

## Supply Chain Management in the 21st Century



# Supply Chain Management in the 21st Century

*with European applications*

*Jan Renaud*

Amsterdam University Press

*Note to the image on the cover page:*

Already in 2014, the largest e-commerce retailer in the world, Amazon Inc, filed an application for a patent at the United States Patent and Trademark Office (USPTO) envisioning an innovative distribution system. In the application document (U.S. patent 9,305,280 filed by Amazon Technologies Inc.) they describe a large airship (zeppelin) serving as a floating fulfillment center in the air, accompanied by a fleet of drones transporting packages from the airship to the destination address on land. Although this innovative distribution system is still in a research phase, and far from being operational, it is one of the many innovations taking place in the organization of Supply Chains.

Cover design: Gijs Mathijs Ontwerpers, Amsterdam

Lay-out: Crius Group, Hulshout

ISBN 978 94 6372 987 1  
e-ISBN 978 90 4855 614 4  
DOI 10.5117/9789463729871  
NUR 780

© J. Renaud / Amsterdam University Press B.V., Amsterdam 2022

All rights reserved. Without limiting the rights under copyright reserved above, no part of this book may be reproduced, stored in or introduced into a retrieval system, or transmitted, in any form or by any means (electronic, mechanical, photocopying, recording or otherwise) without the written permission of both the copyright owner and the author of the book.

Every effort has been made to obtain permission to use all copyrighted illustrations reproduced in this book. Nonetheless, whosoever believes to have rights to this material is advised to contact the publisher.

# Table of Contents

<b>Foreword</b>	<b>9</b>
Synopsis	9
The didactical approach	9
The aim of this textbook	10
<b>Chapter distribution and learning objectives</b>	<b>13</b>
<b>1 An Introduction to Supply Chains in the 21st Century</b>	<b>19</b>
An introductory Supply Chain case: The evolution of the supermarket sector in the Netherlands	19
The importance of global Supply Chains (SC) has grown rapidly due to globalization	25
Organizational resources and assets	29
Designing and managing a Supply Chain requires the use of metrics	31
Product and production process	33
The basic architecture of mass production and distribution	35
Demand, orders, and the bullwhip effect	39
Facility location and Customer Response Time	40
Mobile service centres: Reversed supply	41
Technological trends that will affect future supply chain operations	42
<b>2 Forecasting in a Supply Chain</b>	<b>47</b>
Forecasting as a valuable tool to optimize Supply Chain planning	47
Forecasting for products with a sales record <sup>1</sup>	48
Forecasting and exploring sales data patterns	48
Combining level, trend, and seasonal components in a single demand	52
From time series decomposition to forecasting	56
Assessing the reliability of the model and calculating forecast errors	57
Forecasting using binary regression	58
The third forecasting method: Holt-Winters exponential smoothing <sup>10</sup>	61
Forecasting with the aid of regression analysis	67
Collaborative forecasting and planning in a Supply Chain	67
Chapter summary	70
<b>3 Capacity Planning and Facility Location</b>	<b>71</b>
Capacity Planning and Facility Location Decisions	71
Capacity Investment, Capacity Costs, and Capacity Classification	74

	Instruments for hedging supply against unexpected demand change	75
	Mass customization and capacity	76
	Capacity planning and geographical location decisions	76
	Decision Support Tools	78
	Designing a production and distribution network	80
	Using linear programming for capacity planning	81
	A general model for optimizing capacity decisions	88
	Location decisions based on gravity models	88
	Location decisions and geographic concentration of competitive suppliers.	89
	Location decisions and Geographic Information Systems (GIS)	92
	Capacity planning in a Supply Chain setting	93
<b>4</b>	<b>Production Planning in a Supply Chain</b>	<b>95</b>
	Production Planning in a Supply Chain	95
	Extending the model with subcontracting and deploying a flexible workforce	105
	Adding more variations to the production planning model	110
	Production planning in a competitive environment	110
	Materials Requirement Planning (MRP) as part of production planning	114
	Lean production and just-in-time (JIT) processes	116
<b>5</b>	<b>Inventory Management in a Deterministic Scenario</b>	<b>119</b>
	Classification based on inventory purpose	121
	Inventory accounting, information technology, and inventory costs	122
	Economic Order Quantity model	125
	The Reorder Point (ROP)	128
	Optimal Economic Order Quantity with quantity or volume discounts	128
	From an example to a general calculation of the economic order quantity with all-unit quantity discounts	130
	Quantity discounts and supply chain optimization	132
	Product aggregation combined in a single order	132
<b>6</b>	<b>Inventory Management under Uncertainty</b>	<b>135</b>
	Inventory Management under Uncertainty	135
	Costs associated with understocking and overstocking	136
	Quantifying uncertainty: Probability scenarios	137
	Safety inventory – or safety stock (ss)	139
	Safety inventory, Cycle Service Level, and fill rate	140
	The impact of aggregating and centralizing safety stock	144

