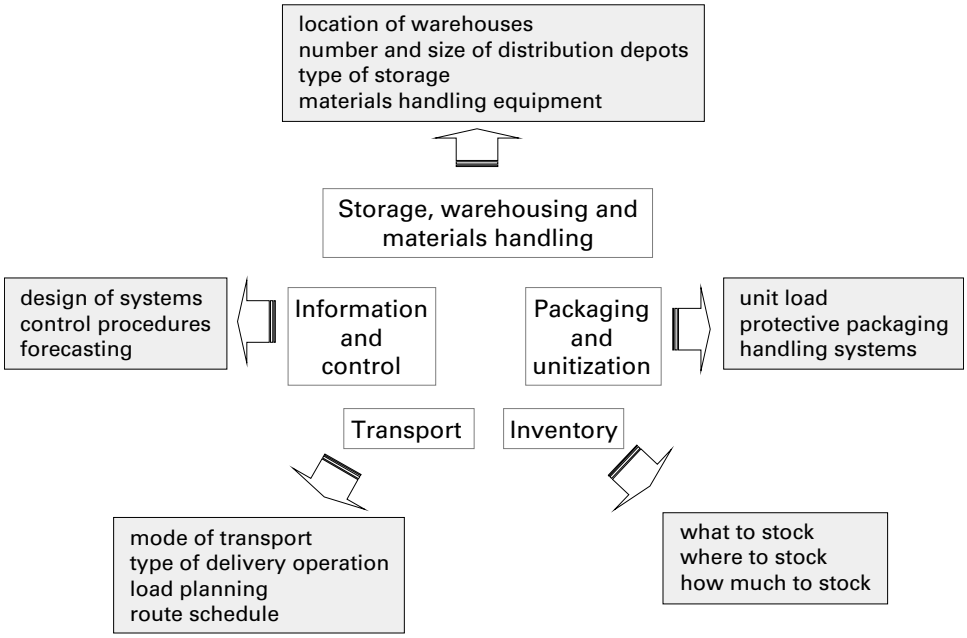
This focus on cost-effectiveness and customer service will be a point of emphasis throughout this book.

A more critical consideration of the difference between logistics and the supply chain is given at the end of Chapter 2. It is developed using some of the ideas that are discussed in that chapter.

For most organizations it is possible to draw up a familiar list of key areas representing the major components of distribution and logistics. These will include transport, warehousing, inventory, packaging and information. This list can be 'exploded' once again to reveal the detailed aspects within the different components. Some typical examples are given in Figure 1.2.

All of these functions and sub-functions need to be planned in a systematic way, in terms both of their own local environment and of the wider scope of the distribution system as a whole. A number of questions need to be asked and decisions made. The different ways of answering these questions and making these decisions are addressed in the chapters of this book as consideration is given to the planning and operation of the logistics and supply chain function. In addition, the total system interrelationships and the constraints of appropriate costs and service levels are discussed.

Figure 1.2 The key components of distribution and logistics, showing a few of the associated detailed elements



Historical perspective

The different elements of logistics and the supply chain have, of course, always been fundamental to the manufacturing, storage and movement of goods and products. For most companies they are recognized as vital functions that contribute to the business and economic environment. The role of logistics has developed such that it now plays a major part in the success of many different operations and organizations. In essence, the underlying concepts and rationale for logistics are not new. They have evolved through several stages of development, but still use the basic ideas such as trade-off analysis, value chains and systems theory together with their associated techniques. Of course, many of these ideas, concepts and techniques have altered, almost beyond recognition, from their original format.

There have been several distinct stages in the development of distribution and logistics.

1950s and early 1960s

In the 1950s and early 1960s, distribution systems were unplanned and unformulated. Manufacturers manufactured, retailers retailed, and in some way or other the

goods reached the shops. Distribution was broadly represented by the haulage industry and manufacturers' own-account fleets. There was little positive control and no real liaison between the various distribution-related functions.

1960s and early 1970s

In the 1960s and 1970s the concept of physical distribution was developed with the gradual realization that the 'dark continent' (as distribution was described in early academic literature) was indeed a valid area for managerial involvement. This consisted of the recognition that there was a series of interrelated physical activities such as transport, storage, materials handling and packaging that could be linked together and managed more effectively. In particular, there was recognition of a relationship between the various functions, which enabled a systems approach and total cost perspective to be used. Under the auspices of a physical distribution manager, a number of distribution trade-offs could be planned and managed to provide both improved service and reduced cost. Initially the benefits were recognized by manufacturers, who developed distribution operations to reflect the flow of their product to their customers.

1970s

The 1970s was an important decade in the development of the distribution concept. One major change was the recognition by some companies of the need to include distribution in the functional management structure of an organization. The decade also saw a change in the structure and control of the distribution chain. There was a decline in the power of the manufacturers and suppliers, and a marked increase in that of the major retailers. The larger retail chains developed their own distribution structures, based initially on the concept of regional or local distribution depots to supply their stores.

1980s

In the 1980s fairly rapid cost increases and the clearer definition of the true costs of distribution contributed to a significant increase in professionalism within distribution. With this professionalism came a move towards longer-term planning and attempts to identify and pursue cost-saving measures. These measures included centralized distribution, notable reductions in stockholding and the use of the computer to provide improved information and control. The growth of the third-party distribution service industry was also of major significance, with these companies spearheading developments in information and equipment technology. The concept

of and need for integrated logistics systems were recognized by forward-looking companies that participated in distribution activities.

