

**Barry Crocker**  
**David Jessop**  
**Alex Morrison**

Seventh Edition

# **INBOUND LOGISTICS MANAGEMENT**

**Storage and Supply of Materials  
for the Modern Supply Chain**



# Inbound Logistics Management

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## Storage and Supply of Materials for the Modern Supply Chain

**Seventh Edition**

**Barry Crocker** BA, MCIPS

**David Jessop** BA, FCIPS

**Alex Morrison** CBE, FCMA, FCIPS, FCIT

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# Brief contents

<b>List of figures and photos</b>	<b>xi</b>
<b>Preface</b>	<b>xiv</b>
<b>Publisher's acknowledgements</b>	<b>xv</b>
<b>List of abbreviations</b>	<b>xvi</b>
<b>1 The supply function</b>	<b>1</b>
<b>2 Identification of materials</b>	<b>20</b>
<b>3 Receipt and inspection</b>	<b>47</b>
<b>4 Issue and despatch</b>	<b>62</b>
<b>5 Records and systems: warehouse management systems</b>	<b>73</b>
<b>6 Materials accounting</b>	<b>93</b>
<b>7 Approaches to the provision of materials: JIT/lean and agile supply</b>	<b>109</b>
<b>8 Stock control techniques</b>	<b>139</b>
<b>9 Stock checking and stocktaking</b>	<b>165</b>
<b>10 Storehouses and stockyards</b>	<b>181</b>
<b>11 Stores operations</b>	<b>195</b>
<b>12 Corporate social responsibility</b>	<b>221</b>
<b>13 Storage equipment</b>	<b>239</b>
<b>14 Materials handling</b>	<b>266</b>
<b>15 Procedures manuals</b>	<b>296</b>
<b>Index</b>	<b>309</b>

# Contents

<b>List of figures and photos</b>	<b>xi</b>
<b>Preface</b>	<b>xiv</b>
<b>Publisher's acknowledgements</b>	<b>xv</b>
<b>List of abbreviations</b>	<b>xvi</b>
<b>1 The supply function</b>	<b>1</b>
Stores	3
Responsibilities	5
Organisation	7
Position of stores within the purchasing and supply organisation	8
Relationships with other departments	9
Materials management	12
Logistics	13
The supply chain concept	14
The British Standard guide to stock control	17
<b>2 Identification of materials</b>	<b>20</b>
Coding of materials	22
Advantages of a coding system	22
Code symbols	27
Interpretation of codes	27
Methods of coding	29
Self-validating codes	32
Organising a materials vocabulary	33
Specification	34
Bar coding	37
Variety reduction	41
Some widely used coding systems	42
<b>3 Receipt and inspection</b>	<b>47</b>
Advance ship notice/advance shipping notification (ASN)	47
Expediting	50
Receipts from suppliers	51
Scrap arising	52

Inspection	53
Vendor quality rating	56
Marshalling receipts	61
Receipt of capital items	61
<b>4 Issue and despatch</b>	<b>62</b>
Authorisation of issues	62
Identification of requirements	63
Timing of issues	63
Methods of issuing stores for internal use	64
Despatch of goods outside the organisation	70
<b>5 Records and systems: warehouse management systems</b>	<b>73</b>
The scope of WMS	73
Operating a typical WMS	76
Voice directed picking (VDP)	78
Radio frequency identification (RFID)	80
Purposes of stock records	81
Electronic data interchange (EDI)	84
Web-based enterprise resource planning (ERP)	87
Enterprise resource planning (ERP)	90
Further reading	92
<b>6 Materials accounting</b>	<b>93</b>
The value of stores in stock	93
Basis of material costing	94
Methods of pricing material issues	96
Arrangement of stores accounts	100
Provisions	103
Control of stock by value	105
Budgetary control	107
Annual audit	108
<b>7 Approaches to the provision of materials: JIT/lean and agile supply</b>	<b>109</b>
Reasons for holding stock	109
Dependent and independent demand	110
Approaches taken in production organisations	111
Lean and agile supply	126
Differing stock control needs of construction, service and retail organisations	128
The extent of stockholdings	131
Ordering quantities	133
Range	135
Consignment stocking	136
Further reading	138

<b>8</b>	<b>Stock control techniques</b>	<b>139</b>
	Provisioning	141
	Approaches to control	142
	Visual approaches to control	144
	Programming deliveries	146
	Ordering quantities	146
	The need for differential control	148
	ABC analysis	149
	Classification of stock according to purpose	151
	Forecasting demand	154
	The use of probability in inventory control	157
	The setting of reorder levels	159
	The provision of safety stocks	160
	Simulation	162
<b>9</b>	<b>Stock checking and stocktaking</b>	<b>165</b>
	Physical security	165
	Responsibility for stock	166
	Purposes of stocktaking	166
	Periodic stocktaking	166
	Continuous stocktaking	168
	Stocktaking procedure	169
	Treatment of discrepancies	173
	Obsolescence and redundancy	176
	Stock checking	179
<b>10</b>	<b>Storehouses and stockyards</b>	<b>181</b>
	New stores buildings	181
	Large central storehouses	182
	Storehouses serving one factory or operating unit	187
	Hiring of storage accommodation	189
	Stockyards	189
	Construction of stockyards	190
	Stockyard facilities	192
	Buildings and enclosures within the stockyard	194
<b>11</b>	<b>Stores operations</b>	<b>195</b>
	Security	195
	Knowledge of materials	197
	Prevention of deterioration	197
	Storehouse location systems	200
	Flow	202
	Departmental stores	204