	Calculating holding costs for cycle inventory, safety inventory, and shipment	148
	Reviewing inventories: Continuous and periodic policy	148
	Postponement as a tool to reduce inventory in a manufacturer setting	149
	Cycle Service Level and fill rate	150
	Management recommendations to reduce costs of safety stock	153
<b>7</b>	<b>Optimal Customer Service Level, Sourcing Policies, and Risk-Sharing</b>	<b>155</b>
	Optimal customer service level, sourcing policies, and risk-sharing	155
	Backlogging and stocking-out	160
	To insource or to outsource: That is the question!	161
	Selecting suppliers and competitive bidding	165
	Total Cost of Ownership	166
	Risk-sharing strategies between supplier and customer	167
	Booking systems and prepayment arrangements	176
<b>8</b>	<b>Asset Mobility and Infrastructure for Supply Chains in the 21st Century</b>	<b>179</b>
	A Concise Overview of Infrastructure Assets and Its Underlying Network Structure for Asset Mobility	179
	Transportation and infrastructure: A classification from uncommon to common	183
	Equivalent to conveyor belts: Pipelines	184
	Freight transport by air	186
	Freight transport by railway	187
	Freight transport by water	191
	Freight transport by road	198
	Passenger service and transport	202
	A brief overview of the future of freight and persons mobility	203
	Infrastructure assets, congestion, and pricing for congestion	221
	The real value of infrastructure assets: Networks and Intermodality	226
	Intermodality	229
	Real-time tracking of shipments	231
	Last-mile delivery in city centres	232
<b>9</b>	<b>Distribution Network Configuration and Optimal Logistics Flows</b>	<b>237</b>
	Distribution Network Models and Optimal Flows	237
	Shortest path problem	240
<b>10</b>	<b>Revenue Management and Optimizing Capacity Usage</b>	<b>261</b>

	Revenue Management and Optimizing Capacity Usage	261
	Dynamic pricing over time	262
	An example	272
11	<b>Managing Bottlenecks and Waiting Lines in a Supply Chain</b>	<b>281</b>
	Managing bottlenecks and waiting lines in a Supply Chain	281
12	<b>Sustainability and Corporate Social Responsibility in a Supply Chain</b>	<b>305</b>
	Sustainability and Corporate Social Responsibility in a Supply Chain	
	<i>The Cobalt Case in the Manufacturing of Electronic Devices</i>	305
	Introduction	306
	What is Corporate Social Responsibility? <sup>4</sup>	307
	Moving from an individual firm CSR policy to a Supply Chain CSR policy	310
	Reporting and metrics for Supply Chain performance	311
	Blockchain technology: A tool to improve supply chain sustainability?	311
	Recycling and waste disposal, considered as a <i>reverse</i> Supply Chain <sup>10</sup>	312
	Drivers of increasing waste streams: Producers and consumers	318
	Intergenerational natural resources usage	321
	Case: The global food Supply Chain and managing bioresources sustainably	322
	A second dimension of sustainability in the food Supply Chain: Food waste	328

# Foreword

## Synopsis

---

*Supply Chain Management in the 21st Century* is a textbook written for final-year Bachelor students in business and management sciences, but it also fits into programmes for MBA students. The book is a useful supplement to curricula of industrial and production engineering students who are considering a career in the field of production planning, procurement, inventory management, and Supply Chain Management in business organizations, public administration entities, and not-for-profit organizations. Every subject in the book starts from the basics and develops the theory and models up to an intermediate level. To be able to follow the text, the basic requisites are an elementary background in mathematics, statistics, and spreadsheet skills.

## The didactical approach

---

The book pursues a blend of theoretical concepts and models alongside practical applications. Supply Chains in the 21st century are faced with challenges that hardly existed in the previous century. Technological advances in the field of Information Technology, autonomous vehicles used in distributions centres, an exponential increase in online shopping and the organization of last-mile deliveries, the Covid-19 crisis, and smart infrastructure, just to mention a few, are impacting supply chain operations and performance significantly in the 21st century. Many of these new developments are discussed in this book.