Late 1980s and early 1990s

In the late 1980s and early 1990s advances in information technology enabled organizations to broaden their perspectives in terms of the functions that could be integrated. In short, this covered the combining of materials management (the inbound side) with physical distribution (the outbound side). The term 'logistics' was used to describe this concept (see Figure 1.1). Once again, this led to additional opportunities to improve customer service and reduce the associated costs. One major emphasis made during this period was that informational aspects were as important as physical aspects in securing an effective logistics strategy.

1990s

In the 1990s the process of integration was developed even further to encompass not only the key functions within an organization's own boundaries but also those functions outside that also contribute to the provision of a product to a final customer. This became known as 'supply chain management' (see Figure 1.1). The supply chain concept gave credence to the fact that there may be several different organizations involved in getting a product to the marketplace. Thus, for example, manufacturers and retailers should act together in partnership to help create a logistics pipeline that enables an efficient and effective flow of the right products through to the final customer. These partnerships or alliances should also include other intermediaries within the supply chain, such as third-party contractors.

2000s

As the new millennium dawned, business organizations faced many challenges as they endeavoured to maintain or improve their position against their competitors, bring new products to market and increase the profitability of their operations. This led to the development of many new ideas for improvement, specifically recognized in the redefinition of business goals and the re-engineering of entire systems.

Logistics and the supply chain were confirmed as key elements to overall business success. Indeed, for many organizations, changes in logistics and the supply chain provided the catalyst for major enhancements to their business. Leading organizations recognized that there was a positive 'value-added' role that logistics could offer, rather than the traditional view that the various functions within logistics were merely a cost burden that had to be minimized regardless of any other implications. Logistics was seen as a key enabler for business improvement.

2010s and beyond

This period saw the confirmation of the importance of a number of concepts and many businesses developed and improved their systems and operations to embrace these. Many of these concepts remain key and are covered in the relevant chapters of this book. Some examples are:

- environmental concerns resulted in the development of many green initiatives in logistics
- the important role of the supply chain was reflected in new approaches to humanitarian logistics
- the recognition of the difference between lean and agile supply chains brought about revised structures to relevant businesses
- the concept of the networked economy was also embraced, acknowledging that the success of a company is intrinsically linked to others so that enterprises need to cooperate and collaborate across their traditional boundaries
- significant technology developments began to impact on logistics and supply chain activities
- e-commerce, e-fulfilment, AI, Big Data analytics

The key recent and likely future issues to be faced in distribution, logistics and supply chain management are reviewed and discussed in Chapter 5.

Importance of logistics and distribution

Importance in the economy

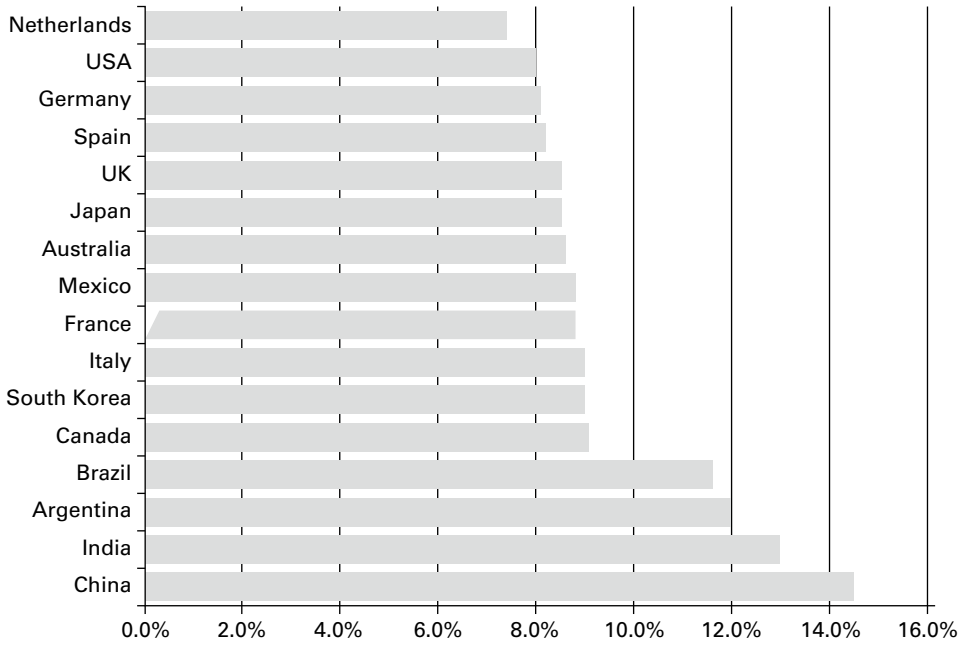
Logistics is an important activity making extensive use of the human and material resources that affect a national economy. Due to the difficulty of data collection, only a limited number of studies have been undertaken to try to estimate and compare the extent of the impact of logistics on the economy.

One study in the UK has indicated that about 30 per cent of the working population were associated with work that is related to logistics. A study undertaken by Armstrong and Associates (2021a) was able to present data at a country level, which indicated that, for the many economies reviewed, logistics represented somewhere between 7.4 and 20 per cent of the gross domestic product (GDP) of that country. The information, for the latest year available, is summarized in Figure 1.3 for certain key countries.

