

Management for Professionals

Colin Scott  
Henriette Lundgren  
Paul Thompson

# Guide to Supply Chain Management

An End to End Perspective

*Second Edition*

 Springer

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# Management for Professionals

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# Guide to Supply Chain Management

An End to End Perspective

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ISSN 2192-8096

ISSN 2192-810X (electronic)

Management for Professionals

ISBN 978-3-319-77184-7

ISBN 978-3-319-77185-4 (eBook)

<https://doi.org/10.1007/978-3-319-77185-4>

Library of Congress Control Number: 2018941880

© Springer International Publishing AG, part of Springer Nature 2011, 2018

Originally published by Springer-Verlag GmbH, Berlin Heidelberg, 2011

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Cover illustration: eStudio Calamar, Berlin/Figueres.

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG part of Springer Nature.

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

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## Foreword

This guide is a really useful reminder of what good practice is and how it should be applied within supply chain management. The book is relevant for students of supply chain management and professional practitioners alike.

The key aspects of supply chain are laid out clearly—plan, source, make, deliver, and return. The book is well constructed in totality—and I can envisage revisiting specific chapters in isolation whilst constructing and delivering supply chain strategy.

This is the first book that I have come across that is focused more upon the concepts underpinning the total supply chain rather than the physical execution of the supply chain. Its range is from forecasting, inventory management and cash through execution strategy and development. I would add it to my arsenal and recommend it to others.

The content is relevant; concepts are clearly explained and supported by case studies that bring the concepts to life. The language used is clear and contemporary; visualisations re-enforce the concepts well. The additional suggested reading at the end of each chapter offers an added opportunity to further develop understanding of specific elements of the supply chain.

Organisations operating on a global stage have to get this stuff right, in both process and physical terms: it is an essential element to delivering profitable growth. This book offers an invaluable guide to understanding the specific dynamics of your supply chain and the fundamentals underpinning it. It provides the framework for delivering a supply chain strategy based upon recognised best practice.

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Martin McCourt

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## Preface

Welcome to the second edition. Supply chain management is a fast-changing business. Recently, it has driven companies around the world to change structure and—maybe more importantly—the way they think about operating in an increasingly volatile global environment. Everything we consume from the food we eat and the clothes we wear to the technology we use is configured from components that have travelled from different corners of the world. As consumers request high-quality products at lower cost, supply chain management has become as critical as sales, marketing and finance in today's organisations.

The goal for supply chain management is to beat the competition and to provide better service at lower cost with a sustainability remit. A key element of success within supply chain management is the speed and effectiveness of innovation. Therefore, within this second edition, we have included more content around this subject.

During our work with large multinational companies in various industries, we have met professionals all over the world who are passionate about achieving these goals. This guide is designed to help professionals, students and everyone else with an interest in this topic to structure their thoughts and methodologies.

Business practitioners who work in supply chain management and those whose business functions interact with it have an interest in reading the guide in both the digital and paper format. Students, whether studying at universities or in vocational training, find this guide a comprehensive introduction to supply chain management. But also people working in other contexts, such as charity projects and professional industry bodies, appreciate this text with its intuitive models and many practical examples.

In writing this guide, we have tried to connect with our readers by using simple and straightforward models. By including more real-life case studies of best practice in this second edition, the guide brings supply chain theory to life. The practical approach and format enables readers to capitalise on the insights presented in the guide.

In preparing this book, we have drawn greatly on the thoughts and concepts of others. If we have omitted to give any credits where credits are due, we apologise and hope that they will make contact to include in future editions. Learning is an interactive experience, so we welcome any feedback or ideas of how to improve this

guide. After all, we have learned most from the people we worked with, for which we are very thankful.

If you would like to get in touch with the authors, please find us online or email us: [supplychain@grangepartnership.com](mailto:supplychain@grangepartnership.com)

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## Acknowledgement

We'd like to acknowledge with thanks our families and everyone who supported us in this project, particularly on the text and case studies.