The scope and the level of the book strike a balance between introductory qualitative textbooks about Supply Chain and operations management, on one side, and specialized papers published in scientific journals, such as *Supply Chain Management*, *Journal of Supply Chain Management*, and academic publications of similar standing on the other side.

The learning approach of the book is based on a blend of theory and exercises. The theory discusses the structure and methodology that are needed to solve practical exercises. The problem-solving, in turn, highlights the value of a consistent theory. Most of the quantitative exercises in the book are presented and solved in spreadsheet format. Several models are discussed and worked out in detail, showing the scope and limits of the model. For mathematically interested readers, formal mathematical proofs have been subsumed in a digital mathematical appendix that will be posted on the book's corresponding website.

Supply Chain is a broad field that generates ever more scientific research and papers, each of which zooms in on increasingly specialized topics. It is therefore impossible to address the full range of subjects making up the field of Supply Chain and business operations, and the scope of the book had to be reduced by making choices. The selection of topics I have pursued offers a coherent general picture of the main fields in Supply Chains, whereby quantitative models are preceded by qualitative descriptions, sometimes taken from real-world situations.

No textbook on Supply Chains in the 21st century would be complete without a chapter about revenue management, and this book is no exception. A final chapter is dedicated to the alignment and coordination of individual Corporate Social Responsibility policies of firms working together in a Supply Chain to create a shared Supply Chain CSR and sustainable Supply Chain policy.

## The aim of this textbook

---

Besides the topicality of global Supply Chains in the 21st century, a field that overlaps with the realm of many business jobs, including financial, accounting, and IT, many textbooks about supply chain and business operations management are either predominantly descriptive or qualitative in their approach, or they are highly quantitative with a focus on mathematical modelling. This book aims to fill a gap and take an intermediate stance between the two approaches.

Another reason for writing this book is that many textbooks are based on US Supply Chain examples, while the number of books with a European perspective is limited. Although the differences in abstract Supply Chain models are small and globally applicable, the institutional framework for companies and Supply Chains working in the United States and Europe are different. Case descriptions and illustrative examples are therefore taken primarily from European institutions and companies.

The book will include some topics that are not commonly found in supply chain textbooks: a description and analysis of infrastructure assets and their impact on logistics operations, and the increasing problem of congestion occurring at all levels in a Supply Chain using basic concepts of queueing theory in distribution planning.

Quantitative problems for each chapter will be posted on the book's corresponding website. The problem set will be expanded over time and adjusted when necessary. The quantitative exercises can be solved with MS Excel and its mathematical and statistical function library as well as the Add-in Solver.

For instructors who prescribe the book for their course, the Excel files with the examples shown as screenshots in the book will be made available. They will also have access to most standard solutions to the questions and problems.

All endnotes at the end of each chapter, containing references as well as more details, extensions, and some entertaining anecdotes about specific subjects and important players in the field of Operations Management, have been consolidated in a separate instructor's manual. That manual will be made available for instructors who prescribe the book for their students.

The author welcomes suggestions from instructors and users that can improve the quality of a future edition of the book.



# Chapter distribution and learning objectives

The last column indicates whether the learning objective is solely discussed in descriptive terms (D) or supported by quantitative models (Q) and/or in Excel format (Ex)

## Chapter 1. Introduction to Supply Chains

### Learning objectives chapter 1

After having studied chapter 1, the student will be able to explain:

- The fast growth of global Supply Chains and value chains in the 21st century D
- Fundamental structures and pyramidal base models of Supply Chains of mass consumer goods D
- The pivotal role of Customer Response Time in Supply Chain problems D
- Classification of production processes and the growth of mass customization D
- The asset flows in a Supply Chain and their mutual relationship D
- The different layers and nodes in a Supply Chain network D
- The bullwhip effect and the streamlining of order flow in a Supply Chain D
- The digitalization of the economy and its impact on distribution systems D

## Chapter 2. Demand Forecasting

### Learning objectives chapter 2

After having studied chapter 2, the student will be able to explain:

- The added value of collaborative demand for the performance of a Supply Chain D
- The difference between qualitative and quantitative forecasting methods D
- The structural and random components of a forecasting model D
- The centred moving average forecasting model Q/Ex
- Forecasting with linear regression and binary variables Q/Ex
- The Holt-Winter forecasting model Q/Ex
- When and which forecasting model is appropriate for which data structure D