Figure 1.3 shows that, for the main European and North American economies, logistics represented between 7.4 per cent and 9.5 per cent of GDP. For the larger

South American nations this range was higher at around 12 per cent, with India at 13 per cent and China at 14.5 per cent. These numbers represent some very substantial costs, and serve to illustrate how important it is to understand the nature of logistics costs and to identify means of keeping these costs to a minimum. Countries with the lowest costs are generally those where the importance of logistics was recognized relatively early and where there has been time to create more efficient systems. It is already apparent that the logistics costs of developing nations will continue to decrease over the next few years as they have decreased in the past few years. About 25 years ago, if the same statistics had been available, these percentage elements would undoubtedly have been a lot higher in all of these countries. In the UK records go back for about 40 years, and logistics costs were then around the 18 to 20 per cent mark.

Figure 1.3 Logistics costs as a percentage of GDP for selected countries



SOURCE Armstrong and Associates, 2021a

The Council of Supply Chain Management Professionals in the United States, in its *Annual State of Logistics Report* (2020), provided figures indicating that logistics costs as a percentage of GDP for the United States had fallen from 8.1 per cent in 2008 to 7.4 per cent in 2009. There was a brief rise to 7.9 per cent for 2018, due to fast growth and capacity shortages, before a return to a more normal level of 7.6 per cent for 2019. The report notes that this final measure indicated 'an unrecognized last hurrah of the *old normal*' before the global pandemic.

Importance to industry

The breakdown of the costs of the different elements within logistics has also been addressed, but again only in a very limited number of surveys, so data is hard to find. One survey of US logistics costs undertaken by Establish Davis (2016) indicated that in the United States transport was the most important element at 48.4 per cent, followed by inventory carrying cost at 22.9 per cent, storage/warehousing at 22.6 per cent, customer service/order entry at 3.9 per cent and administration at 2.3 per cent.

In past studies of this nature, the transport cost element of distribution has always been the major constituent part in the United States. US transport costs are especially affected by the long distances travelled, so the transport cost element is markedly higher there than it is in Europe.

The statistics described above are useful to provide a broad perspective on the importance of the relative logistics components. When looking at industry and company level, however, it is essential to be aware that these costs are average figures taken across a number of companies.

The relative make-up of these costs can vary quite significantly between different industries. Listed in Table 1.1 are some examples of the major logistics costs from different types of company, shown as a percentage of sales turnover. These are taken from an industry cost audit carried out in the UK by Dialog Consultants Ltd and they illustrate how extreme these variations can be. There are some quite major variations among the results from the various companies and there can be a number of reasons for these cost differences. For example:

- Logistics structures can and do differ quite dramatically between one company and another, and one industry and another.
- Channels can be short (i.e. very direct) or long (i.e. have many intermediate stocking points).
- Supply chains may be operated by different players: manufacturers, retailers, specialist third-party distribution companies, or indeed by a mixture of these.

Also, it should be noted that in the examples shown in Table 1.1 the relative importance of logistics is measured in relationship to the overall value of the particular products in question, which has implications for comparing relative importance between different companies. For example, cement is a low-cost product (as well as being a very heavy one!), so the relative costs of its logistics are very high. Spirits (whisky, gin, etc) are very high-value products, so the relative logistics costs appear very low.

Two key factors related to the relative importance of logistics in industry are:

- Small companies tend to have proportionately higher logistics costs than large companies (about 13 per cent of the cost of sales compared to about 4.5 per cent).

Table 1.1 Logistics costs as a percentage of sales turnover

Main Company Business	Cost as Percentage of Turnover				
	Transport Cost %	Warehouse/ Depot Cost %	Inventory Investment/ Holding Cost %	Administration Cost %	Overall Logistics Cost %
Office equipment	3.20	10.70	0.87		14.77
Health supplies	1.36	9.77	0.66	0.19	11.98
Soft drinks	2.53	2.71	0.44		5.68
Beer (food and drink)	8.16	2.82	0.56	2.19	13.74
Spirits distribution	0.37	0.27	0.07	0.10	0.81
Cement	25.20	9.10	7.10	4.60	46.00
Automotive parts	2.07	6.35	1.53		9.96
Gas supply (non-bulk)	9.41	2.45	0.02		11.98
Computer maintenance	0.45	0.10	0.29	0.05	0.88
Computer supply	0.65	0.78	0.09		1.52
Healthcare	0.96	1.08	1.21		3.25
Specialist chemicals	7.23	1.95	0.20	0.49	9.87
Fashion	0.38	1.31	0.33		2.02
Food packaging	3.14	3.73	0.85		7.72

SOURCE Benchmark survey of UK companies by Dialog Consultants Ltd (unpublished)

This is principally because large companies can benefit from economies of scale.

- Companies with high product values tend to have proportionately lower logistics costs than those with low product values (about 4.5 per cent of the cost of sales compared to about 10.5 per cent). This is because the high value of their goods tends to distort downwards the importance of the respective logistics costs.