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# Contents

<b>1</b>	<b>Introduction to Supply Chain Management . . . . .</b>	<b>1</b>
<b>2</b>	<b>Guide to Plan in Supply Chain Management . . . . .</b>	<b>9</b>
<b>3</b>	<b>Guide to Source in Supply Chain Management . . . . .</b>	<b>43</b>
<b>4</b>	<b>Guide to Make in Supply Chain Management . . . . .</b>	<b>61</b>
<b>5</b>	<b>Guide to Deliver in Supply Chain Management . . . . .</b>	<b>87</b>
<b>6</b>	<b>Guide to Return in Supply Chain Management . . . . .</b>	<b>107</b>
<b>7</b>	<b>Guide to Strategy in Supply Chain Management . . . . .</b>	<b>129</b>
<b>8</b>	<b>Guide to People in Supply Chain Management . . . . .</b>	<b>143</b>
<b>9</b>	<b>Guide to Finance in Supply Chain Management . . . . .</b>	<b>161</b>
<b>10</b>	<b>Guide to Customer Service in Supply Chain Management . . . . .</b>	<b>175</b>
<b>11</b>	<b>Guide to Outsourcing in Supply Chain Management . . . . .</b>	<b>189</b>
	<b>Index . . . . .</b>	<b>203</b>

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## About the Authors

**Colin Scott** is an author, learning specialist and executive coach for global companies with over 30 years of experience in business and supply chain management. In his operational career, he worked for manufacturers and third-party logistics providers and managed major change projects. He was responsible for international transport operations as well as systems strategy and implementation, holding Commercial Manager positions, focusing on customer account management and regional financial responsibility, including the management of client inventory and the implementation of strategic sourcing processes.

Over the past two decades, Colin has focused on management development, designing and delivering learning programmes around the globe for some of the world's largest companies. He thoroughly enjoys supporting large retailers, manufacturers, consultancies, transportation and logistics companies in meeting the ever-increasing challenges in customer service, cost, innovation and sustainability.

Educated at Durham University and Nottingham Business School, Colin holds diplomas in logistics and management studies and is an accredited trainer and assessor in Team Management Profiling. He works with some of the world's leading business schools supporting their executive leadership and supply chain development programmes. Colin is also a non-executive director of a global manufacturing company.

**Henriette Lundgren** is an author, coach and business trainer. With more than 15 years of experience, her main focus is on corporate learning and leadership development for international businesses. Previously, she worked in various line management and project management positions, leading demand planning and sourcing teams in the consumer goods and chemical industry. She also oversaw the implementation of SAP systems in manufacturing, planning and customer service at the international level.

Henriette holds a degree in International Business from Maastricht University (NL) and a Master in Organizational Psychology from the Open University in Germany. She also received a Professional Diploma from the Chartered Institute of Logistics and Transportation (CILT) with distinction and is a member of the Association for Talent Development (ATD).

Based in Upstate New York, Henriette has worked and lived in various countries, including the UK, Italy, Poland, Sweden, Germany and the Netherlands. In her free time, Henriette enjoys climbing walls and sailing lakes.

**Paul Thompson** is an author, coach and business learning specialist with extensive experience in designing and running global programmes for large corporations. He enjoys working with leading companies and has developed and delivered learning activities across a wide range of industries. Many of Paul's programmes include the use of business simulations, which improve interaction during the event and increase learning transfer after it. He is a qualified assessor for the Margerison–McCann Team Management Wheel.

After graduating with a first-class degree in manufacturing sciences, Paul spent a decade managing different parts of the business for two of the world's largest and most successful companies. In his roles, Paul has managed sales, finance, planning, supply chain, logistics, warehousing and manufacturing operations.

He has led major change management projects including outsourcing international warehousing and distribution and implementing customer service excellence systems. In addition, he also oversaw the implementation of both SAP and JD Edwards successfully within the supply chain.

In his free time, Paul coaches local sports teams and supports local community projects.

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# Abbreviations

2D	Two-dimensional
3PL	Third-party logistics
AI	Artificial intelligence
AS	Average stockholding
ASN	Advanced shipment notice
B2B	Business to business
B2C	Business to consumer
CFO	Chief financial officer
CILT	Chartered Institute of Logistics and Transportation
CLSC	Closed-loop supply chain
CM	Category management
COC	Cost of capital
COFC	Container on flat car
COG	Centre of gravity
CRP	Capacity requirements planning
CS	Category sourcing
CSR	Corporate social responsibility
DC	Distribution centre
DRP	Distribution requirements planning
DSD	Direct store delivery
EDI	Electronic data interchange
ELV	End-of-life vehicle
EOQ	Economic order quantity
EPA	Environmental Protection Agency
EURIDICE	European Interdisciplinary Research on Intelligent Cargo for Efficient, Safe and Environmentally Friendly Logistics
FA	Forecast accuracy
FE	Forecast error
FG	Finished goods
FMCG	Fast-moving consumer goods
FTL	Full truck load
GHG	Greenhouse gas
GSCM	Green supply chain management

