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Dmitry Ivanov • Alexander Tsipoulanidis •
Jörn Schönberger

Global Supply Chain and Operations Management

A Decision-Oriented Introduction to the Creation of Value

Second Edition

Springer

Dmitry Ivanov
Department of Business Administration
Berlin School of Economics and Law
Berlin, Germany

Alexander Tsipoulanidis
Department of Business Administration
Berlin School of Economics and Law
Berlin, Germany

Jörn Schönberger
Faculty of Transportation
and Traffic Science "Friedrich List"
Technical University of Dresden
Dresden, Germany

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Dmitry Ivanov
To my parents who inspired the dreams and without whom this book would have never been completed
To my wife who makes the dreams come true inspiring with love and smile and without whom this book would have been completed much earlier
To my children: get inspired and climb, reach the peak, enjoy, stay inspired

Alexander Tsipoulanidis
To my family:
Joanna, Marina, Irini, Ursula, and Reimar
I love you all!
To my father:
Ioannis (1934–2002) - I miss you!

Jörn Schönberger
For my family:
Maybe this book explains what I'm doing in the lecture hall ...

Preface

About This Book

In everyday life, all of us take supply chain and operations management (SCOM) decisions. If you move to a new flat, location planning is first necessary. Second, you need a plan of how to design the overall process. This includes capacity planning, transportation planning, and human resource planning. You also need to replenish some items and do procurement planning. Finally, a detailed schedule for the day of the move is needed.

Similarly, building a new house involves many SCOM decisions. Again, it starts with location selection. If you decide to coordinate the overall process by yourself, it is necessary to coordinate the entire supply chain of different manufacturers and workmen. In turn, they need the detailed data of your plans and forecasted data to plan their own process and sourcing activities. In order to avoid traffic jams at the building site, detailed coordination at the vehicle routing level is needed.

SCOM belongs to the most exciting management areas. These functionalities are tangible and in high demand in all industries and services. This study book intends to provide both the introduction to and advanced knowledge in the SCOM field. Providing readers with a working knowledge of SCOM, this textbook can be used in core, special, and advanced classes. Therefore, the book is targeted at a broad range of students and professionals involved in SCOM.

Special focus is directed at bridging theory and practice. Since managers use both quantitative and qualitative methods in making their decisions, the book follows these practical knowledge requirements. Decision-oriented and method-oriented perspectives determine the philosophy of the book. In addition, because of the extensive use of information technology and optimization techniques in SCOM, we pay particular attention to this aspect.

Next, a strong global focus with more than 80 up-to-date cases and practical examples from all over the world is a distinguishing feature of this textbook. The case studies encompass different industries and services and consider examples of successful and failed SCOM practices in Europe, America, Asia, Africa, and Australia.

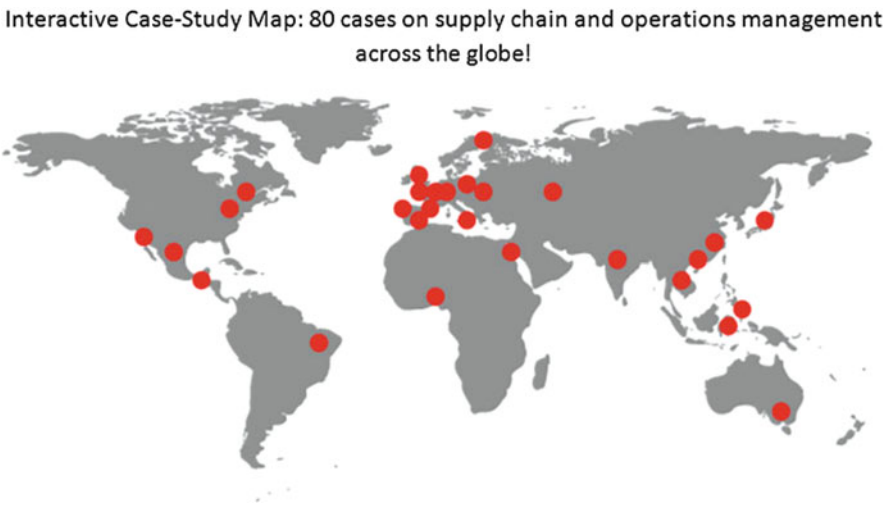

Fig. 1 Interactive case-study map in the e-supplement

Finally, following the expectations of modern students and our teaching experiences in SCOM over the past 15 years, we divided this textbook into a hardback and an electronic supplement. In the hardback, basic theoretical concepts, case studies, applications, and numerical examples are explained. The e-supplement supports the hardback and provides students and teachers with additional case studies, video streams, numerical tasks, Excel files, slides, and solutions (see Fig. 1).

The e-supplement of this book can be accessed via the URL www.global-supply-chain-management.de without further registration. For course instructors, a special area is set up that contains further material. The e-supplement is updated with additional topics, exercises, and cases.