Work-in-progress stores	205
Sub-stores	205
Special storage facilities	205
Centralisation of storage facilities	208
Central stores	209
The assessment of stores efficiency	213
The measurement of stores efficiency	214
Redundant stock	219
<b>12 Corporate social responsibility</b>	<b>221</b>
What is corporate social responsibility?	221
European Directives on health and safety at work	224
Manual lifting	226
The Control of Substances Hazardous to Health regulations	230
Mechanical lifting	233
Human factors in accident prevention	235
Fire precautions	236
Further reading	237
<b>13 Storage equipment</b>	<b>239</b>
Adjustable steel shelving	239
Bins	244
Pallets	244
Racks	248
Portable receptacles	255
Measuring equipment	256
Ladders and steps	256
Cleaning equipment	257
General tools	257
Live storage	257
Automation of warehouse work	261
<b>14 Materials handling</b>	<b>266</b>
Benefits of proper materials handling	266
Manual handling	268
Mechanical handling	271
Assessment of handling problems for mechanisation	272
Hand-operated equipment	272
Power-driven equipment	275
The relationship of materials handling to transport	292
<b>15 Procedures manuals</b>	<b>296</b>
The need for procedures manuals	296
Procedures	296

## Contents

Advantages and disadvantages of a manual	297
Preparation of the manual	298
Contents of the manual	299
Publication and distribution	305
Implementation of the manual	305
Work study	307
<b>Index</b>	<b>309</b>

# List of figures and photos

## Figures

1.1	Direct and indirect transactions	1
1.2	Warehouse added value functions	4
1.3	A typical stores organisation	8
1.4	The purchasing and supply function	9
1.5	The sequence of operations in a typical purchasing/stores transaction	10
1.6	The logistics concept	15
1.7	The supply chain flow	16
1.8	Storekeeping: functions and key tasks (after BS5729)	18
2.1	A page from a stores vocabulary document	23
2.2	Different items bearing the name 'supports'	25
2.3	Similar parts bearing different names	25
2.4	A materials label combining man and machine readable symbols	38
2.5	An example of an MESC code	43
2.6	A tailored solution to one firm's classification and coding problem	45
5.1	WMS in relation to other management information and technical systems	74
5.2	The maintenance of data in a computerised system	84
5.3	EDI enabling internal and external communications	85
5.4	A summary of drivers for e-procurement adoption	88
5.5	A typical e-procurement solution	89
5.6	An integrated supply chain management database system	91
5.7	Shared data in the supply chain	91
7.1	Bill of materials	114
7.2	Flows of information (⇄) and materials (→) in a material requirements planning system	116
7.3	Bill of materials for assembly A	116
7.4	MRP master production schedule	117
7.5	Wright's classification of MRP/MRP II user	118
7.6	The 'ships and rocks' analogy	120
7.7	Control charts as employed in statistical process control (SPC)	121
8.1	Two typical approaches to control compared	145
8.2	Optimum order quantity	147
8.3	Typical ABC curve showing 80:20 relationship	150

8.4	Differential approaches to nine categories of stock	151
8.5	Stock may have to be classified in a variety of ways for storage, handling and control purposes	152
8.6	Perfect forecasting	156
8.7	Actual experience of stock fluctuation	157
8.8	An example of a problem which might be solved by setting up a simulation	163
9.1	Counting scales	171
9.2	A hand-held radio terminal	173
11.1	Schematic layout of store with 'straight line' flow	203
11.2	Schematic layout of store with 'U' or 'horseshoe' flow	204
11.3	Hazard symbols	208
11.4	Meeting customer requirements	218
12.1	An assessment checklist	225
12.2	Weight ranges in lifting	228
12.3	How to handle materials manually	229
12.4	How do I avoid or reduce the risk from frequent and heavy lifting?	231
13.1	Typical arrangement of a single-sided two-bay run of open-type shelving	241
13.2	Typical arrangement of a single-sided two-bay run of closed-type shelving	241
13.3	Typical arrangement of a single-sided two-bay run of closed-type shelving fitted with dividers, bin fronts and card holders	242
13.4	A stacking plastic bin	244
13.5	Some common types of pallet and container	246
13.6	The main types of racking used for unit loads	250
13.7	Drive-in pallet racking in high density configuration (plan)	253
13.8	Floor space utilisation of different types of pallet racking	253
13.9	The principle of mobile binning	259
13.10	A vertical and horizontal carousel	261
13.11	Benefits derived from automation implementation	265
14.1	A pallet truck	274
14.2	Principle of the counterbalance fork-lift truck	276
14.3	Principle of reach truck operation	277
14.4	An automatically guided vehicle (AGV)	284
14.5	A scissor lift	286
14.6	Fork-lift truck operator test	289
15.1	A specimen flow chart	302
15.2	A stock checking procedure	303
 <b>Photos</b>		
	A general purpose installation	6
	A portable data capture unit and scanner	40
	A radio data terminal fitted to an order picking station enables data to be entered in 'real time'	83

A mezzanine in use	188
Cantilever storage	192
A two-tier shelving system	243
Small parts storage using spigots and plastic bins	245
Pallet collar	248
A live storage installation	258
Live storage of palletised loads	259
A high density mobile racking system	260
An automated stacker crane installation	264
Powered belt and roller conveyors	275
A general purpose LPG powered counterbalance fork-lift truck	277
Side-loading reach truck handling sheet-material in cantilever racks	278
An order picker	279
A semi-goliath crane	281
Container Stacker Crane	282
Trailer mounted container, ramp, 'ride on' pallet transporter and palletised equipment	294
A standard container being handled by a counterbalanced fork-lift truck	294

# Preface

This text, now in its seventh edition, seems to provide a useful resource as a standard book for practitioners and students interested in the themes suggested by the title.

With the advent of 'logistics' and supply chain management and other approaches which view supply as an integrated process – which begins with the discovery of a customer requirement and includes all the activities associated with meeting that need – much consideration was given to the idea that the themes covered in the previous edition might be expanded to cover more fully the distribution aspects of supply. In the end, the decision was made not to do this, as the area already covered is quite wide, and there are a number of 'distribution'/logistics/supply chain management texts already on the market. This edition is not offered as a complete treatment of logistics, but rather concentrates on the aspects of inbound logistics management.