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HAZMAT	Hazardous material
IF	In full
IP	Intellectual property
ITT	Invitation to tender
JIT	Just in time
KPI	Key performance indicator
L&D	Learning and development
LCA	Life cycle assessment
LNG	Liquid natural gas
LT	Lead time
LTL	Less than a truck load
MAPE	Mean absolute percentage error
MPS	Master production schedule
MRP	Materials requirements planning
NDC	National distribution centre
NLP	Neuro-linguistic programming
NVA	Non-value added
OEE	Overall equipment effectiveness
OEM	Original equipment manufacturer
OOS	Out of stock
OT	On time
OTIF	On time in full
P&L	Profit and loss
Q	Order quantity
R&D	Research & Development
RCCP	Rough cut capacity planning
RDC	Regional distribution centre
RFI	Request for information
RFID	Radio frequency identification
RFP	Request for proposal
RFQ	Request for quotation
RL	Reverse logistics
RM	Raw materials
ROCE	Return on capital employed
RRT	Rolling road train
S&OP	Sales and operations planning
SC	Supply chain
SCC	Supply Chain Council
SCM	Supply chain management
SCOR	Supply chain operations reference
SKU	Stock keeping unit
SLA	Service level agreement
SLF	Service level factor
SRM	Supplier relationship management

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SS	Safety stock
SU	Supplier uncertainty
TCO	Total cost of ownership
TOC	Theory of constraints
TOFC	Trailer on flat car
TPS	Toyota Production System
TQM	Total quality management
ULD	Unit load device
VARK	Visual, auditory, read/write, kinaesthetic
VFFS	Vertical form fill and seal
WACC	Weighted average cost of capital
WEEE	Waste electrical and electronic equipment
WEF	World Economic Forum
WIP	Work in progress



## 1.1 What Starts a Supply Chain?

Whether you are a tea or coffee drinker—have you ever wondered how your hot drink makes its way onto your breakfast table? Have a look at the supply chain diagram in Fig. 1.1. What do you see?

Firstly, let's consider the flow of materials—these are depicted in the middle part of the diagram. They range from raw materials (tea leaves), to work in progress (silo), all the way to finished goods (a cup of tea). This goods flow encompasses the supplier's supplier through to the end consumer.

Secondly, we have the flow of information, e.g. order confirmation or dispatch advice.

In addition, there are also reverse flows. These reverse flows can be in the form of:

- Goods, e.g. quality defect products or obsolete products
- Information, e.g. customer feedback
- Packaging material, e.g. outer cartons
- Transportation equipment, e.g. cages, pallets or containers

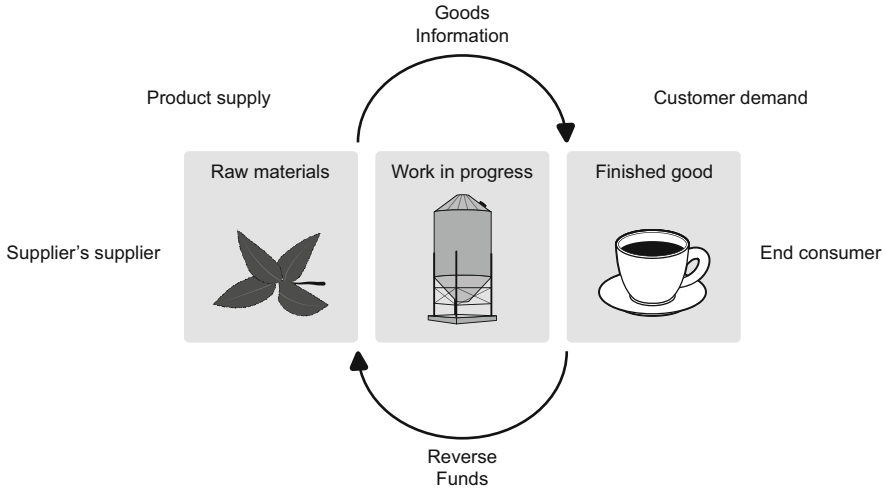
We also have the reverse flow of funds. This is the money that flows back into the supply chain. Ultimately, the supplier's supplier wants to be paid for the delivery of tea leaves!