### Chapter 3. Capacity planning and location decisions

#### Learning objectives chapter 3

After having studied chapter 3, the student will be able to explain:

- The different capacity concepts for organizations and their relevant cost components D
- The relation between capacity planning and production planning D
- The decision tree as a decision support tool for capacity investments Q
- Optimization models for integrated capacity and distribution planning Q/Ex
- Qualitative factors for the selection of a location for new capacity D
- Gravitation model for finding an optimal geographical location for capacity Q/Ex
- The Hotelling model explains the geographical concentration of competing retailers D

### Chapter 4. Production planning

#### Learning objectives chapter 4

After having studied chapter 4, the student will be able to explain:

- The interrelation between products, production processes, and production planning D
- How one product can be produced by different combinations of production factors D
- Some common levers to match production to demand: inventory; overtime; and subcontracting Q
- Basic models for production planning at the lowest cost in spreadsheet format Q/Ex
- The Bill of Materials and Enterprise Resource Planning D

### Chapter 5. Inventory policy under certainty conditions

#### Learning objectives chapter 5

After having studied chapter 5, the student will be able to explain:

- Classification of different inventory assets in relation to production and sales D
- Classification of costs associated with keeping inventory D
- The Economic Order Quantity base model and the reorder point in an inventory cycle Q/Ex
- The EOQ model with marginal units and with all-units quantity discounts Q/Ex
- The minimalization of inventory cost with a coordinated inventory policy in a Supply Chain Q/Ex
- The impact of joint orders on total inventory costs Q/Ex

**Chapter 6. Inventory policy under uncertainty****Learning objectives chapter 6**

After having studied chapter 6, the student will be able to explain:

- The relation between the Cycle Service Level and the fill rate to benchmark inventory policy Q/Ex
- The calculation of safety stock when demand follows a normal distribution and lead time is constant Q/Ex
- The calculation of safety stock when both demand and lead time follow a normal distribution Q/Ex
- The impact of centralization of inventory on the total inventory costs Q/Ex

**Chapter 7. Procurement, inventory risk-sharing, and the Cycle Service Level****Learning objectives chapter 7**

After having studied chapter 7, the student will be able to explain:

- Cost of understocking and overstocking and the optimal Cycle Service Level Q/Ex
- The main components of procurement policy in private companies D
- The main components of public tenders for procurement by public agencies in the EU D
- The concept of Total Cost of Ownership D
- Supplier selection and negotiation strategies for procurement D
- Instruments for risk-sharing between producer and retailer: buyback contracts, revenue sharing contracts and quantity flexibility contracts Q/Ex

**Chapter 8. Asset Mobility and Infrastructure****Learning objectives chapter 8**

After having studied chapter 8, the student will be able to explain:

- The main asset flows in a Supply Chain: goods, persons, information, and financial flows D
- The trade-off between inventory and logistics D
- The relation between transportation modes, infrastructure, and Customer Response Time D
- The five major transportation modes for goods: water, road, rail, air, and pipeline, with main cost components and travel time D
- Institutional features of infrastructure assets for different transportation modes D
- Travel modes for persons in a service Supply Chain D
- Information flows and data traffic in a Supply Chain with its supporting infrastructure D

- The impact of congestion on infrastructure assets on lead time and logistical performance D
- The distribution configuration for the last-mile delivery D

**Chapter 9.** Optimization of transportation and distribution planning in networks

**Learning objectives chapter 9**

After having studied chapter 9, the student will be able to explain

- The network patterns of infrastructure assets and their impact on distribution and logistics planning D
- The use of the shortest-path algorithm and the travelling salesman for logistics planning Q/Ex
- Various distribution configurations from supplier to business customers D
- Typical features of distribution configurations for online and offline consumer purchases D

**Chapter 10.** Revenue Management and Capacity Usage

**Learning objectives chapter 10**

After having studied chapter 10, the student will be able to explain

- How dynamic pricing can improve the occupancy rate of capacity Q/Ex
- How an overbooking policy with uncertain demand can lead to improved capacity utilization D
- How to calculate the optimal number of overbookings when demand is normally distributed Q/Ex
- How vertical price agreements in a distribution chain affect the reseller's price Q/Ex
- The pivotal role for the price-reaction curve in the determination of the optimal retailer's price Q/Ex

