John Mangan
Chandra Lalwani

GLOBAL LOGISTICS AND SUPPLY CHAIN MANAGEMENT

3RD EDITION

WILEY

Global Logistics and Supply Chain Management

Third Edition

Students and managers who read this book and learn from it and build upon the ideas and insights it contains can only benefit.

Martin Christopher, Emeritus Professor of Marketing and Logistics, Cranfield University, UK

This 3rd edition of Global Logistics and Supply Chain Management covers comprehensively all traditional and emergent aspects of the field.

Samir K Srivastava, Professor, Indian Institute of Management Lucknow

A very comprehensive book that clearly explains all relevant concepts.

Vivek Natarajan, Associate Professor, Lamar University, USA

A highly appropriate blend of theory and practical application.

Edward Sweeney, Professor, Aston University, UK

This book fills an important gap as globalisation is ever more present and international connectivity has become a key issue for economic development. It is important to have a book that addresses these issues from a logistics and supply chain perspective.

Ruth Banomyong, Associate Professor, Thammasat Business School, Thailand

A very practical book, which appeals to a wide range of audiences, combining strategic and operational aspects of global logistics and supply chain management.

Sarah Shaw, Lecturer in Logistics and SCM, Hull University Business School, UK

This book is really useful, interesting and valuable - not only for lecturers and students but also for businesses.

Trinh Thi Thu Huong, Associate Professor, Foreign Trade University, Vietnam

Global Logistics and Supply Chain Management

Third Edition

John Mangan
Chandra Lalwani

WILEY

Registered office
John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, P019 8SQ, United Kingdom

Library of Congress Cataloging-in-Publication Data

Names: Mangan, John, 1968- author. | Lalwani, Chandra, author.
Title: Global logistics and supply chain management / John Mangan, Chandra Lalwani.
Description: 3rd Edition. | Hoboken : Wiley, 2016. | Revised edition of the authors' Global logistics and supply chain management, 2012 and 2008. | Includes bibliographical references and index.
Identifiers: LCCN 2015049840 (print) | LCCN 2016000503 (ebook) | ISBN 9781119117827 (pbk.) | ISBN 9781119123958 (pdf)
Subjects: LCSH: Business logistics.
Classification: LCC HD38.5 .M3637 2016 (print) | LCC HD38.5 (ebook) | DDC 658.7—dc23
LC record available at http://lccn.loc.gov/2015049840

ISBN 9781119117827 (pbk)
ISBN 9781119123996 (ebk)

A catalogue record for this book is available from the British Library.

Set in 10/12 Optima LT Std by SPi Global, India

Printed in Great Britain by TJ International, Padstow, Cornwall

Dedication

Maeve, Cathal, Eibhlín and Eoghan
Mohini, Nikita, Nishant,
Anoushka, Ishika and Shay

Contents

Foreword

Globalisation of industry and commerce has brought with it many benefits but also a multitude of challenges. Companies that once served only local markets now reach out to customers and consumers located far from their original home base. At the same time, their sourcing and manufacturing arrangements extend around the world. As a result their supply and distribution networks have become more complex and often more uncertain. The task of managing and co-ordinating this global web of physical and information flows has become a key priority for businesses as they strive to remain competitive in a turbulent and constantly changing marketplace. Consequently, the need for higher levels of logistics and supply chain management capabilities is now greater than ever before.

However, as this globalisation of supply chains continues apace there is a growing skills and talent gap in terms of the availability of managers with the knowledge and experience that is essential for the effective management of these complex networks. One way in which this gap is being closed is through the increased provision of specialist graduate-level and post-experience courses offered by a growing number of universities, business schools and other institutions.

To support these educational and management development initiatives it is vital that relevant and practical sources of information and up-to-date case material are easily accessible. It is therefore to be welcomed that this new edition of *Global Logistics and Supply Chain Management* has now been published. Building on the success of earlier editions, this book has become one of the leading texts in its field. Students and managers who read this book and learn from it and build upon the ideas and insights it contains can only benefit.

Martin Christopher
Emeritus Professor of Marketing and Logistics
Cranfield University, UK

About the Authors

D. John Mangan is Professor of Marine Transport and Logistics at Newcastle University in the UK. He has spent his entire career around the logistics sector, starting as an air freight clerk, then as a civil servant focused on marine transport, and following this he commenced his academic career – qualifications include masters degrees (Lancaster and Cranfield), PhD (Cardiff Logistics Systems Dynamics Group), Fulbright Scholar (Boston College) and FCILT. He previously held academic roles at University College Dublin, the Irish Management Institute, the University of Hull (where he was founding Director of the University of Hull Logistics Institute) prior to taking up his current position at Newcastle University in 2008.