Thus, tracking your breakfast drink all the way back from its source of raw materials shows a number of nodes and processes involved. In fact, a definition of a supply chain can be considered all the nodes and processes encompassed within these flows.

Figure 1.1 also depicts two forces in this chain of goods, information and funds, which are:

1. Product supply
2. Customer demand





**Fig. 1.1** The supply chain of a cup of tea

Which of these two starts the supply chain?

Imagine a scenario where a retail outlet is operating from *customer demand*. You enter as a consumer with the intention to buy some tea bags. You find the tea and coffee shelf empty. Instead of the full assortment of black, green, fruit and herbal tea, there is a sign over the counter saying, “Please order your favourite tea here”. Irritated by the absence of *product supply* you would probably go and see the shop assistant for clarification. They would then explain to you that the shop is running a *customer demand* driven tea supply chain where the end consumer can place an order directly in the shop. The order is then automatically transmitted to the tea bag supplier in India in order to grow, pick and process the required amount of tea leaves that are filled into tea bags. Does that work?

It probably does not. Commodities, such as tea, coffee, rice, bread, milk and most other basic consumer products that you find in supermarkets are more likely to be produced on a *product supply* basis. This means that the supply chain starts supplying before you come into the supermarket to buy some tea bags. As a consequence, you find supermarket shelves full of products for everyday use. The same applies to small household equipment, electronics and general fashion clothes—mostly these are sourced, produced and shipped in advance. So in these cases, *product supply* also starts the supply chain.

Unlike tea bags, some products are produced based on *customer demand*. These products are typically characterised by a high degree of customisation or product innovation.

Here, the customer order starts the chain of supply, manufacturing and transport activities of your desired product. Some typical products of *customer demand* driven products are: tailor-made clothes, customised tools and dinner in an up-market fish restaurant. Here customers see the fish that they are going to eat later on still swimming

in the fish tank when they enter the restaurant. The chain starts moving after you have expressed your wish or after you have set your order. Thus, the supply chain starts with *customer demand*.

To summarise, supply chains can be triggered by product supply (commodities) or by customer demand (customised products). The degree of customisation dictates how much and in which format the supplying company holds inventory: no stock at all, raw or basic materials only or sub-assemblies of their products. The strategies and associated decoupling of product supply from customer demand form a crucial part of supply chain management (see Chap. 7 on Strategy).

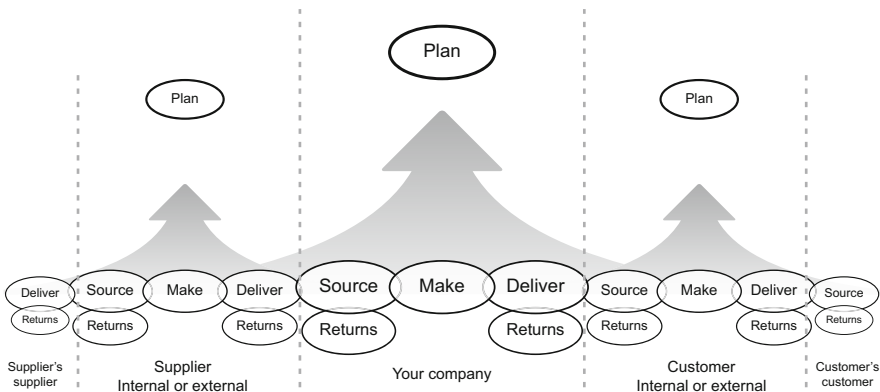
## 1.2 A Functional View of Supply Chain Management

In order to understand the supply chain better, it makes sense to consider the broad spectrum of generic functional processes in the supply chain (see Fig. 1.2).

Let's go back to our first example in this chapter: the tea bag supply chain. Imagine that you are the manufacturer of these tea bags. When you start engaging in supply chain management, you will most likely be confronted with some of these questions:

- How many tea bags are you going to sell?
- Where are you going to sell them and when?
- How much production do you need to schedule in your factory?
- What are your raw and packaging materials you need in order to fulfil the production plan?

All of these belong to the functional *plan* process, where demand and supply are balanced to develop a course of action to meet sourcing, production and delivery



**Fig. 1.2** Broad spectrum of generic functional processes in the supply chain. Source: <http://www.supply-chain.org>, SCOR model, Supply Chain Council Inc., Copyright © 2010

needs. The plan process aligns the supply chain plan with the financial plan (see Chap. 2 on Plan).