**Chapter 11.** Queueing Management in a Supply Chains

**Learning objectives chapter 11**

After having studied chapter 11, the student will be able to explain

- How queueing theory helps to understand and model delays in a Supply Chain D
- How delays are an element of the broader phenomenon of risk propagation (chain reactions) in a Supply Chain D
- The economic and psychological aspects of waiting lines D
- Different queueing disciplines in a waiting line D

- The role of the Poisson distribution and Exponential distribution for waiting line management Q/Ex
- The determination of structural parameters to benchmark waiting lines Q/Ex
- A specific queueing model for a Supply Chain: Jackson networks D

## Chapter 12. Sustainability in Supply Chain

### Learning objectives chapter 12

After having studied chapter 12, the student will be able to explain:

- The main components of Sustainability and Corporate Social Responsibility D
- Complications to transform a sustainability policy of a single corporation into a sustainability policy of an entire Supply Chain D
- How Blockchain technology has the potential to advance sustainability in a Supply Chain D
- How a Supply Chain can be extended by integrating the after-sales phase D
- Drivers and management of consumer waste: an inverted Supply Chain pyramidal structure D
- Institutional dimensions of consumer waste management D
- **Case:** the global food supply chain: *the Tragedy of the Commons*, food waste and food loss and models for sustainable management of biological resources with the concepts of *carrying capacity* and *maximum sustainable yield* D/Q /Ex



# 1 An Introduction to Supply Chains in the 21st Century

## An introductory Supply Chain case: The evolution of the supermarket sector in the Netherlands

---

The food retail industry, with the supermarket chains as main players, is a good example of understanding the different dimensions of and relations within a Supply Chain. This sector can be characterized as a well-organized industry with a long-standing, highly competitive environment. Over the years, the Dutch food retail sector has experienced spells of merger waves and acquisitions. It has a well-developed logistics and distribution system, and is fertile ground for new marketing techniques. It is a major source of jobs in the Netherlands. It uses sophisticated inventory management systems, invests in IT, is expanding in the 21st century in online sales, and is endowed with many other features of modern businesses models.

Prior to World War II, most grocery stores were privately owned family businesses, ubiquitous in European cities and towns, and offering a limited product assortment that met the basic needs of their customers in the field of food and drinks. The inflow of food from outside the country was limited: no Chilean wine; no Italian Pasta; no Spanish jamón, although many spices arriving from colonial areas were sold in the grocery stores. Most stores had an loyal group of customers who belonged to their catchment area. Moreover, the store manager was close to the customer and able to detect consumer satisfaction with his products quickly. Most stores were supplied directly by food manufacturers without the physical interface of distribution centres. Already by the end of the nineteenth century, single grocery stores were starting to expand their assortment with meat, bread, vegetables, fruit, dairy products like milk and butter, spirits, and others. The enactment of the trademark law enabled entrepreneurs to run several stores under the same trademark, with a similar product assortment and store layout. One of the oldest food retailers with an established brand name in the Netherlands is Albert Heijn. Named after the Dutch entrepreneur who founded it, in Zaandam, in 1887, today it is the largest supermarket chain in the Netherlands and is currently part of the Ahold-Delhaize concern.

A typical innovation introduced by supermarkets was self-service. Customers could walk freely through the store space, mostly arranged in aisles, and pick the food and household items they needed from the shelves, depositing and moving them in a shopping trolley. In the old service system, the customer

waited in front of a counter and asked the shop assistant to pick the items from the shelves. In a modern supermarket layout, the checkouts are located close to the store exit.

Especially after the creation of the European Economic Community, on 1 January 1958, a new flow of foreign food entered the assortment of Dutch supermarkets; at the same time, Dutch supermarkets opened new stores abroad. The assortment expanded with a large portfolio of foreign food, including Italian pasta and Greek produce, thus the creation of the single European market resulted in a boost to foreign products penetrating the Dutch food market.

In the 1980s, two large German supermarket chains entered the Dutch food retail market: Lidl and Aldi. The last two decades of the 20th century saw a wave of acquisitions. Many familiar brand names, such as Konmar, De Boer, Edah, Bas van der Heiden, and more than 40 other brand names, disappeared from the supermarket landscape as they were consolidated, integrated, reorganized, or absorbed in other larger food retail chains. Achieving economies of scale to withstand the competition was a driving force. At the same time, supermarkets continued to expand their supply thereby outcompeting smaller, more specialized food shops: the supermarket added vegetables and fruit sections, displacing many independent greengrocers in the process (430↓ between 2008 and 2017, according to CBS 2018 Statline). They added meat sections, outcompeting many small independent butcher shops (405↓ between 2008 and 2017, according to Statline), and sections of bread and other cereal products, taking custom from many small independent bakeries (10↓ between 2008 and 2017, according to CBS 2018 Statline), as well as sections of dairy products. Despite this, the number of stand-alone specialized cheese shops actually increased, reaching 100 stores between 2008 and 2017 (CBS 2018 Statline). Specialized liquor stores fared less well, with many customers now shopping in the supermarkets' dedicated alcoholic drinks aisles (110↓ between 2008 and 2017, according to CBS 2018 Statline).