Chandra Lalwani is Emeritus Professor of Supply Chain Management at the University of Hull Business School. He is Adjunct Professor at RMIT University in Australia and a Visiting Professor at Newcastle University in the UK. He holds a BEng in Electrical Engineering, an MEng in Control Systems and another MEng in Systems Engineering. He obtained his PhD from the University of Wales in 1978 based on his research on the dynamic modelling of commodity flow systems. Prior to joining the University of Hull he taught at Cardiff University Business School where he was also responsible for doctoral research in logistics and operations management. He is editor emeritus of the *International Journal of Logistics Management* published by Emerald.

About the Contributors

Chuda Basnet (Chapter 9) is an Associate Professor at the University of Waikato, New Zealand. He has received a Bachelor's degree in Mechanical Engineering, a Master's degree in Industrial and Management Engineering, and a PhD in Industrial Engineering and Management. He teaches in the areas of operations management and supply chain management. His research interests are in manufacturing modelling, supply chain management and decision support systems. He has published papers in *Decision Support Systems, Journal of the Operational Research Society* and *Annals of Operations Research*.

Paul Childerhouse (Chapter 9) Professor Paul Childerhouse is the Director of Logistics and Supply Chain Management at Massey University, New Zealand. He obtained his PhD in 2002 for his research into supply chain integration and market-orientation whilst at Cardiff University. His major research interests are in supply chain networks and culture. He is practitioner focused and enjoys auditing and advising organisations on how to improve their supply chain practices. He has published over 40 articles in quality journals including**:** *Journal of Business Logistics, Journal of Operations Management, International Journal of Physical Distribution and Logistics Management, International Journal of Production Research* and *OMEGA*.

Martin Murphy (Chapter 8) is the Managing Director of SCMG (Supply Chain Management Group). He has worked internationally with businesses and organisations over the last 20 years providing strategic advice and tactical support on supply chain projects. This includes oil and gas companies, chemicals and refining, pharmaceuticals, aerospace and defence, manufacturing, automotive, rail and transport through to local and central government, non-departmental public bodies and the higher education sector. He has worked on assignments all over Europe, North America, the Middle East and Far East. He has a degree in Mechanical Engineering and an MBA. Martin is an Industry Advisor to *Strategic Outsourcing*, an international journal, and regularly delivers training workshops and speaks at conferences on the subjects of supply chain management, contract management, procurement and logistics.

Shams Rahman (Chapter 15) is a Professor of Supply Chain Management at the School of Business IT and Logistics, RMIT University, Australia. His academic qualifications include an ME in Industrial Engineering, MSc in Mechanical Engineering and PhD in Operations Research. Shams, a former British Commonwealth scholar, has worked in various universities in Australia, the UK and Thailand. In Australia he worked for the

University of Western Australia, University of Sydney, Wollongong University, prior to joining RMIT University. He also held visiting fellowships at the Virginia Tech, USA and University of Exeter, UK and is currently an International research scholar to Shanghai University of International Business and Economics, Shanghai, China. Shams has extensive consulting experience, organising and delivering workshops and training with and for multinational companies. He is frequently called upon to make presentations for professional bodies and senior executives on issues such as supply chain sustainability, talent management, six sigma and quality management, reverse logistics, and theory of constraints. He is on the editorial board of 15 international journals and has published widely in international journals. He is a foundation member of the International Advisory Committee of the Asia-Pacific Federation of Logistics and Supply Chain Systems.

Risto Talas (Chapter 6) is a Lecturer in maritime piracy and terrorism at Hull University Logistics Institute. His PhD at Cass Business School was in maritime port security efficiency modelling. He also lectures at the University of the West Indies in risk management and scenario planning for ports; and at City University where he developed the MSc elective in maritime security. Previously he worked for Maritime and Underwater Security Consultants Ltd as a port security consultant which included a secondment to UK Trade & Investment as an International Business Specialist promoting UK companies in the port security sector. Prior to his MBA at Cass Business School he worked as a marine war and terrorism underwriter for a Marine Syndicate at Lloyd's of London. He is the author of various book chapters, academic and newspaper articles in maritime security and piracy.