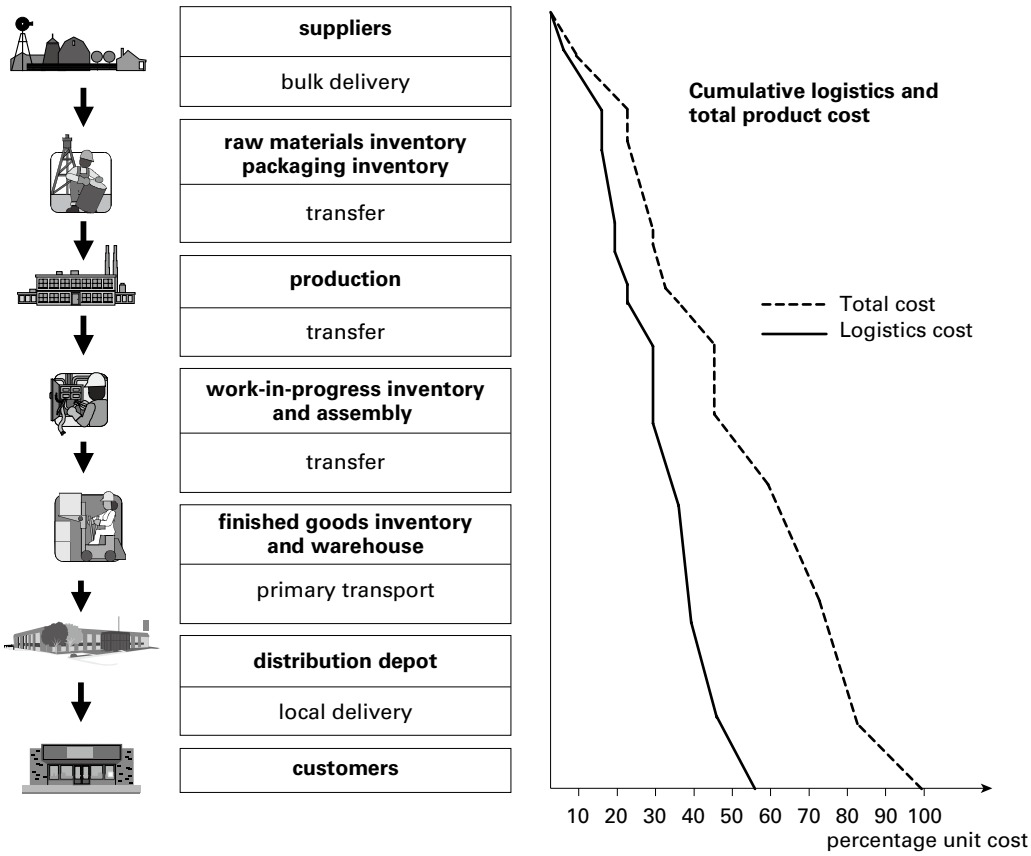
These and other associated aspects are discussed in subsequent chapters.

Logistics and supply chain structure

The discussion in the previous sections of this chapter has illustrated the major components to be found within a logistics or supply chain system: transport, warehousing, inventory, etc. The fundamental characteristics of a physical distribution structure are illustrated on the left-hand side of Figure 1.4, and can be considered as the flow of material or product, interspersed at various points by periods when the material or product is stationary. This flow is usually some form of transportation of the product. The stationary periods are usually for storage or to allow some change to the product to take place – manufacture, assembly, packing, break bulk, etc.

This simple physical flow that is illustrated thus consists of the different types of transport (primary, local delivery, etc) and stationary functions (production, finished goods inventory, etc).

Figure 1.4 A typical physical flow of material from suppliers through to customers, showing stationary functions and movement functions, linked to a diagram that reflects the 'value-added' nature of logistics



There is also, of course, a cost incurred to enable the distribution operation to take place. The importance of this distribution or logistical cost to the final cost of the product has already been highlighted. As has been noted, it can vary according to the sophistication of the distribution system used and the intrinsic value of the product itself. One idea that helps to emphasize the importance of distribution and logistics is that these different elements of logistics are providing an 'added value' to a product as it is made available to the final user – rather than just imposing an additional cost. This is a more positive view of logistics and is a useful way of assessing the real contribution of logistics and distribution services. Figure 1.4 also provides an example of this cost or added value for a typical low-cost product.

Figure 1.4 concentrates on the physical flows of goods and materials, demonstrating some of the different links and functions that are fundamental to logistics. What is not shown, but will be seen as vital to the success of the process, is the vast amount of information that is essential to enable and support logistics operations. This is key, and will be considered in detail in many chapters of this book.

Integrated logistics and the supply chain

02

Introduction

In Chapter 1, different definitions of logistics were introduced, and the main components of logistics were outlined. It was shown that the various logistics and supply chain functions are part of a flow process operating across many business areas. In this chapter, the emphasis is on the integration of the various logistics components into a complete working structure that enables the overall system to run at the optimum. Thus, the concept of 'total logistics' is described, and the importance of recognizing the opportunities for appropriate trade-offs is discussed. Some key aspects of planning for logistics are reviewed, and the financial impact that logistics has in a business is described. Finally, a number of key developments in logistics integration are considered, including the impact of the globalization of many companies, the use of integrated planning systems, how logistics can help to create competitive advantage and the concept of supply chain (SC) management.

The total logistics concept

The total logistics concept (TLC) aims to treat the many different elements that come under the broad category of distribution and logistics as one single integrated system. It is a recognition that the interrelationships between different elements, for example delivery transport and storage, need to be considered within the context of the broader supply chain. Thus, the total system should be considered and not just an individual element or subsystem in isolation.

An understanding of the concept is especially important when planning for any aspect of distribution and logistics. The simple, practical example in the box helps to emphasize the point.