The 21st century has seen an increase in the number of foreign supermarkets establishing themselves in the Netherlands. There are now, for example, more than 75 Polish supermarkets, a growing number of Asian supermarkets – so-called tokos – and rising numbers of Turkish supermarkets as well as supermarkets from other countries. Each has its own assortment of national and local dishes and food. All supply is organized under a single roof, saving shopping time for consumers who no longer need to walk from one small shop to the next one.

Another typical feature of supermarkets is the supply and replenishment of store locations – often on a daily basis (especially fresh food). The twenty-first century saw a growth in the establishment of new distribution centres (DC) or the expansion of existing DCs. They are spread throughout the Netherlands to

optimize the distribution network and use state-of-the-art Information Technology and robotization for handling the movement of goods within the DC (intrafacility). Simultaneously, lorries designed with customized layouts, like cooling systems, were introduced so that the goods could be transported from the DCs to individual retail locations.

Focusing on the Dutch supermarket landscape in 2017, according to data disclosed by the Dutch Central Bureau of Statistics (March 2018, CBS), there are approximately 6,000 supermarket stores offering direct employment for more than 300,000 people, and many more indirect jobs, such as accountants taking care of store administration, marketing, IT firms, and other companies whose major clients are supermarkets.

The Dutch supermarket sector entered the twenty-first century consolidated – with fewer food retail brand names – but with more brick-and-mortar stores (185↑ between 2008 and 2017, according to CBS 2018 Statline) operating under the same brand name than a couple of decades before. Adding non-food items to the store shelves, especially medicines, detergents, and personal care products, means the modern supermarket is closer to a hypermarket.

The table below shows a ranking for supermarket chains controlling more than 100 stores in the Netherlands in 2017. It is based on both the number of brick-and-mortar stores operating under the same or related trade name or label – an indicator that is more interesting for Supply Chain analysis than market share – and the number of distribution centres (DCs) supplying these stores.

Store Label	Parent/ owner company	Approximate # of stores	# of DCs & purchase organization
1. Albert Heijn	Ahold-Delhaize	971 stores (includes 81 AH to Go and 37 AH XL)	7 (online excluded & own procurement)
2. Jumbo	Jumbo Group Holding	626 stores	7 (own procurement)
3. Aldi	Siepmann (Süd) & Markus Foundation (Aldi Nord)	501 stores	9 (own procurement)
4. Lidl	Schwarz Gruppe	425 stores	7 (own procurement)
5. Plus	Sperwer Group	263 stores	6 SuperUnie
6. Spar	Sperwer Group / Sligro Food Group (<= 100%)	260 stores (other brand names like Attent included: 500)	1 (SuperUnie)
7. Coöp	Coöp Supermarkets	294 stores (including related brands)	2 (SuperUnie)
8. Dirk van den Broek	Detailresult Group	121 stores	1 SuperUnie

Data taken from: <http://www.distrifood.nl/formules>, corporate websites, and Wikipedia.

Supermarkets operate not only in a strongly competitive environment, but also within a tight institutional and regulatory framework. They are subject to European Union food directives and to national food safety laws, which include standards that ensure food does not compromise consumer health. Supermarkets are also subject to public regulatory laws and require, among other things, a municipal permit to open a store within a municipality's boundaries. Many Dutch municipalities have a spatial planning and zoning policy as well as a retail policy, which allows them to set limits and conditions on the number of supermarkets in specific city areas, and even to pursue a spatial spread of supermarkets where each store serves a particular catchment area. This regulation imposes limits on the number of retail locations within a city or town and also affects the competition within a city (intracity competition).