Preface

We are delighted to present the third edition of our textbook which builds upon our first edition (published in 2008) and second edition (published in 2012). We acknowledge in particular the contributions of Dr Tim Butcher (Royal Melbourne Institute of Technology) who was co-author on the first and second editions, and Dr Roya Javadpour (California Polytechnic State University) who was co-author on the second edition. This book traces its origins to the University of Hull Logistics Institute in the UK where Mangan, Lalwani and Butcher worked together between 2005 and 2008. It was during this time that we recognised the need for this textbook which we are glad to say has been very well received by students, practitioners and lecturers. In this third edition we have endeavoured to again produce a comprehensive book with the following key characteristics:

- *Be concise* – logistics is a very pragmatic subject and it has been our intention throughout to 'stick to the point'. We hope that you the reader will appreciate this. Notwithstanding such intended brevity, we have endeavoured to cover both practical and strategic aspects of the subject matter. The book is neither a 'how to' cook book, nor is it a high-level strategy book with little relevance to practice. The aim of the book is to convey to both advanced students and practitioners of logistics and supply chain management the diverse operational and strategic content of the subjects of logistics and supply chain management.
- *Truly global, up-to-date perspective* – the world is changing daily and the typical 'Western' worldview no longer necessarily dominates. As we will see in the book, logistics is a key driver of globalisation and a facilitator of international trade and development. We have thus endeavoured to reflect these characteristics by adopting a truly global perspective and hope that the book will appeal to students regardless of where they are located. The context of logistics is constantly shaped by emerging trends and new technologies and we have tried to ensure that the book is as up to date as possible and takes cognisance of these trends and technologies. Sadly, despite much progress, today's world still contains many divisions, conflicts, tensions and inequalities. We have attempted to be aware of these while fully embracing a neutral and non-political perspective.
- *Pedagogical approach* – we have endeavoured to use a variety of pedagogies in this book, which we hope will create a fertile learning platform for the reader. Both long(er) and short(er) case studies are included and are intended to highlight key issues in a focused manner. Key points are detailed in separate boxes and this should also help with revision. Italics are used within the text to

emphasise specific issues. Various terms are in **bold** when first used to indicate that explanations for these terms are given in the **glossary** at the end of the book. We hope that you find these various features useful. There are two other features of our pedagogical approach which we believe are especially important.

Firstly, the authors named on the cover are not the only people to have contributed to this book. We are very fortunate to have contributions from various experts in specific areas of logistics and supply chain management. They have written chapters and case studies based on their specific areas of expertise and which we believe add to the richness of this book over and above what we could have achieved working on our own. The second pedagogical feature we wish to highlight is the mix of qualitative and quantitative content in this book. We are of the view that many logistics and supply chain management books tend to occupy one of two opposite positions, either containing a large share of quantitative material or else none at all. We believe that a certain level of quantitative aptitude and knowledge is an important feature of most logistics and supply chain managers' jobs (for example, in the areas of logistics costs analysis and inventory management). Many such managers, however, do not routinely engage in sophisticated mathematical analysis; this is usually the domain of operations researchers, engineers and management accountants. We thus aim to convey the necessary quantitative features of logistics and supply chain management, while at the same time not burdening the reader with excessive quantitative analysis.

These various characteristics and perspectives adopted in the book are discussed further in Chapter 1 which details the book's framework. The book is divided into three parts, again this is discussed and the content of each part elaborated in Chapter 1. In this third edition, we have restructured the book and updated relevant content from the second edition. For example new cases have been added, data in all chapters has been updated, and new chapters have been added on topics such as technology, information flows in the supply chain, and management science applications to logistics and supply chain management.

BOOK COMPANION WEBSITE

Our text is also supported by additional teaching and learning resources, which are available on the companion website at **www.wiley.com/college/mangan**. They include PowerPoint slides, suggested answers to end-of-chapter questions and case teaching notes for lecturers. Students will also find an online glossary and multiple choice quizzes.