The contents have been brought up to date considerably to reflect the changing technology in this area, with much greater attention being paid to e-commerce, including enterprise resource planning (ERP), e-procurement, extranets, electronic advanced shipping notifications (ASNs), radio frequency identification (RFID), warehouse management systems (WMS) and automated storage and automated retrieval systems (AS/AR), as well as lean and agile supply and corporate social responsibility (CSR), and the target readership is, as before, the increasing number of students pursuing logistics, supplies, materials management and related supply chain management subjects, as well as those employed in the field.

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# List of abbreviations

ACDS	Anti-corrosion desiccant system	BSW	British Standard Whitworth (thread)
AGV	Automatically guided vehicle	BWG	Birmingham wire gauge
AID	Aeronautical Inspection Directorate	CAD	Computer aided design
ANS	American National Standard	CAM	Computer aided manufacture
ANSI	American National Standards Institute	CC	Cubic centimetres; centrifugal casting
API	American Petroleum Institute	CD ROM	Compact disc read only memory
AVDP	Avoirdupois	CEN	European Committee for Standardisation
AWB	Air way bill	CIE	Company (French)
AWG	American wire gauge	CIF	Cost, insurance and freight
BA	British Association (thread)	CIPS	Chartered Institute of Purchasing and Supply
BEAMA	British Electrical and Allied Manufacturers Association	C and I	Cost and insurance
BG	Birmingham gauge	COD	Cash on delivery
BHP	Brake horsepower	COSHH	Control of Substances Hazardous to Health
BL	Bale; barrel	CP	Charter party
BOM	Bill of materials	CPA	Contract price adjustment; critical path analysis
BPICS	British Production and Inventory Control Society	CTS	Crates
BRG	Bearing	DC	Direct current
BS	British Standard	DEG	Degree
BSF	British standard fine (thread)	DIA	Diameter
BSI	British Standards Institution	DIN	Deutsches Institut für Normung (Germany)
BSP	British standard pipe (thread)	DISCH	Discharge
		DRG	Drawing
		DWT	Deadweight tonnage
		EA	Each

EC	European Community	MAX	Maximum
EDI	Electronic data interchange	MESC	Materials and equipment standard code
E & OE	Errors and omissions excepted	MHE	Mechanical handling equipment
EOQ	Economic order quantity	MIN	Minimum
EPOS	Electronic point of sale	MISC	Miscellaneous
EQT	Equipment	MPS	Master production schedule
ETA	Estimated time of arrival	MRO	Maintenance repair and operating
FAQ	Fair average quality	MRP	Material(s) requirements planning
FAS	Free alongside ship	NA	Not applicable
FIFO	First in, first out	NBS	National Bureau of Standards (US)
FIG	Figure	NC	American national coarse (thread)
FLT	Fork-lift truck	NF	Norme française
FO	Firm offer	NOM	Nominal
FOB	Free on board	NOS	Numbers
FOC	Free of charge	NPL	National Physical Laboratory
FRT	Freight	NT	Net
FT	Foot; feet	OD	Outside diameter
GR	Grade; gross	OR	Owner's risk
GRWT	Gross weight	OS	Oversize
GRN	Goods received note	OZ	Ounce
GRV	Goods received voucher	PA	Per annum
HEX	Hexagon	PC	Personal computer
HMC	Her Majesty's Customs	PO	Post Office
HRC	Hardness, Rockwell C-scale	POB	Post Office box
HTS	High tensile strength	POD	Place of delivery
ID	Inside diameter	PRESS	Pressure
IL	Institute of Logistics	PPM	Parts per million
IM or IMP	Imperial	QUAL	Quality
INSTR	Instrument	QTY	Quantity
ISWG	Imperial standard wire gauge	RECD	Received
JIS	Japanese Industrial Standard	RH	Right hand
JIT	Just in time	RORO	Roll on, roll off
KG, KILO, KILOG, KILOGRAM	Kilogramme	RPM	Revolutions per minute
LB	Pound	SAE	Society of Automotive Engineers; stamped addressed envelope
LH	Left hand	SG	Specific gravity
LIFO	Last in, first out		
LO/LO	Lift on, lift off		
LPG	Liquefied petroleum gas		

List of abbreviations

SPEC	Specification	UL	Unit load
SQ	Square	ULW	Unladen Weight
SS	Stainless steel	UNC	Unified coarse (thread)
STD	Standard	UNF	Unified fine (thread)
STK	Stock	US	Undersize;
SWG	Standard wire gauge		Unserviceable
SWL	Safe working load	USS	United States Standard
SWP	Safe working pressure	VA	Value analysis
TBG	Tubing	VAR	Various
TEMP	Temperature	VE	Value engineering
THD	Thread; threaded	WG	Wire gauge
TIR	Transport International Routier	WMS	Warehouse management system
TPI	Threads per inch	WP	Working pressure
TQM	Total quality management	WT	Weight
TS	Tensile strength	WW	Whitworth (thread)
		YS	Yield strength

# 1

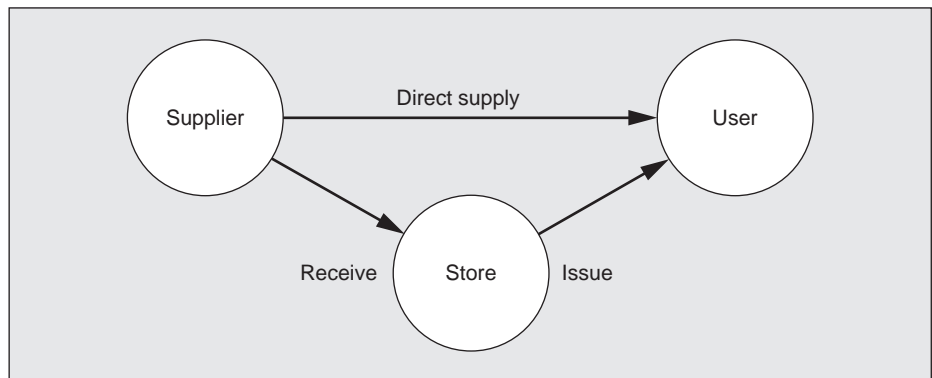
## The supply function

The control of inventories and the management of supplies have, in common with the other major branches of commercial and industrial work, become specialist activities.