EXAMPLE The total logistics concept

A company produces plastic toys that are packaged in cardboard boxes. These boxes are packed onto wooden pallets that are used as the basic unit load in the warehouse and in the transport vehicles for delivery to customers.

A study indicates that the cardboard box is an unnecessary cost because it does not provide any significant additional protection to the quite robust plastic toys and it does not appear to offer any significant marketing advantage. Thus, the box is discarded, lowering the unit cost of the toy and so providing a potential advantage in the marketplace.

One unforeseen result, however, is that the toys, without their boxes, cannot be stacked on to wooden pallets, because they are unstable, but must be stored and moved instead in special trays. These trays are totally different to the unit load that is currently used in the warehouse and on the vehicles (i.e. the wooden pallet). The additional cost penalty in providing special trays and catering for another type of unit load for storage and delivery is a high one – much higher than the savings made on the product packaging.

This example illustrates a classic case of *sub-optimization* in a logistics system. It shows that if the concept of total logistics is ignored, this can be a significant cost to a company. As the product packaging costs have been reduced, those concerned with this company function will feel that they have done their job well. However, the overall effect on the total logistics cost is, in fact, a negative one. The company is better served by disregarding this potential saving on packaging, because the additional warehouse and transport costs mean that total costs increase.

This simple example of sub-optimization emphasizes the importance of understanding the interrelationships of the different logistics elements. A more positive action would be to measure and interpret these and other interrelationships using a planned approach to identifying and determining any *cost trade-offs*. This approach will be a benefit to the logistics system as a whole. Such a trade-off may entail additional cost in one function but will provide a greater cost saving in another. The overall achievement will be a net gain to the system.

This type of trade-off analysis is an important part of planning for logistics. Four different levels of trade-off can be identified:

1 *Within logistics components:* this refers to the trade-offs that occur within single functions (e.g. warehousing). One example would be the decision to use random storage locations compared to fixed storage locations in a depot. The first of these provides better storage utilization but is more difficult for picking; the second is easier for picking but does not provide such good storage utilization.

2 *Between logistics components:* these are the trade-offs that occur between the different elements in logistics. To reverse the earlier packaging example, a company might increase the strength and thus the cost of packaging but find greater savings through improvements in the warehousing and storage of the product (i.e. block stacking rather than a requirement for racking).

3 *Between company functions:* there are a number of areas of interface between company functions where trade-offs can be made. This is illustrated in Figure 2.1, which lists some potential trade-offs and indicates how the different company functions might be affected. One example is the trade-off between optimizing production run lengths and the associated warehousing costs of storing the finished product. Long production runs produce lower unit costs (and thus more cost-effective production) but mean that more product must be stored for a longer period (which is less cost-effective for warehousing).

4 *Between the company and external organizations:* there may be opportunities for a trade-off between two companies that are directly associated with each other. For example, a change from a manufacturer's products being delivered direct to a retailer's stores to delivery via the retailer's distribution depot network might lead to a cheaper solution overall for the two companies.

These types of trade-offs are thus at the heart of the total logistics concept. For the planning of distribution and logistics, it is important to take this overall view of a logistics system and its costs. The other side of the equation is, of course, the need to provide the service level that is required by the customer. This balance of total logistics cost and customer service level is essential to successful logistics.

Planning for logistics

In order to ensure that the concept of total logistics is put into practice and that suitable trade-offs are achieved, it is essential that a positive planning approach is adopted. In this section, the various planning horizons with their associated logistics decisions are described. In Chapter 6, a more formalized planning framework is discussed. This is developed in subsequent chapters into a more practical and detailed approach to logistics planning.

Planning should be undertaken according to a certain hierarchy that reflects different *planning time horizons*. These are generally classified as strategic, tactical and operational. They are represented on the left side of Figure 2.2. There is an overlap between the different levels, which emphasizes that there are some factors that can be considered at different stages in this planning hierarchy. The relative importance of these various elements can differ between one company and another. For example, the choice of transport mode might be a strategic decision for a company that is

Figure 2.1 Some potential trade-offs in logistics, showing how different company functions might be affected

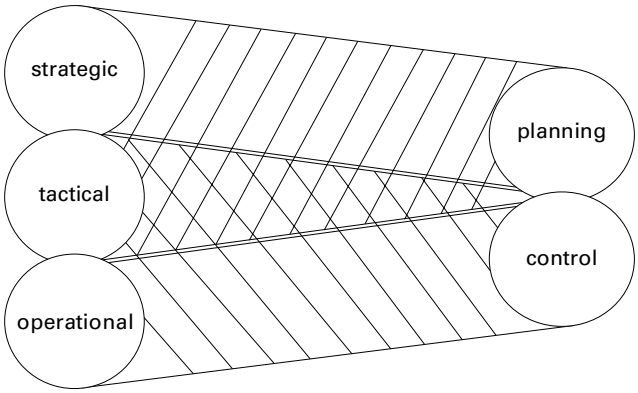
Trade-off	Finance	Production	Distribution	Marketing
Longer production runs	Lower production unit costs	Lower production unit costs	More inventory and storage required	Lower prices
Fewer depots	Reduced depot costs (though transport costs likely to increase)	No impact	Less complicated logistics structure	Service reduction due to increased distance of depots from customers
Reducing stocks of finished goods	Reduced inventory costs	Shorter production runs so higher production unit costs	No need to expand storage facilities	Poorer product availability for customers
Reducing raw material & component stocks	Reduced inventory costs	Less efficient production scheduling due to stock unavailability	Lower stock-holding requirements	No direct impact
Reducing protective transport packaging	Reduced packaging costs	No impact	Reduced transport modal choice	Increase in damaged deliveries
Reducing warehouse supervision	Cost savings through lower headcount	No impact	Reduced efficiency due to less supervision	Lost sales due to less accurate order picking

setting up a new global logistics operation, but might just be a tactical decision for another company that is principally a supplier to a locally based market and only occasionally exports over long distances. Choice of transport mode could even be an initial strategic decision and also a subsequent tactical decision for a single company.