RELATIONSHIP TO OTHER DISCIPLINES, ESPECIALLY OPERATIONS MANAGEMENT

Chapter 1 details the various factors that have led to the evolution of logistics and supply chain management. Figure 1 outlines the various disciplines which we believe logistics and supply chain management are closely linked to. In fact it is only in recent

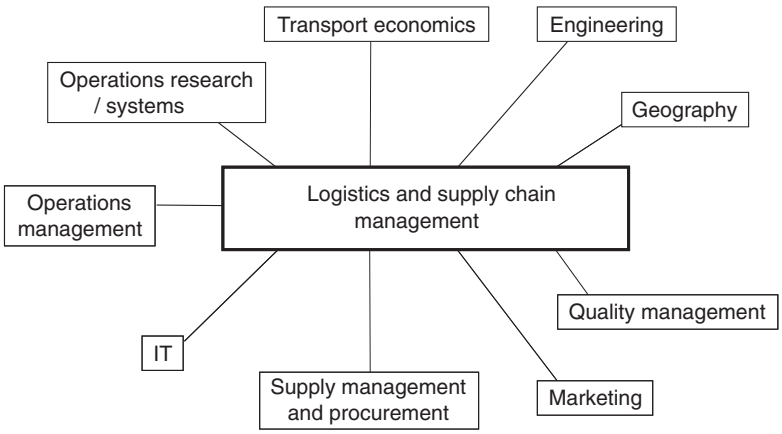


Figure 1 Links to other disciplines

years that third-level courses and explicit career paths have emerged in logistics and supply chain management. It is thus often the case that many practitioners today will have backgrounds in one or other of the disciplines illustrated in Figure 1. Various issues pertaining to some of these disciplines are discussed in this book.

Perhaps the discipline to which logistics and supply chain management is most often closely linked is *operations management*. As we will see in Chapter 1, supply chains involve three interdependent flows: material, information and resources. We discuss these flows in depth throughout the book. The study of operations management is also concerned with these flows. We are in fact of the view that this book could also be effectively used for teaching more general operations management courses, and especially those with a particular emphasis on logistics and supply chain issues. It is becoming increasingly apparent that many operations managers today are engaging more and more in wider supply chain management activities. As processes become increasingly automated and simplified, the focus of many operations managers is shifting to service issues beyond core manufacturing, and to flows and interactions along the supply chain. All of these issues are discussed in this book.

Logistics and supply chain management are ever changing and demanding disciplines, but provide attractive and rewarding opportunities to people who wish to work in these areas. The purpose of this book has been to equip you, the reader, regardless of whether you are a student or a practitioner, with the necessary knowledge and skills to allow you to work more effectively in these areas. We hope you enjoy working with this book and find it of benefit.

John Mangan and Chandra Lalwani

Acknowledgements

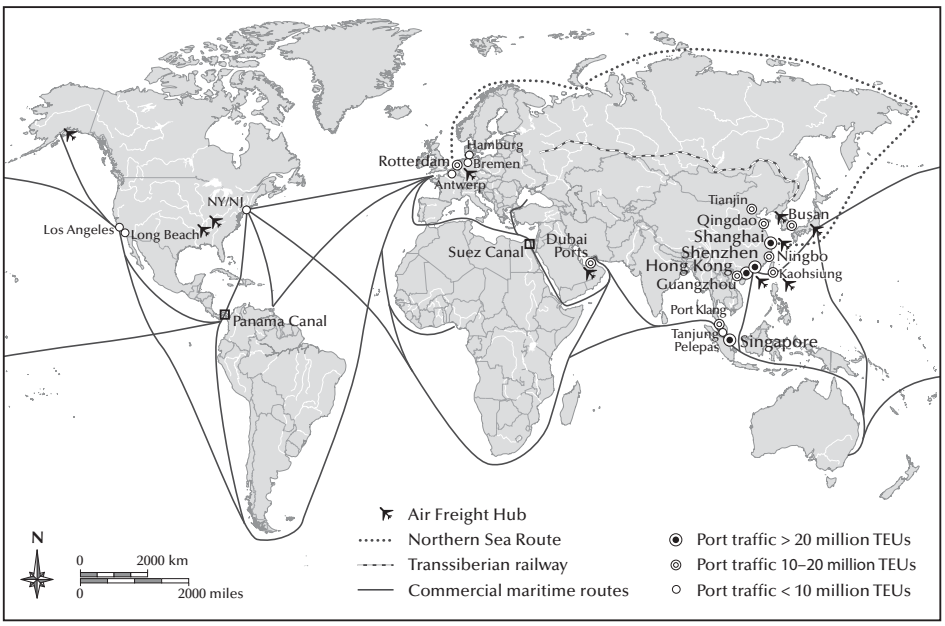
Many people have helped us on our journey to produce the first, second and now third editions of this book over the past ten years. First and foremost, the book would not exist but for the continuing support and advice received from many people at John Wiley & Sons Ltd. These include Steve Hardman, Joshua Poole and Juliet Booker; special thanks too to the various anonymous reviewers, professional proof readers and typesetters whom we have dealt with across all three editions. We thank them all for their professionalism and patience. Thanks also to the many lecturers and students who have used the first and second editions: we thank them for their feedback which is always beneficial. Thanks too to our Universities and our many colleagues who have given us the space and encouragement to complete this time-consuming, yet rewarding, project. We wish to acknowledge with gratitude the various copyright holders for allowing us to use certain material. Special thanks to Dr Jan Hoffmann and Dr Hassiba Benamara from UNCTAD's Trade Facilitation Section who kindly provided us with very valuable data for Chapter 2.