The supply function has the responsibility for the receipt, custody and distribution of very large sums of money in the form of goods, and for the determination of appropriate quantities of material to be held in order that operational needs may be met in as economic a manner as possible. The supply function must be managed and operated in a highly efficient way. The contribution that a good supply function can make to the success of an organisation is today almost universally recognised, in terms of the contribution to the bottom line profit.

The stores should be considered as a *temporary* location for materials needed for operational purposes, and should be planned, organised and operated in such a way that the period of residence of each item is as short as possible consistent with economic operation. The only reasons for carrying operating stocks are that the material is needed and that supply cannot be exactly matched with demand. Figure 1.1 shows that a single transaction in direct supply replaces the three operations, receive – store – issue. One activity replaces three. Obsolete, redundant or surplus material is simply money sitting on a shelf, requiring more money to be spent on its custody. It should be pointed

**Figure 1.1**  
Direct and indirect transactions



out that as short a time as possible may range from the hour or two that deliveries of bulk milk may remain in the receiving tanks at a processing plant, through to the several years that emergency equipment, for example, a blow-out preventer in an oilfield store, can justifiably be kept. In general, if demand is steady or highly predictable, then we should store for very short periods if at all. The rapid adoption of just-in-time (JIT), lean supply and agile supply approaches in recent years reflects the general awareness that stocks are expensive to hold, and that opportunities should be sought to make better use of the money they represent. When demand is highly unpredictable then storage for longer periods may be necessitated.

There is no standard system of management and control which can be universally recommended or applied but, later in the text, we examine warehouse management systems (WMS) which over time have been introduced into warehouses. This book examines at length these principles and other practices but it must always be borne in mind that the conditions of operation are very diverse.

In a mass production unit, such as a car plant, vast quantities of materials and component parts have to be provided every day. Large sums of money are involved and it is essential to organise the materials function so that the investment is kept to the minimum. From the supplies point of view the most important thing is to keep the quantities of incoming goods as near as possible to the amounts the assembly lines will use daily. Shortages must be avoided or production lines will have to stop. At the same time, too much must not be delivered or it will clog up the marshalling and production areas, apart from the fact that excess deliveries will tie up more capital. So the emphasis is on the manufacturing schedule and everything is governed by that. For bulky or expensive materials or components, the flow will have to be managed hour by hour and this demands a very high degree of cooperation and efficiency.

The Armed Services are different. They need to have enough equipment, ammunition and stores on hand to be able to go into action at short notice. The requirement here is not to keep the amount of stock down as far as possible, but to keep it up to the minimum operational requirement. The obvious example is a warship about to set off on a long spell of sea duty. It must be stocked up with fuel, ammunition, food, clothing and everything else that may be wanted during the voyage.

Between these two extremes there is a great variety of different organisations – wholesale and retail concerns, airlines, petroleum refineries, mining, process industries, sea, air, rail and road transport, electricity, gas and water supply undertakings, hospitals, schools, agricultural enterprises and many others.

It therefore follows that before a system for the provision of materials can sensibly be designed, account must be taken of the nature and needs of the organisation it is intended to serve.

# Stores

## ■ Purpose

Taking manufacturing as an example, the primary objective of the stores function is to provide a service to the operating departments. All other stores activities, although they have their own relative importance, are subordinate to this main responsibility.

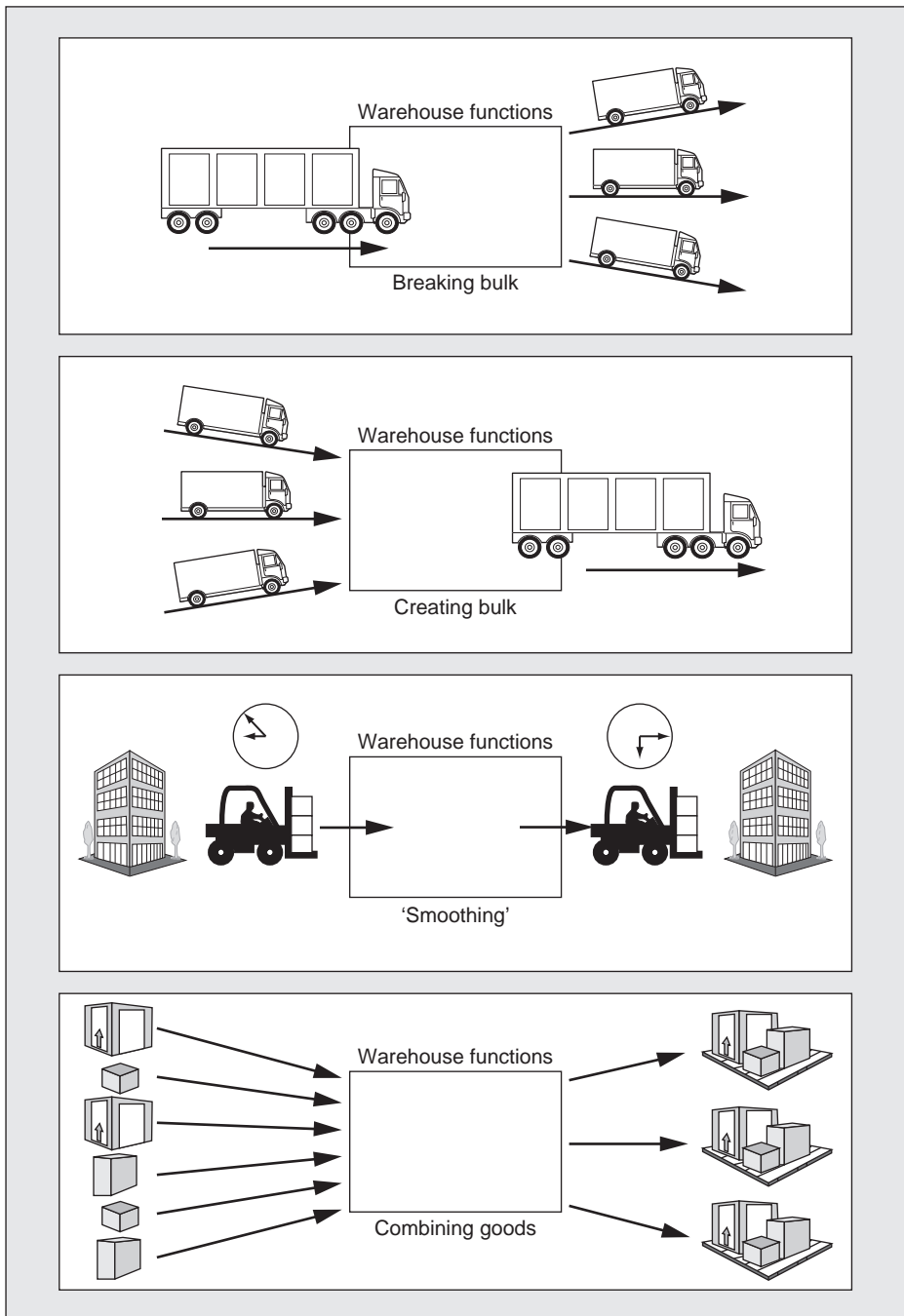
The service given can be analysed into five parts, as follows:

- 1 To make available a balanced flow of raw materials, components, tools, equipment and any other commodities necessary to meet operational requirements
- 2 To provide maintenance materials, spare parts and general stores as required
- 3 To receive and issue work in progress and finished products
- 4 To accept and store scrap and other discarded material as it arises
- 5 To account for all receipts, issues and goods in stock.

In the general business context the storehouse or warehouse function performs roles beyond providing simply a subsidiary service to another function. The storehouse or warehouse can add value in a number of ways, including:

- *Breaking bulk.* Where goods are supplied in large quantities, perhaps because of economies of scale of manufacture or transportation, then it may be the case that the storehouse performs the activity of taking delivery of bulk consignments and issuing in smaller lots to customers or users. The storehouse enables the more efficient matching of demand with supply.
- *Creating bulk.* It may be the case that a good is produced in small quantities in a variety of locations, and needs to be brought together into larger lots for economic shipment to the market or users. The accumulation and aggregation of these smaller supply quantities is another way in which a warehouse or stockyard can add value. Milk, vegetables, latex and many other natural products are brought together in this way.
- *Smoothing.* In manufacturing, we can think of the storage as an activity which enables production to be certain of having supplies of materials and components as and when needed, or we can store finished goods until the customer needs them. In both cases we are smoothing; that is to say accommodating the fact that the rate of supply and demand and the associated timings do not exactly match.
- *Combining.* Materials in, say, a retail grocery concern are supplied from a variety of origins, yet we serve our customers best by allowing them to select according to their shopping list from the range of products that we offer. If the store did not provide the value-adding

**Figure 1.2**  
**Warehouse added value functions**



function of bringing these materials together into a single location then the customer would find it impossible to enjoy any real choice as shopping would take up an impossible amount of time.

## Responsibilities

### ■ Economy

It has been emphasised that service is the principal objective of the stores function, but it is obviously desirable to provide that service economically. Frequently, but not always, the most important consideration here is to keep the inventory value at the lowest practicable level to economise in the use of working capital and to minimise the costs of storage. It will be readily understood that there is some conflict between the need to give a good service and the need to economise in stockholdings. On the one hand, the more stock held, the easier it is to have items available on demand; on the other hand, the more stock held, the greater the cost, though of course ordering very frequently in order that stockholding costs may be kept low can itself lead to high costs. It is necessary to seek, find and operate a satisfactory compromise between the various opposing forces. In addition, the stores organisation itself should be economically operated and cooperate with other functions to achieve savings in material and other costs wherever practicable, especially nowadays as both lean and agile supply operations are continually striving to eliminate non-value-adding activities within these areas.

### ■ Identification

Identification is the process of systematically defining and describing all items of stock. It includes the preparation of a stores code or vocabulary, the adoption of materials specifications and the introduction of a degree of standardisation. Part of this work may be done by design, planning or standards departments, and the purchasing department also has an interest.

### ■ Receipt

Receipt is the process of accepting, from all sources, all materials, equipment and parts used in the organisation, including supplies for manufacturing or operating processes, plant maintenance, offices, capital installations and finished products.

### ■ Inspection

Inspection, in this context, means the examination of incoming consignments for quantity and quality. Very often there is a separate inspection department which does this work, but otherwise goods are inspected by stores personnel. Whatever the system of inspection in force, it is the duty of the stores function to see that the inspection is done before items are accepted into stock.

Quality assurance activities, and 'co-maker' relationships between buyers and suppliers, have reduced the extent to which the inspection of incoming goods is undertaken, but it remains an important activity.

## ■ Issue and despatch

This is the process of receiving demands, selecting the items required and handing them over to users. It also includes, where necessary, the packaging of issues and the loading of vehicles with goods for delivery.

## ■ Stock records

These are maintained in a warehouse management system (WMS) which records all transactions, receipts, issues, returns and balances of stock (see Chapter 5 for WMS).

## ■ Stores accounting

Stores accounting is the process of recording stock movements and balances in value.

### A general purpose installation

(Source: Courtesy of Dexion Comino Ltd part of the Constructor Group AS)



## ■ Stock control

Stock control is the operation of continuously arranging flows of materials so that stock balances are adequate to support the current rate of consumption, with due regard to economy. It includes the related process of provisioning, which is the means whereby instructions are given for the placing of orders. In some concerns the production control department may take a large share in provisioning, at least as far as production materials are concerned via the materials requirement planning (MRP) systems.

## ■ Stocktaking, stock checking and stock audit

Stocktaking is the process of physical verification of the quantities and condition of goods, usually on a periodic basis for the purpose of ensuring that an appropriate figure appears in the organisation's accounts. Stock checking is similar, but may be done on an ad hoc basis for operational reasons. Stock audit involves an external agency, and the purpose is verification. Perpetual inventory control (PIC), or cycle-counting, will be discussed in detail later in the text.