The next step is to find suppliers of tea leaves, tea bag sachets and outer packaging cartons in order to source your materials that you need for production. You might also decide to source services such as transport and warehousing. This *source* function is sometimes called purchasing or procurement, and it describes the process of buying goods or services to meet planned or actual demand. The emphasis in this stage of the process is on selecting suppliers, establishing policies and assessing performance (see Chap. 3 on Source).

Once demand and supply are planned, and materials are sourced, you can start with the actual manufacturing or making of tea bags. Thus, the header *make* in this model describes all processes that transform your raw materials or sub-assemblies into the finished product with the aim to meet customer demand. This process within the supply chain operations reference model looks at questions such as:

- How to set up manufacturing?
- How to make sure the production runs efficiently?
- How to improve the making process? (see Chap. 4 on Make)

After manufacturing, your products are ready for distribution or delivery. Under the *deliver* function, all supply chain processes are included that provide finished goods to customers. Thus, the order management, warehousing and transport management of your tea bags all form part of this process (see Chap. 5 on Deliver).

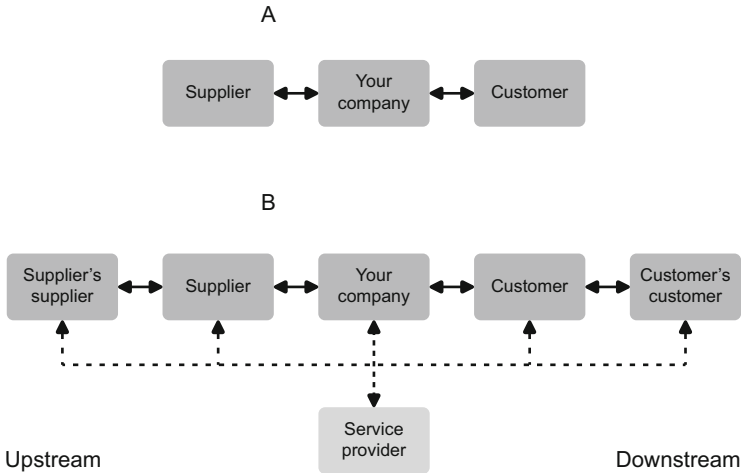
The last process in the chain concerns reverse logistics or product *return*. This functional process comprises all tasks that are associated with the return of product. Returns can occur for quality reasons, for recycling or for post delivery customer support (see Chap. 6 on Return).

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### 1.3 Supply Chain Architecture

Let's now have a look at the make up and architecture of a supply chain. In its simplest format, a supply chain consists of three nodes. The company, e.g. the producer of tea bags, the supplier, e.g. local companies that produce raw and packaging materials, and the customer of that company, e.g. local supermarkets as demonstrated in the following example (see Fig. 1.3).

In an extended supply chain, we consider three additional supply chain nodes. On the upstream side (towards supply), there is the supplier's supplier or the ultimate supplier at the beginning of the extended chain. In our tea bag example, it could be the cotton farmer in Texas who provides the raw material for the supplier to produce tea bag sachets. At the downstream side (towards demand), there is the customer's customer or the end consumer at the end of the extended supply chain. The distinction here is the different kind of customers that exist between your company and the end consumer.



**Fig. 1.3** Supply chain architectures. (a) Simple supply chain (b) Extended supply chain

Customers in supply chains can be distributors, wholesalers or retailers. Distributors are companies that take inventory in bulk from manufacturers and deliver an assortment of related product lines to customers. Distributors are common in regions where retailing is fragmented, e.g. in some parts of Latin America, and for certain channels of distribution, e.g. petrol stations and airports. Wholesalers—often known as cash and carry markets—buy from distributors or manufacturers directly. They often specialise in certain product ranges and supply special industries, like hotels, restaurants and catering, with larger quantities of products. Retailers, on the other hand, stock products in smaller quantities and sell them to the general public. These are the different kinds of customers in a product supply chain.

In this guide, we will sometimes refer to supply chain or product companies. These are companies that sit in the middle of the chain—just like in the example of the simple or extended supply chains—and bring products to market together with their supply chain partners.

Finally, there are entire categories of companies that are service providers to other nodes in the supply chain. These perform services in areas such as:

- Transportation
- Warehousing
- Finance
- Market research
- New product design
- Technology
- Sustainability

Service providers specialise in certain skills and expertise. They are often able to provide these services more efficiently than manufacturers, distributors, wholesalers, retailers or end consumers.