Our esteemed colleague Dr Tim Butcher (RMIT University) was our co-author on the first and second editions; we are most grateful for his contributions. Similarly, Dr Roya Javadpour (California Polytechnic State University) was a co-author on the second edition and we thank her too for her contribution.

Special thanks are due to our good friend – and leading thinker in the field - Emeritus Professor Martin Christopher of Cranfield University who again kindly provided the foreword.

We sincerely thank the various chapter contributors whose expert inputs have added considerably to our own endeavours: Dr Helen Peck, Professor Chuda Basnet (Waikato University), Professor Paul Childerhouse (Massey University), Mr Martin Murphy (SCMG), Professor Shams Rahman (RMIT University) and Dr Risto Talas (University of Hull). We would like to also thank the various case contributors for agreeing to the inclusion of their insightful cases: Dr Peter Baker (Cranfield University), Mr Ciarán Brady (PLS Pharma Logistics), Professor Louis Brennan (Trinity College Dublin), Dr Graham Heaslip (National University of Ireland, Maynooth), Dr Elizabeth Jackson (Royal Veterinary College), Dr Andrew Potter (Cardiff University), Mr Mark Clintworth (European Investment Bank), Ms Anne Nagle (Nagle Business Solutions), Dr Seamus O'Reilly (University College Cork), Dr Aris Matopoulos (Aston University), Dr Agata Banaszewska (Jaguar Land Rover), and Professor Prem Chhetri (RMIT University).

Map


Hamburg
Rotterdam
Bremen
Antwerp
NY/NJ
Los Angeles
Long Beach
Panama Canal
Suez Canal
Dubai
Ports
Tianjin
Qingdao
Busan
Shanghai
Shenzhen
Ningbo
Hong Kong
Kaohsiung
Guangzhou
Port Klang
Tanjung
Pelepas
Singapore
N
0
2000 km
0
2000 miles
Air Freight Hub
Northern Sea Route
Transsiberian railway
Commercial maritime routes
Port traffic > 20 million TEUs
Port traffic 10–20 million TEUs
Port traffic < 10 million TEUs

Part One

Logistics and Supply Chain Context

1 Introduction

LEARNING OBJECTIVES

- Explain the origins of both logistics and supply chain management.
- Define both terms and outline how logistics and supply chain management differ from each other.
- Highlight the importance of these areas in both manufacturing *and* services contexts.
- Identify how best practice logistics and supply chain management can yield both cost reduction *and* value addition.
- Show how supply chains have a major influence on society.

INTRODUCTION

This chapter lays the foundations of the textbook and explains the origins and applications of logistics and supply chain management, as well as giving descriptions of key concepts. A framework for the textbook is developed and this illustrates where each chapter fits in the overall schema of the book, while the various perspectives adopted by the authors when writing this book are also described.

The chapter comprises six core sections:

- The evolution of logistics and supply chain management
- What is logistics?
- What is supply chain management?
- Distinguishing logistics and supply chain management
- Applications to manufacturing *and* services
- Book framework

THE EVOLUTION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT (SCM)

Both **logistics** and SCM are fascinating and exciting areas that touch all of our lives. Just think of the many different products that are purchased and consumed each day – how do they reach the customer and at what cost? Although logistics and SCM are areas that have only come to widespread prominence in the last two decades or so, the reality is that they have roots which run much longer than that. Later in the chapter we will trace the word 'logistics' back to its original military application in ancient Roman and Byzantine times. One of the first references in the academic literature to the notion of taking a supply chain view (although that specific term was not used) is in what is widely regarded as a seminal paper by the MIT academic Jay Forrester published in the *Harvard Business Review* in 1958.[1] In that paper, Forrester put forward a schematic of the production–distribution system (what we would call today a supply chain) and he simulated how inventory levels can fluctuate along that chain.