## ■ Storage

Storage comprises the management of warehouses, storehouses and stockyards, the operation of handling and storage of equipment, and the safe custody and protection of stock. Here we are confronted with the conflicting objectives of maximising utilisation while maintaining high levels of accessibility.

# Organisation

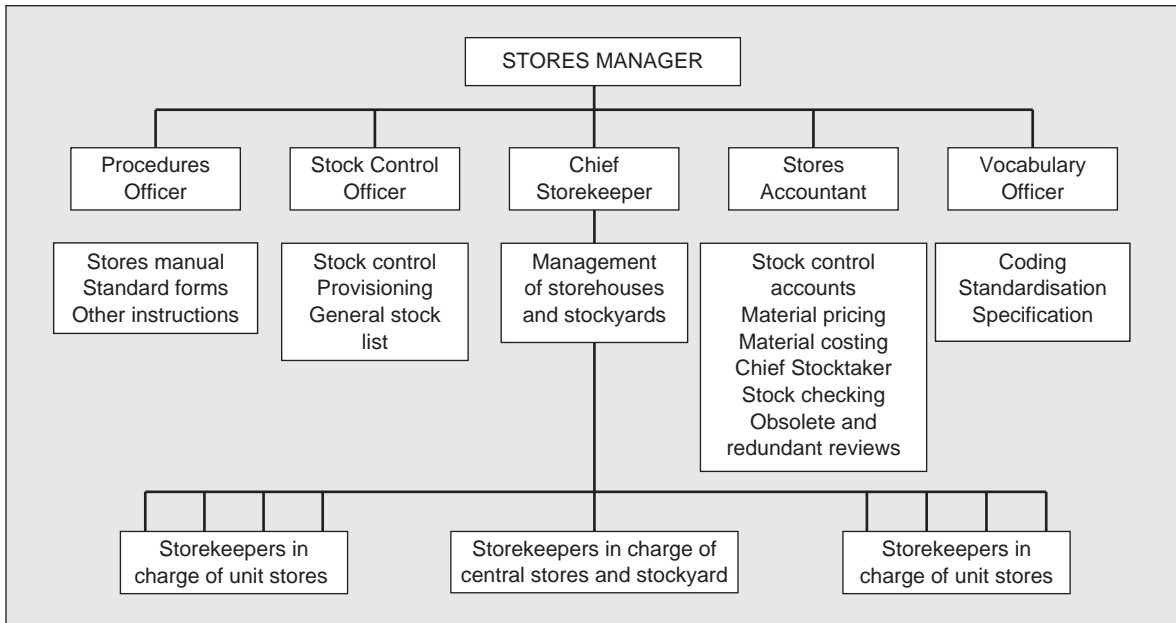
## ■ Policy directive

In any enterprise it is essential that all stores and warehouse staff are fully trained in all the functionalities of the warehouse management system (WMS) and the strategy covering supplies policy, procedures and organisation, ensuring clear definition of the limits within which the function operates, and conveying authority to act within these limits.

## ■ Internal organisation

In a small firm the supplies function may be operated from a single office run by one manager but, in a large organisation, it is necessary to apportion the various duties to separate sections, for example:

- 1 Identification or vocabulary section
- 2 Standardisation section



**Figure 1.3 A typical stores organisation**

- 3 Storehouse section
- 4 Stockyard section
- 5 Stock control section
- 6 Records/system updating section
- 7 Accounts/audit section.

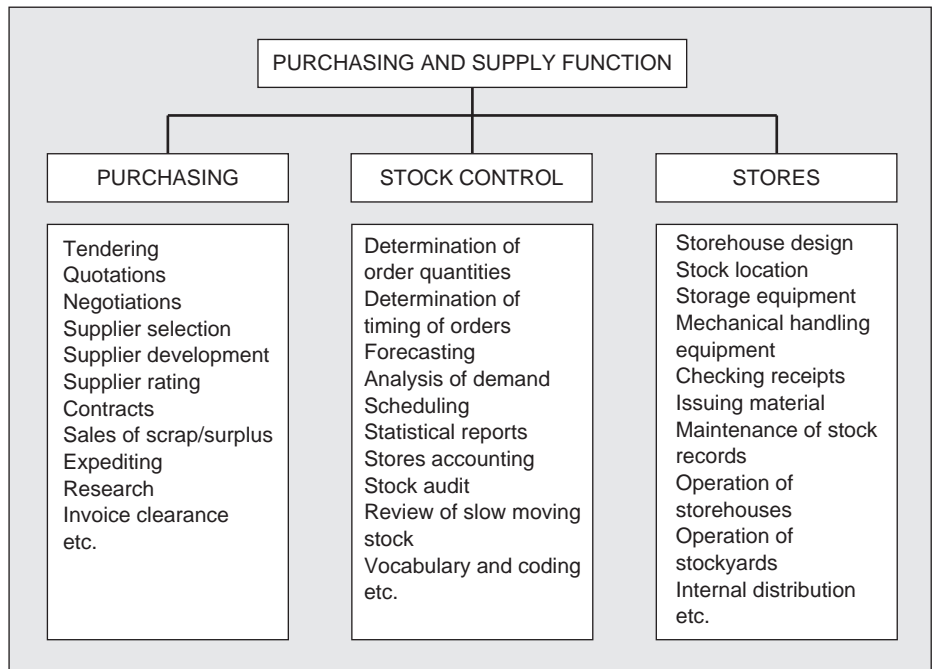
Usually, in a large organisation, the person in charge of the stores function occupies a senior supervisory position of managerial status, being described as the stores controller, stores manager, stores superintendent or stores officer. A specimen organisation chart for a large department is shown in Figure 1.3.