Figure 2.2 also indicates the interrelationship of *planning and control* within this hierarchy. Both of these different elements are essential to the running of an effective and efficient logistics operation. One way to envisage the difference between these two concepts is as follows: *planning* is about ensuring that the operation is set up to run properly – it is 'doing the right thing' or preparing for and planning the operation 'effectively'; *control* is about managing the operation in the right way – it is 'doing the thing right' or making sure that the operation is being run 'efficiently'.

Once again it is not relevant to define exactly which strategic, tactical and operational decisions or tasks within a company should be classified as either planning or control. Most elements need to be planned correctly in the first place, and then subsequently they need to be monitored and controlled to ensure that the operation is running as well as it should be. The practical means of monitoring and controlling logistics are described in Chapter 38.

Figure 2.2 Logistics planning hierarchy



Some of the major aspects and differences between the three time horizons are summarized in Figure 2.3. The importance and relevance of these different aspects will, of course, vary according to the type and scale of business, product, etc. It is helpful to be aware of the planning horizon and the associated implications for each major decision that is made.

Figure 2.3 The major functions of the different planning time horizons

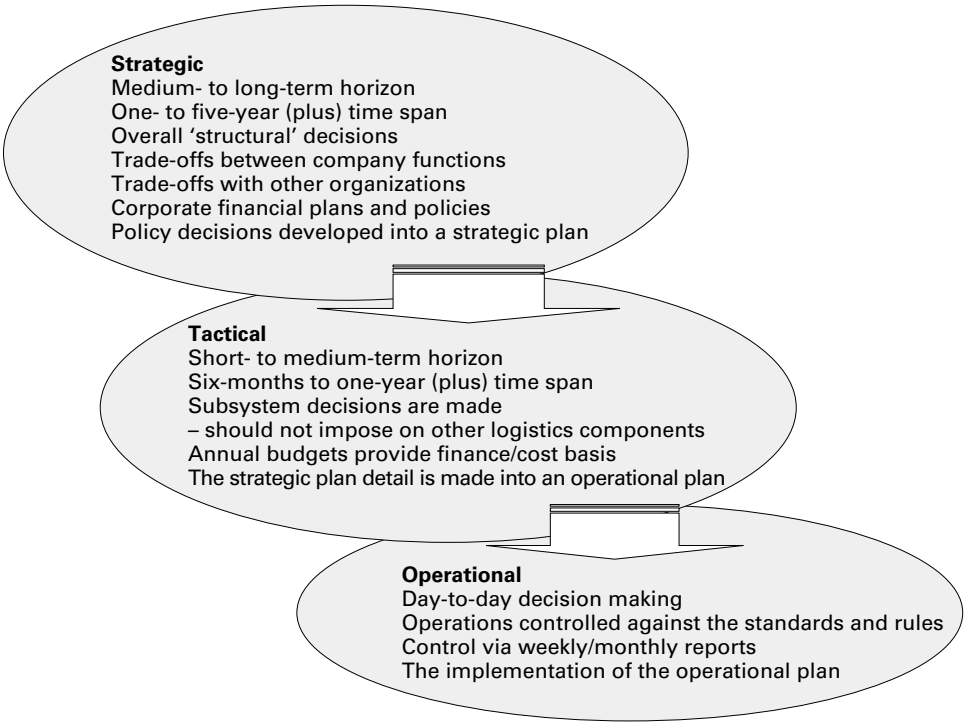
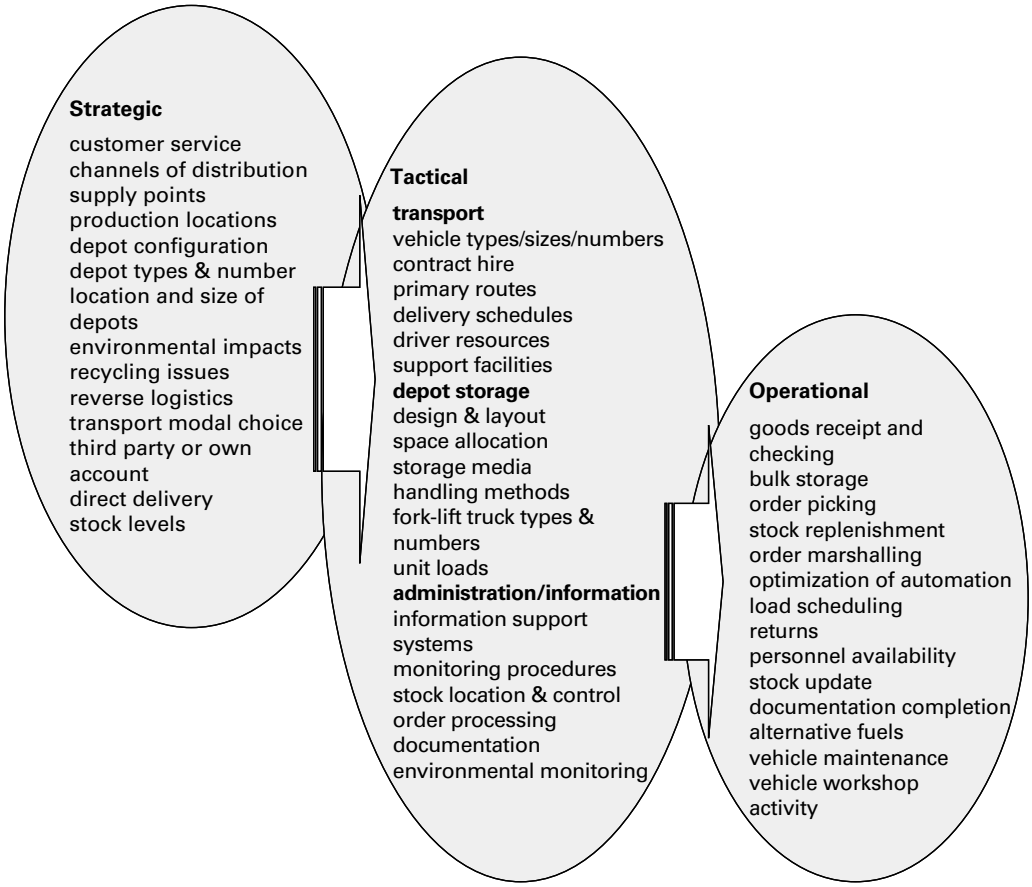