The commonly accepted abbreviation for supply chain management is SCM, so that abbreviation will be used in the remainder of this book.

Not only are logistics and SCM key aspects of today's business world, but they are also of importance in the not-for-profit and public sectors. In addition, while the origins of much logistics thinking and practice are in a manufacturing context, we are witnessing increased and highly successful application of logistics and SCM principles in a services context also (just think of the efficiencies which have been driven into many service-based activities such as banking and hospitals where the emphasis has shifted to serving more customers, better, faster, cheaper). We will return to this topic in Chapter 16, which will focus on services supply chains and also introduces the concept of servitisation.

The terms logistics and SCM, although often used interchangeably, are distinct and will be defined later in the chapter. First, however, it is appropriate to examine how some key developments over the past couple of decades have shaped the evolution of these important areas. In fact six separate and important developments, each of which evolved largely independently, can be identified and are now detailed.

Reduced transport intensity of freight

In the past, international trade was dominated by bulky raw materials. Times have, however, changed and in-process and finished products, not raw materials, now play a much greater role in world trade. Some simple examples illustrate this clearly. Compare the value of the various consumer electronics products transported around the world today with the bulky, low value products that were being transported 100 years ago. Agricultural produce, and indeed other comparatively high-volume/low-value freight, does still of course traverse the world but, in general, the size and value of the freight which is transported today is very different to that of times past. In the case of agriculture, many food producers, rather than transporting bulky foodstuffs, now tend to try and 'add value' to the product: for example rather than ship live chickens, the international poultry trade generally comprises processed,

ready-to-cook chicken. The same is true for many other trades, across a range of industries, whereby manufacturers try and increase the value-to-volume ratio of products being shipped. We will see in later chapters that there is also an increasing trend towards having the final value-adding stages in the production of various products as close as possible to the final customer; in fact, in some cases the customer actually completes these latter stages of production (facilitated, for example, by 3D printing).

In logistics when we use the term 'to ship' we do not necessarily mean that the freight went onboard a ship - the term is generally used to mean that the freight was sent (by any mode(s) of transport) from one place to another.

Higher value freight is better able to 'absorb' transport costs than is lower value freight, with the 'transport cost penalty' imposed by having to move freight over greater distances often being somewhat offset by the fact that the freight is of higher value. Hence, we refer to a generally reducing **transport cost sensitivity** of freight.

For many individual shipments: increased value/decreased volume = lower transport cost sensitivity.

Indeed for some products it is now not even necessary to ship physical product at all. Just think for example of the way much software is now transmitted around the world via the internet. This replacement of physical product by virtual product is referred to as **material substitution**.

Falling product prices

In many markets, increased competition and falling marketplace prices have forced numerous companies to reduce costs. Just think of the falling prices of various electronics products in recent years such as DVD players, or that the prices of many automobiles have stayed flat in real terms at best, despite the fact that product specifications, performance and quality have improved dramatically. This has forced companies to focus on other areas where savings can be made, and the storage and movement of inventory is a key area in this regard. Thus companies will seek to ensure that any products (especially those with flat or declining value) being transported are configured (in terms of product design, packaging etc.) so as to reduce as much as possible their transport cost sensitivity.

Deregulation of transport

The important role played by transport in logistics will be discussed later in the book. There are five principal modes of transport namely air, road, water, rail and pipeline (in addition the Internet can be regarded as a sixth transport mode). In recent decades transport markets in many countries have been **deregulated** by various governments. The essence of effective deregulation is that by removing unnecessary barriers to competition, markets become more contestable and (in theory at least) prices should come down and service should improve. We say 'in theory' because the reality in some deregulated

markets has been somewhat different (with private monopolies sometimes replacing public ones) but, in general and over the long run, deregulation has had a positive impact on many transport markets, leading to the provision of both more and cheaper services. This of course in turn makes it easier and more efficient to move freight around the world.

A good example is that of *FedEx*, a company which today has one of the world's largest fleets of freighter aircraft. Constrained by burdensome government regulations in the United States in the 1970s, it was not until the late 1970s with the deregulation of the US air freight market (which relaxed the rules governing both who could participate in the market and how they would be allowed to operate) that the company was able to expand and grow.