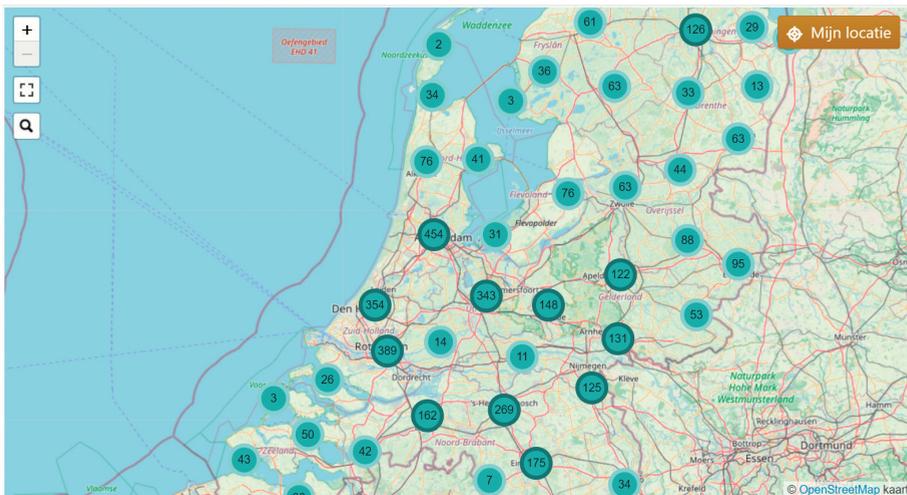
If a supermarket applies for a permit, local residents, as well as incumbent competitors in the geographical area of interest, can submit objections to the establishment of the newcomer. This can lead to a review of the proposed supermarket location by either the municipality or the supermarket itself.

Another feature of the organization of the food retail industry is the deployment of franchising. The franchisee running a supermarket under a well-recognized protected brand name is an entrepreneur. He or she bears most of the business risk of the supermarket using the franchised formula licenced by the franchiser. The franchisee pays a fee to the franchiser and must abide by the conditions set out in the franchise contract.

Generally, customers will not be able to distinguish from the appearance of the outside or inside of a store whether the supermarket is an affiliate (branch) owned and controlled by the parent company, or a franchised store run by an independent entrepreneur. There is an interesting issue, however, regarding competition in a franchising situation. According to European anti-trust regulations, vertical price restraints are not permitted, with some exceptions. The franchising company cannot force the franchisee store to sell products at a predetermined price, nor can it impose a minimum price. This means that, as an entrepreneur, the franchisee can deviate from the recommended consumer price issued by the franchising company. However, this prohibition on vertical price agreement does not apply to affiliate stores that are owned by the parent company. In that case, the parent company has more control over the price setting of the products sold.

Another remarkable feature shown in the table above is the sourcing or procurement organization: with the exception of the first four supermarkets in the table, the remaining chains are members of a purchasing cooperative called "SuperUnie". On behalf of its members, this cooperative negotiates prices and conditions with major food manufacturers, such as Friesland-Campina, Unilever, Coca-Cola, Heineken, etc. Combining purchasing power is a way to negotiate lower prices and get quantity discounts from the manufacturers and is an established part of their sourcing policy.

A last distinctive feature of the supermarket landscape is the rise of online sales in recent decades. The scope and size of online sales differ per supermarket chain. Albert Heijn has a fully rigged online organization with a website containing a detailed product database, digital payment facilities, a network of distribution centres dedicated to online sales, and is equipped with a fleet of vans for transportation to customer locations and managing other ingredients necessary for online sales. The last issue to address is the proximity of food retailers, mainly supermarkets, to their customers. The map below shows the density of supermarket locations in the Netherlands.



The map shows the situation in 2014. The greener the area the higher the density of supermarkets.

Not surprisingly, supermarkets follow customers. Major cities have the highest supermarket density while rural, sparsely populated areas, like the northern part of the Netherlands, have very few supermarkets. Supermarket sales remain heavily dependent on the physical proximity of the customers, although online sales are growing. Around 2017, the number of supermarkets in the Netherlands exceeded 6000 locations, approximately 1300 of which are concentrated in the four major cities and its agglomerations (Amsterdam, Rotterdam, The Hague, and Utrecht)

**Source:** <https://www.allesupermarkten.com/kaart/>

We conclude this industry case by expanding the scope and placing the Dutch food retail industry in a global perspective with comparative data to benchmark the Dutch supermarket industry against globally operating supermarket chains. However, it should be noted that such comparisons face the claim of comparing apples with pears. Let us therefore start with some conceptual terms. In English-speaking countries, a distinction is made between supermarkets, hypermarkets, and

convenience stores. These conceptual differences refer to the product assortment and the size of a store, expressed in the square metre floor space of its premises.