Figure 2.4 Some of the main logistics elements for the different planning time horizons

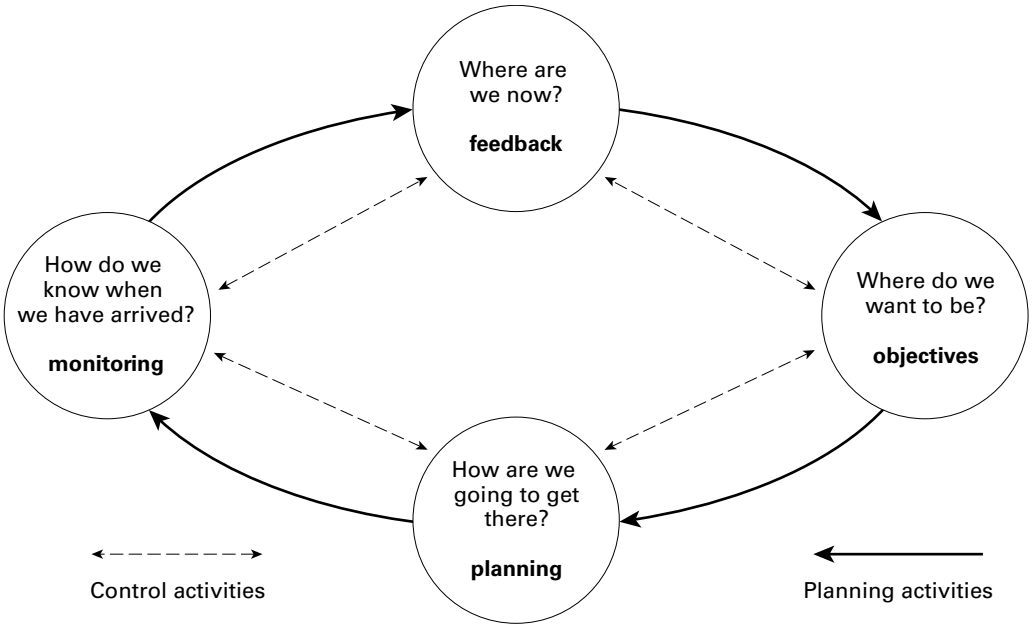


It is possible to identify many different elements within distribution and logistics that can be broadly categorized within this planning hierarchy. As already indicated, these may vary from one company to another and from one operation to another. Some of these – in no particular order – are as indicated in Figure 2.4.

These examples serve to emphasize the complexity of distribution and logistics. In addition, they underline the need for appropriate planning and control. Distribution and logistics are not merely the transportation of goods from one storage point to another. There are many and varied elements that go together to produce an effective distribution and logistics operation. These elements interrelate, and they need to be planned over suitable time horizons.

The planning and control of an operation can also be described within the context of a broader planning cycle. This emphasizes the need for a systematic approach, where continual review takes place. This is a particularly important concept in logistics, because most operations need to be highly dynamic – they are subject to

Figure 2.5 The planning and control cycle



continual change, as both demand and supply of goods and products regularly vary according to changes in customer requirements for new products and better product availability. One example of a fairly common framework is shown as the planning and control cycle in Figure 2.5. The key stages in the cycle are as follows:

1. The cycle begins with the question 'Where are we now?' Here the aim is to provide a picture of the current position. This might be through a regular information feedback procedure or, initially, through the use of a specific logistics or distribution audit.
2. The second stage is to determine the objectives of the logistics process, to identify what the operation should be trying to achieve. These objectives need to be related to such elements as customer service requirements, marketing decisions, etc.
3. The third stage in the cycle is the planning process that spans the strategic and operational levels previously discussed.
4. Finally, there is a need for monitoring and control procedures to measure the effectiveness of the distribution operation compared to the plan. This should be undertaken on a regular weekly, monthly and annual basis.