Supply chain structures, however, may have many more nodes involved if you look at them from the very beginning until the very end. Drawing your own or your customer's supply chain can help you understand the supply chain dynamics better.

When you look at your finished supply chain map, you probably find multiple upstream and downstream nodes, including some of service providers. You could further ask yourself:

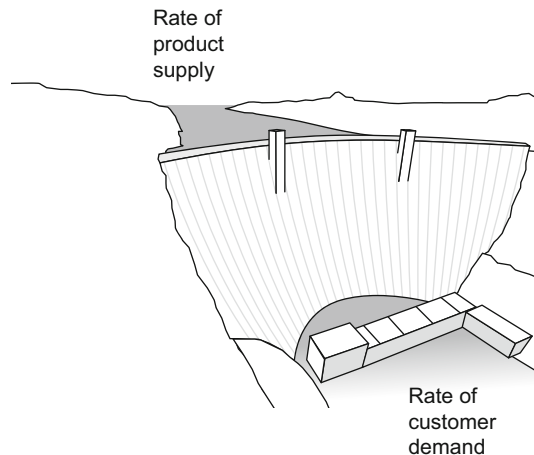
- What's the geography of my supply chain map?
- What happens when a flow is interrupted?
- Who pays for the cost of inefficient supply chains?

## 1.4 Supply Chain Dynamics

Although their set-up often appears to be static, supply chains in reality are quite dynamic. Ideally, supply chains react to changes in their environment. Maybe it helps to draw another picture to illustrate this point. A supply chain can be compared to a huge water reservoir, like the Hoover Dam close to Las Vegas (see Fig. 1.4): it reacts to how much water is needed in a given period (rate of customer demand) and opens its reservoir accordingly (rate of product supply). It is important that the rate of supply mirrors the rate of demand; otherwise the outcome will be very unfavourable for Las Vegas.

The same is true for the different nodes in the supply chain. Their task is to balance the rate of product supply in accordance with the rate of customer demand. This is, as practitioners of supply chains will know, very difficult at times. External influences will affect the equilibrium. The demand for ice cream, for example, depends on how hot it is during the summer. Price cuts and promotional activities will influence the sale of cars. Other macroeconomic factors such as exchange rates,

**Fig. 1.4** Balancing supply and demand





**Fig. 1.5** The inventory challenge

affect world travel and consumption. Yet, it is useful to keep the water reservoir image in mind when working in supply chains.

Managing supply chains can feel at times like surfing. It is constant rolling, riding and gliding on and off the waves (see Fig. 1.5).

As a surfer, you are aiming to stay on top of the wave! In supply chains, the wave stands for inventory and you are constantly managing the level of inventory against the risk of being out of stock. You may decide to increase your level of inventory and therefore reduce the level of stock outs. This situation feels comfortable as long as your Finance Director does not push for a reduction in working capital and higher returns on capital employed (see Chap. 9 on Finance). Thus, inventory reduction might become necessary despite being paired with an increased risk of out of stocks. The challenge in supply chain management is to balance the level of inventory while maintaining a high level of service (see Chap. 10 on Customer Service).

A famous simulation of dynamics in the supply chain is the *beer game*. The set-up is simple: there are four nodes (factory, distributor, wholesaler and retailer) that source, produce and move beer within the supply chain. The aim is to minimise total supply chain costs, which can be achieved through holding little (but not too little!) inventory. Then it happens: the bullwhip effect! A small change in real customer demand leads to a huge amplification of the upstream demand signal and increased volatility of orders through to suppliers. The initial out of stock situation soon becomes a massive excess stock problem. In order to improve the situation, we need to communicate, share a demand forecast between the different nodes and reduce information and product flow lead-times.

In addition to those just mentioned, there are more learning points from the *beer game* that lead to best practice in supply chain management. The human factor, for example, becomes highly important in supply chain performance. Silo thinking (thinking in isolation) needs to be avoided and a lack of supply chain understanding needs to be addressed (see Chap. 8 on People). Also, loss of control, lack of service and frequent quality problems can be the consequence when dealing with many nodes in the supply chain. Therefore, the management of partners in the supply chain, e.g. third party logistics providers, becomes crucial (see Chap. 11 on Outsourcing).