A **hypermarket** is generally larger in square meters than a supermarket and contains a bigger non-food section in the total product assortment – although this is not yet as diversified as department stores like HEMA. Many hypermarkets – and this they have in common with the extra-large supermarkets (XL) – are located in city fringes provided with car parking facilities.

A **convenience store** is generally smaller than the other two and focuses on quick purchases by consumers who have no time to do extensive shopping. These stores also serve to remedy unexpected shortages, e.g. when a family discovers in the evening they have run out of coffee. Convenience stores generally have smaller product assortments – often also fast food and snacks, but also non-food items – than super- and hypermarkets, have longer opening times during the evening (and sometimes nocturnal opening times), and are located in (densely) populated areas: the customer must be able to reach the store in a relatively short time. Their products are often slightly higher priced than the same product sold in hyper- and supermarkets. Taking this classification into account, the approximate global ranking in terms of the number of locations (stores) is displayed below:

<b>CBA</b>	Hungarian-based supermarket chain owning around <b>5200 stores</b> . One of the largest in Central and Eastern Europe.
<b>BIM</b>	BIM is a Turkish retail company with operations mainly in Turkey. It has <b>over 8255 locations</b> in several countries
<b>Ahold Delhaize NV</b>	Overall, the company has <b>6556 stores</b> in 11 countries. The merger with Belgian Delhaize in 2016 added approximately 3400 stores worldwide
<b>Tesco plc</b>	This UK-based company has nearly <b>6970 stores</b> worldwide. It employs some 460.000 people and is one of the UK's top employers.
<b>Lidl</b> Owned by Schwarz Gruppe	Lidl headquartered in Germany operates <b>more than 11,000 stores</b> in Europe and has recently expanded to the US.
<b>Aldi</b> Owned by Siepmann (Aldi Süd) and Markus Foundation (Aldi Nord)	Aldi is the other large German discount supermarket chain and has approximately <b>12,400 stores</b> in 18 countries.
<b>5. Carrefour</b>	French multinational retailer Carrefour owns supermarkets, hypermarkets, and convenience stores across the world, with operations in more than 30 countries. The company has nearly <b>12,225 locations</b> .
<b>3. Wal-Mart</b> Walton Family owns 51% of the Wal-Mart shares	Wal-Mart Stores (United States) employs 2.3 million people, which makes it the largest private employer in the world. It operates hypermarkets, discount department stores, and grocery stores in 28 countries and has around <b>11,500 locations</b> .

<p><b>2. SPAR</b></p>	<p>SPAR has around <b>13,110 locations</b> in 42 countries. This <b>Dutch</b> multinational operates stores of different types, divided in sub-brands. It has hypermarkets under the <i>Interspar</i> name, mid-sized supermarkets under <i>Eurospar/Superspar</i>, and small stores called Spar Express, designed for gasoline stations and small sites like university campuses.</p>
<p><b>1. 7-Eleven</b> owned by the <b>Japanese</b> company Seven &amp; I Holdings Co</p>	<p>7-Eleven is the largest convenience chain in the world with over <b>71,100</b> locations in 18 countries. Most locations are in East Asia.</p>

Data taken mainly from [https://en.wikipedia.org/wiki/List\\_of\\_supermarket\\_chains#Multinational](https://en.wikipedia.org/wiki/List_of_supermarket_chains#Multinational) retrieved on January 4 of 2022.

As described above, the food retailer's industry shows some features that are not only typical for the food retail industry, but which also touch basic Supply Chain features and management of firms operating in other industries. Some of these common features are:

1. Location decisions and institutional constraints on establishing stores and distribution centres
2. Inventory Management
3. Logistics and distribution network: modes of transportation for moving goods from DC to store or the customer in case of online sales.
4. Vertical pricing policy: price coordination between the manufacturer, retailer, and between a franchiser and its franchisees
5. Sourcing or procurement policy

Each of these issues will be discussed in more detail in theory and practice in one or more chapters of this book.

## The importance of global Supply Chains (SC) has grown rapidly due to globalization

---

The creation of a common market in Europe, with the establishment of the European Economic Community on the 1 January 1956, has not only promoted global free trade agreements, it has also given a boost to a persistent upward trend in the trade of goods and services between many countries of the world. Economies that were historically disconnected from each other have established step-by-step economic and trade connections, whereby the world economy, and especially the European Union, are now configured as a densely interconnected network of economic relations without precedence in history. Many unexplored countries, which, for centuries were mainly the working grounds for missionaries and, under colonial