The cycle has then turned full circle, and the process is ready to begin again. This takes account of the dynamic nature of logistics, the need for continual review and

revision of plans, policies and operations. This must be undertaken within a positive planning framework in order to ensure that continuity and progress are maintained.

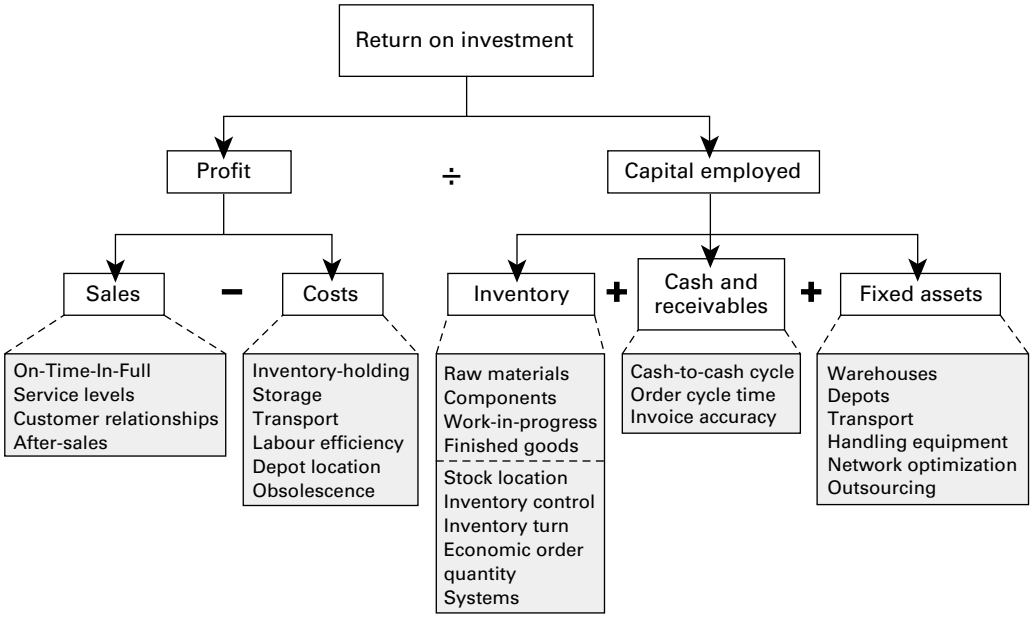
The financial impact of logistics

Logistics can have a variety of different impacts on an organization's financial performance. Logistics was traditionally seen as an operational necessity that cannot be avoided; however, a good logistics operation can also offer opportunities for improving financial performance.

For many companies, a key measure of success is the return on investment (ROI): the ratio between the net profit and the capital employed in the business. For improved business performance, this ratio needs to be shifted to increase profits and reduce capital employed. There are many different ways in which logistics can have both a positive and a negative impact on the ROI. These are outlined in Figure 2.6. This shows ROI as the key ratio of profit and capital employed, with the main elements broken down further as sales revenue *less* cost (representing profit) and inventory *plus* cash and receivables *plus* fixed assets (representing capital employed).

Profit can be enhanced through increased sales, and sales benefit from the provision of high and consistent service levels. One of the aims of many service level

Figure 2.6 The many ways in which logistics can provide an impact on an organization's return on investment



agreements is to try to achieve on-time-in-full (OTIF) deliveries – a key objective of many logistics systems. On the other hand, costs can be minimized through efficient logistics operations. There are a number of ways that this might happen, including:

- more efficient transport, thus reducing transport costs
- better storage and handling leading to reduced storage costs
- reduced inventory holding leading to less cash being tied up in inventory
- improved labour efficiency, thus reducing costs

The amount of *capital employed* can also be affected by the different logistics components. For example, there are many different types of inventory held by companies, including raw materials, components, work-in-progress and finished goods. The key logistics functions impact very significantly on the stock levels of all of these. This impact can occur with respect to stock location, inventory control, stockholding policies, order and reorder quantities and integrated systems, among others. Cash and receivables are influenced by cash-to-cash and order cycle times – both of these being key logistics processes. Finally, there are many fixed assets to be found in logistics operations: warehouses, distribution centres/depots, transport and materials handling equipment. The number, size and extent of their usage are fundamental to effective logistics planning. Also, there may be good opportunities to outsource some or all of these operations, which has a significant effect on reducing fixed assets.

Much of this book is taken up with the practical logistics issues that enable the maximization of profit, the minimization of costs and thus the improvement of ROI.

Globalization and integration

One notable element is the number of companies that operate in the global marketplace. This necessitates a broader perspective than when a national company operates internationally. In the latter, although companies may have a presence across a wide geographic area, this is supported on a local or regional basis through local or regional sourcing, manufacturing, storage and distribution. In the former, the company is truly global, with a structure and policy that represent a global business. Typical global attributes will include: global branding, global sourcing, global production, centralization of inventories and the centralization of information, but with the ability to provide for local requirements, be these electronic standards for electrical goods, language on packaging or left-/right-hand-drive alternatives in the automotive industry. All of these aspects serve to emphasize the added difficulty of operating effectively in a global environment. Global logistics and supply chain networks are far more complicated and it is necessary to plan and manage logistics as a complete and integrated system.