Productivity improvements

Up to the mid-1950s most maritime freight was carried on bulk vessels. This began to change, however, when some ship owners started to carry freight containers. In 1956 an iconoclastic entrepreneur Malcom McLean put 58 aluminium truck bodies aboard an ageing tanker ship (called the *Ideal-X*) which set sail from Newark, NJ to Houston, TX in the United States. This marked the start of containerised transport as we know it today.[2] Containers can be stacked on top of each other onboard the ship, thus allowing very efficient space utilisation and cargo handling. Furthermore, freight could now move from origin to destination across many modes and services with greater ease of handling. The introduction and growth of containerisation led to huge changes in ports which previously were dominated by large workforces responsible for manual handling of bulk cargo. Containerisation also reduced the costs of transporting freight by maritime transport and significantly improved its efficiency. Containerisation spread to other modes and various alliances were formed between combinations of transport companies.

There were of course many other improvements in transport, for example in propulsion technologies (faster transport) and the application of various information and communications technologies. Companies such as DHL, FedEx and UPS have pioneered the use of barcoding and online tracking and tracing of freight, developments which also increase the efficiencies of logistics systems. Another technology, radio frequency identification (RFID), is now emerging and should also drive more efficiencies into logistics systems. Technology is a very important component and enabler of logistics and SCM, and Chapter 11 and Chapter 12 in particular will look in detail at information flows and technology applications.

Emphasis on inventory reduction

The penultimate trend to consider has been a shift of management and financial attention into analysing where an organisation's funds are tied up. Inventory management will be covered in detail in Chapter 9, but suffice to say for now that many organisations have become increasingly aware of the fact that often significant funds are tied up in unnecessary inventory. Furthermore it became obvious in the latter years of the twentieth century that often inventory was not well managed. During the decades which followed

World War II the responsibility for, and management of, inventory in many firms was very fragmented. The various functions in which inventory played a key role, for example transport, warehousing, purchasing and marketing, were usually considered by managers to be separate and distinct. However, firms began to realise that cost savings and significant efficiency gains could be harnessed from more integrated and focused management of inventory. As far back as 1962 the late Peter Drucker, one of the foremost management thinkers of the twentieth century, wrote a celebrated *Fortune* magazine article entitled 'The Economy's Dark Continent'.[3] In this article he suggested that distribution represented the last frontier for significant cost reduction potential in the firm.

Increased market competition and customer requirements also led to the necessity to see improvements in the management of inventory as an essential competitive weapon. In the increasingly competitive, global marketplace firms began to realise that they could leverage marketplace advantage through superior logistics performance. Cost savings were identified through eliminating unnecessary inventory and just-in-time (JIT) deliveries became normal operating practice in many industries. Indeed many companies came to recognise the risks associated with holding too much stock which rendered them less flexible in their ability to respond to changing demand conditions.

Changes in company structure

A more recent trend concerns changes in how companies are structured and operate. In recent years many companies have become less **vertically integrated** (a concept that implies ownership or at least control of upstream suppliers and downstream customers) and more specialised. Outsourcing has become more common, with suppliers playing a more central role for many manufacturers (subsequent chapters in the book will consider in detail strategies and practices such as JIT, outsourcing, etc). Many companies have also come to realise that so-called functional or silo-based thinking (viewing the various departments within the firm as separate and non-overlapping entities) will only hinder the overall performance of the company and they have as a result endeavoured to ensure that the various functions and activities across the company are integrated more closely. In more recent years in particular, competition based on *time*, for example order to delivery time, has become a key success factor (KSF) in many markets.

All of the above six trends, while they emerged independently, have both placed an increased emphasis on the role of transport and inventory, and have led to improvements in the way freight is handled and moved around the world. They have led to what is often termed the *supply chain revolution*.

Before proceeding further it is important to highlight one small, but important, distinction. People often use the terms 'freight' and 'cargo' interchangeably, however, they are in fact distinct, at least in terms of their use within the logistics sector. In essence: *cargo = freight + mail*. Mail, also known as post, is of course still a very important component of trade and commerce, despite the many technological advances which shape today's world. It is an important and regular source of revenue for many transport companies, especially airlines. Sometimes people also use the term 'goods', usually to refer to freight

(not cargo), but we will try to avoid use of this term. Another term worth defining at this juncture is **consignment** which the *Collins English Dictionary* defines as 'a shipment of goods consigned'; the **consignor** is the term used for the company (e.g. a manufacturer) who sends the consignment and the **consignee** is the term used for the company (e.g. a retailer) who receives the consignment.