## Position of stores within the purchasing and supply organisation

In the industrial field particularly, the specialisation of production and the increasing complexity of modern products and machinery requires a very high standard of organisation and performance in stores work, and the range of materials, components and spares is continually expanding. Stores and purchasing are largely interdependent, and any inefficiency or lack of cooperation on either side is soon reflected in the other. To cope satisfactorily with the whole supply problem in modern conditions, a complete ‘dovetailing’ of these two functions is essential.

There are occasionally special circumstances in an industry which would justify some split in control, but the more progressive concerns show an increasing tendency to set up a completely integrated purchasing and stores

**Figure 1.4**  
**The purchasing and supply function**



department responsible for all these activities, bringing the work under one responsible departmental manager (see Figure 1.4).

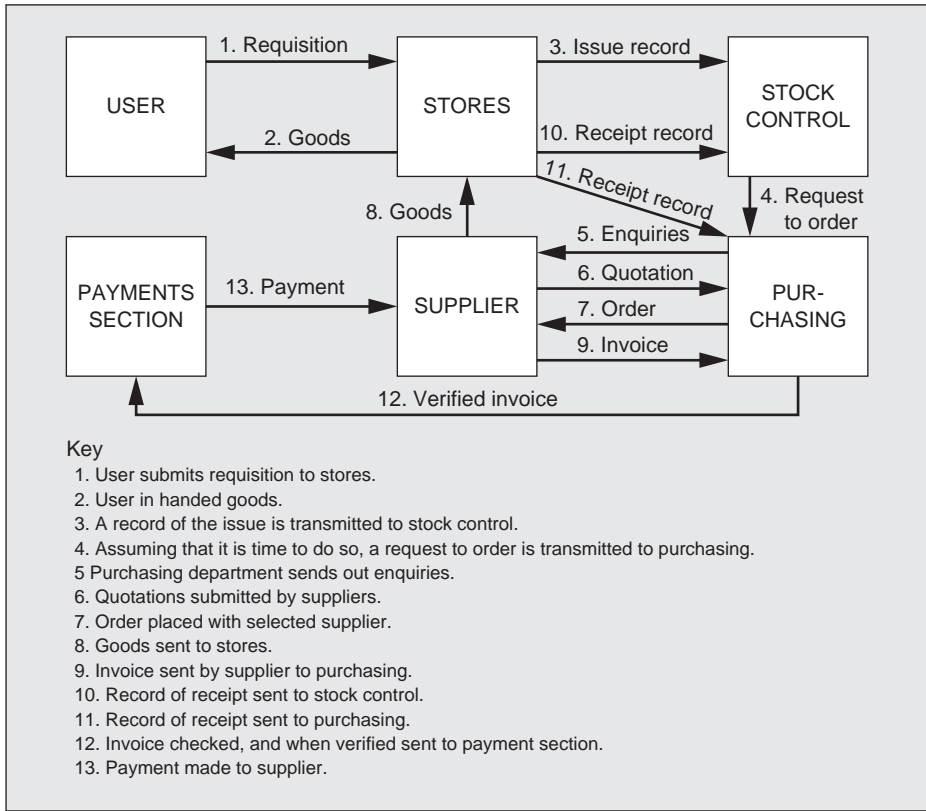
An arrangement of this kind has obvious advantages, the chief of which are outlined as follows:

- 1 The department head only reports to the line management and his responsibility for the price and availability of materials is clear and unavoidable.
- 2 A single department control eliminates friction and ensures the maximum cooperation of each section.
- 3 It is easier to give a more comprehensive training to the staff, and improves promotion prospects.
- 4 It facilitates the introduction of techniques such as lean supply as internal functions are integrated.

## Relationships with other departments

To discharge its responsibilities adequately, the stores department must actively cooperate with other departments, not only to provide a service (to its internal customers) but also to give and receive information (from its internal suppliers) so that the service is efficient and effective (see Figure 1.5). The nature of the other functions involved varies in different organisations, as does the scope and responsibility of the stores function, so that it is difficult to be precise about the relationships unless each case is considered separately. By

**Figure 1.5**  
**The sequence of operations in a typical purchasing/stores transaction**



way of example the following notes indicate the position as it is normally found in production companies. Enterprise resource planning (ERP) and warehouse management systems (WMS) facilitate this process of cross-functional working and are discussed later in Chapter 5.

**■ Production department**

This department is the main supplies ‘internal customer’ and it is therefore of the first importance that the services to production are satisfactory in all respects. The closest cooperation is essential not only on the provision of materials but also on the stock levels to be maintained in accordance with the policy for inventory control.

The stores department provides materials, tools and other shop supplies at the required times and in the required quantities to meet the factory programme, advises anticipated difficulties or failure in supply, and notifies any substitute or surplus materials available from stock. The storehouses are ready to accept work in progress and finished goods at any time and to receive scrap, offcuts, rejected items and salvaged or reclaimed materials as they arise, so that the shop floor may be promptly cleared.

The production department sends in to the appropriate storehouses not only the work in progress and finished goods but also any excess materials, tools, fixtures and equipment not currently required, and notifies as soon as possible any impending changes in the production schedule.

## ■ Design and engineering departments

It is most desirable to have close contact with these departments, particularly from the point of view of specifications, standards and obsolescence. Arrangements are made to see that, before any new design, modification or technique is put into production, due note is taken of materials to the old design, so as to avoid obsolescence and, whenever possible, new items and modifications are introduced to coincide with the running down of existing stocks. The design or engineering departments are consulted when obsolescent or obsolete items are being listed for disposal.

In this way the enterprise resource planning (ERP) system and the warehouse management system (WMS) can be continually updated to allow for minimum waste in the form of obsolete stocks.

## ■ Quality department

Accommodation for inspection personnel may be provided in storehouses, and they are notified of all receipts via electronic advanced shipping notifications (ASN). The stores department is responsible for holding goods received in 'quarantine' and submitting samples to inspection promptly. In return, the inspection department inspects and tests deliveries without delay, and indicates acceptance or rejection. The supplies function must work closely with the quality department if quality is approached from an 'assurance' viewpoint.