THE ROLE OF LOGISTICS IN NATIONAL ECONOMIES

The size of the logistics sector varies from country to country. Spending in the US logistics and transportation industry, for example, totaled $1.33 trillion in 2012, and represented 8.5 percent of annual gross domestic product (GDP).[4]

Economists note that a variety of factors determine the wealth and rate of growth of national economies. These factors are many and varied, and range from available energy sources to institutional factors such as a good banking system. In the late 1990s the US economy experienced a rapid rise in productivity. Closer examination of the economic data by researchers at the McKinsey and Company Global Institute revealed the impact on national productivity of developments in the retail sector, and most notably the impact of the giant retailer Wal-Mart.

According to Beinhocker (2006)[5] 'Wal-Mart's innovations in large-store formats and highly efficient logistical systems in the late 1980s and early 1990s enabled the company to be 40 percent more productive than its competitors'. Wal-Mart has been a global leader in best practice retail logistics, with many other retailers imitating some of its strategies. In the case of the US economy, the increases in Wal-Mart's productivity led to an 'innovation race' with suppliers and other retailers also seeking to enhance their productivity, in turn leading to a rise in whole-sector productivity. Wal-Mart is one of the world's largest companies and in the context of the discussion in this chapter it is interesting to observe the considerable impact and importance of how it organises its logistical systems.

WHAT IS LOGISTICS?

Now that the key developments which have shaped the evolution of logistics and SCM have been outlined, it is appropriate to attempt to describe and define these concepts. Some authors have pointed to the often confusing and overlapping 'plethora of terminology' that is used in logistics and SCM.[6] While at one level defining logistics and SCM might seem an elementary task, it is in fact critically important to define, and differentiate, these terms correctly at this juncture as this will shape your understanding and interpretation of the contents of this book. First to logistics. The *New Oxford Dictionary of English* defines logistics as:

> the detailed coordination of a complex operation involving many people, facilities, or supplies. Origin late 19th century in the sense 'movement and supplying of troops and equipment', from French *logistique*, from *loger* lodge

There are various views with regard to the linguistic origins of the word, with some pointing to the Greek adjective *logistikos* which means 'skilled in calculating' (and

which most likely gave us the mathematical term *logistic*). It has also been noted that in Roman and Byzantine times there was a military official called *Logista*. In more recent times we have seen, as in the above definition, the French words *logistique* and *loger*. Most agree that the word entered the English language in the 19th century, with its application generally seen in military terms and concerned with the organisation of moving, lodging and supplying troops and equipment.

These origins suggest then that logistics has something to do with applications of mathematics and is primarily a military concern. Indeed the field of military logistics has evolved quite considerably and is now quite sophisticated.[7] Similarly there are many useful applications of mathematics to logistics. Today, however, logistics spans beyond the military and mathematical domains. It was in fact only in the latter decades of the 20th century that the term logistics entered into common non-military use. The US based Council of Supply Chain Management Professionals (www.cscmp.org) suggests the following definition of logistics and which we adopt in this book (note: we have added the underlining (of transportation and storage) to the original definition):

> **Logistics** is the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements.

Another way of understanding what is involved in logistics is to see it as including various (actually we can think of at least eight) 'rights': getting, in the right way, the right product, in the right quantity and right quality, in the right place at the right time, for the right customer at the right cost. Some of these 'rights' may be obvious, others perhaps less so. For example, the right customer: in many industrial locations today typically many different companies will be co-located on the one site. Even on the one production line there may be various subcontractors collaborating with the manufacturer and there will be clear demarcation lines with regard to who has ownership of what, where and when. Therefore getting the product to the right place may be only half the journey, the challenge would be to get it to the right customer at this right place. To consider briefly 'the right way': there is now a substantial and growing interest in environmental and related issues, and Chapter 14 deals in detail with sustainability. There is thus a necessity to get the product to the customer in the 'right way', meaning in such a way as to cause as little damage as possible to the environment.

Logistics involves getting
. . . the right product
. . . in the right way
. . . in the right quantity and right quality
. . . in the right place at the right time
. . . for the right customer at the right cost

Logistics was once described as 'just trucks and sheds'; others see it as concerned with 'just wheels and walls'. As the discussion above illustrates, and notwithstanding the fact