This is vitally important in just-in-time and lean-supply environments in which a 'ship-to line' philosophy is employed, ostensibly fast-tracking quality-assured material through to production with minimum stores involvement and inspection. This reduces non-value-added activities (such as inspection and storage) and ensures a smooth continuous flow of material to production in a timely manner.

## ■ Maintenance department

The supplies service in this case consists in acquiring appropriate materials and machinery spares and being in a position to issue them as and when required. To facilitate this work, the maintenance department advises details of the forward programme on repairs and overhauls as far as possible, particularly where planned maintenance is in operation, and advises on the initial quantities of spares to be provided when any major new plant or machinery is installed.

## ■ Finance department

There is a continuous exchange of information covering verification of records and physical stock, clearance of invoices both inwards and outwards, revision of prices, supply of material-cost information, and control of working capital allocated to the financing of stock. Procedures are organised to work together effectively to control the value of inventory and cost of materials. The warehouse management system (WMS) provides detailed valuation of stock in real-time allowing effective stock management to continually reduce stock in line with the varying usages.

## ■ Transport department

The stores department is itself sometimes responsible for transport but, where there is a separate transport department, it is essential that the two work together harmoniously. The supply function reports details of loads, pick-up locations and discharge points, makes facilities available for the speedy, safe loading or discharge of goods, and provides a weighbridge service. The transport department is responsible for the ready availability of vehicles and for advising any circumstances which may delay deliveries or collections, such as breakdowns, strikes or adverse weather.

## ■ Sales department

The service provided is normally the acceptance, storage, packing and despatching of finished products. The sales department cooperates by advising, via the ERP and WMS system, of any appreciable fluctuation in the demand for the finished goods which may affect storage accommodation, and is also responsible for giving instruction on the quantities of spare parts or other materials to be held for servicing sales already made.

## Materials management

Purchasing and supply activities have, in most organisations, long been recognised as warranting departmental status and authority, and the fact that purchasing and supply tasks frequently involve intercourse with other parts of the organisation, as well as with the outside world, is obvious. However, the placing of purchasing and supply in the organisational framework has sometimes led to difficulties in establishing smooth flows of materials and clear channels of communication.

Increasingly, it is being reflected in organisational structures that the involvement of the purchasing and supply function with 'materials' does not begin with the receipt of a detailed specification and request to order, neither does it end when materials are delivered. It has always been the

case, for example, that buying activity may involve some contribution to the 'what to buy?' debate, and that the interests of the purchasing executive in bought materials do not end as soon as the material is placed in store.

Many organisations have adopted a broad concept of procurement that goes beyond simply 'buying', and indeed is usually more than 'buying + stock control + stores management'. This concept or approach is known generally as *materials management*, though the approach taken varies greatly from company to company.

M.R. Leenders, H.E. Fearon and W.B. England describe the concept as follows:

An organisation that has adopted the materials management organisational concept will have a single manager responsible for planning, organising, motivating and controlling all those activities principally concerned with the flow of materials into an organisation. Materials management views material flows as a system.

The specific functions that might be included under the materials manager are material planning and control, production scheduling, material and purchasing research, purchasing, incoming traffic, inventory control, receiving, incoming quality control, stores, in-plant materials movement, and scrap and surplus disposal. Not all functions are necessarily included: the ones often excluded are production scheduling, in-plant materials movements, and incoming quality control.

*(Purchasing and Materials Management, 9th edn, Irwin, Illinois, 1989, p. 4)*

The main benefit which seems to arise from the adoption of the materials management approach is an improvement in communication and coordination between departments. There is less sub-optimisation, and centralised responsibility and control enables smoother and faster flow of materials. Comprehensive and linked approaches to the acquisition, storage and movement of materials can be devised and employed, thereby reducing the risk of errors at the interface between independent departments.

Materials management is not just a matter of managerial organisation. It is rather a matter of philosophy. It may not matter too much how the components of the materials function in an organisation are organised, provided that a single executive, probably called the materials manager, holds all the appropriate reins.

## Logistics

It is generally agreed and recognised that the term logistics has its origins in military usage, where it is used to cover the movement and accommodation of materials and personnel involved in operations. Recent years have seen a wider use of the expression logistics in the business context. However, since business usage of the term is relatively new, there is, as yet, no complete or universal agreement as to the exact meaning of the term.

Definitions of logistics abound; the following are given by way of example:

*Logistics* is the process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customer requirements.

(Council of Logistics Management (CLM), USA)

The area of support management used throughout the life of the product or system to efficiently utilize resources assuring the adequate consideration of logistics elements during all phases of the life cycle so that timely influence on the system assures an effective approach to resource expenditures.

(Society of Logistics Engineers (SOLE), USA)

The process of managing the movement and storage of goods and materials from their source to the point of ultimate consumption.

(Institute of Logistics (IL), UK)

It is interesting to note that the CLM and IL definitions, along with many others, which lack of space precludes, are concerned with movement and storage of goods in a general sense. The CLM imply a manufacturing context and the IL definition seems to be more widely applicable. The SOLE definition differs markedly, in that it suggests that the focus of logistics is on the long-term, life cycle support of products or systems, for example, capital plant and equipment.

The various definitions of logistics often betray their origins by their content. There is a view that logistics is mainly about distribution, held, of course, by those bodies mainly concerned with marketing and distribution. It is a way of linking physical distribution management with earlier events in the supply chain.

Another view is that logistics is primarily concerned with acquisition and storage, and the other aspects follow on. It may be suggested that the Chartered Institute of Purchasing and Supply, in including logistics as a final professional level examination subject, views logistics in this way. Their syllabus seems to indicate this view.

The third main school of thought is that logistics is mainly concerned with support operations, and that it is very much a service activity, undertaken to ensure that expensive systems or equipment is maintained continuously through its life cycle.

Figure 1.6 gives a simple interpretation of the general view of 'Logistics'.

## The supply chain concept

The Chartered Institute of Purchasing and Supply, in the professional syllabus document, define the supply chain as:

- 1 Specification of requirements.
- 2 Sourcing and acquisition of materials and services.