This second edition of our textbook consists of 17 chapters divided into four parts:

Part I Introduction to Supply Chain and Operations Management

- Chapter 1 Basics of Supply Chain and Operations Management
- Chapter 2 Examples from Different Industries, Services, and Continents
- Chapter 3 Processes, Systems, and Models

Part II Designing Operations and Supply Network: Strategic Perspective

- Chapter 4 Supply Chain Strategy
- Chapter 5 Sourcing Strategy
- Chapter 6 Production Strategy
- Chapter 7 Facility Location
- Chapter 8 Transportation and Distribution Network Design

- Chapter 9 Factory Planning and Process Design
- Chapter 10 Layout Planning

Part III Matching Demand and Supply: Tactical and Operative Planning

- Chapter 11 Demand Forecasting
- Chapter 12 Production and Material Requirements Planning
- Chapter 13 Inventory Management
- Chapter 14 Scheduling and Routing

Part IV Advanced Topics in Supply Chain and Operations Management

- Chapter 15 Supply Chain Risk Management and Resilience
- Chapter 16 Digital Supply Chain, Smart Operations, and Industry 4.0
- Chapter 17 Pricing and Revenue-Oriented Capacity Allocation

Each *chapter* contains the following elements:

- Introductory case study
- Learning objectives
- Theory with practical insights and case studies
- Tasks with example solutions
- Key points and outlook
- Additional tasks and case studies placed in e-supplement
- Further supplementary materials: online tutorial, Excel files, and videos.

Each chapter starts with an introductory case study. Subsequently, major decision areas and methods for decision support are handled. Finally, applications can be taught based on additional case studies and numerical tasks. The summary of key points and an outlook end each chapter. Throughout the book, practical insights are highlighted.

The second edition contains three new chapters: "Supply Chain Risk Management and Resilience," "Digital Supply Chain, Smart Operations, and Industry 4.0," and "Pricing and Revenue-Oriented Capacity Allocation." These new chapters provide structured knowledge on the principles, models, and technologies for managing supply chain risks and improving supply chain and operations performance with the help of digital technologies such as Industry 4.0, additive manufacturing, Internet of Things, advanced optimization methods, and predictive analytics. The existing chapters have been updated and new case studies have been included. In addition, the preface provides a guideline (Table 1) for instructors concerning how to select and structure the materials from this book for different courses in supply chain and operations management and with regard to different educational levels such as general undergraduate, specialized undergraduate, and graduate courses. The companion web site for this textbook www.global-supply-chain-management.de has been updated accordingly. In addition, the book is now supported by e-manuals

Table 1 Recommendations for instructors on course structuring at different teaching levels using this textbook

Undergraduate core course in Operations Management			
1, 4.2, 5.2, 7.4, 7.5, 8.6, 9, 10, 12.2, 12.6, 13.2–13.4, 14.3, and 14.5			
Undergraduate major courses in Supply Chain and Operations Management			
Sourcing and Production Management	*Distribution and Transportation Management*	*Supply Chain Management*	*Selected Topics in Supply Chain and Operations Management*
1.2.1, 4.2, 4.3.1, 4.3.2, 5, 6, 9.3–9.5, 11, 12.2–12.5, 13.2, 13.5–13.7, 14.5	7, 8, 11, 14.2–14.4	1.2.2, 3.3, 4.2–4.4, 5.3, 7.2, 7.4, 7.5, 8, 13.5–13.9	2, 3, 7.3, 16, 17
Graduate courses in Supply Chain and Operations Management			
Advanced Operations Management	*Global Supply Chain Management*	*International Logistics Management*	*Supply Chain and Operations Analysis*
2, 9.2, 9.5, 9.6, 16; 17 AnyLogic Handbook in E-Supplement; Case Studies in E-Supplement	2, 4.3, 4.4, 5.3, 11.3, 13.5, 13.6, 15; 16 anyLogistix Handbook in E-Supplement; Case Studies in E-Supplement	2, 8, 10, 16; Case Studies in E-Supplement	3.4, 7.3; AnyLogic and anyLogistix Handbooks in E-Supplement; LP and CWLP Excel Spreedsheet Templates in E-Supplement

for supply chain and operations simulation and optimization in AnyLogic and anyLogistix.

In addition, in the e-supplement, different additional materials can be found, which are highlighted in each chapter.

The advantage of using the e-supplement is that it offers the possibility of updating the case studies and adding additional materials more dynamically than producing new editions of the textbook. Another advantage is to be able to keep the hardback text short and concise. Finally, modern students are quite different from students who studied 20 years ago: they cannot imagine the study process without online resources.

Table 1 summarizes some recommendations for instructors concerning how to structure courses at different teaching levels using this textbook. This structure relies on the teaching concept in the bachelor's specialization "Supply Chain and Operations Management" and the master program "Global Supply Chain and Operations Management" at the Berlin School of Economics and Law.

The authors gratefully acknowledge all those who have helped us in bringing this book to publication. First and foremost, we have greatly benefited from the wealth of literature published on the subjects of SCOM and related topics. We thank Dr. Marina Ivanova for coauthoring Chap. 4 "Supply Chain Strategy" and Chap. 6 "Production Strategy." We would like to thank all our colleagues from the Berlin

School of Economics and Law and University of Bremen. The book has benefited immensely from their valuable insights, comments, and suggestions.

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Last but not least—we cordially thank our families who supported us enormously during our work on the book.

Berlin, Germany — Dmitry Ivanov
Berlin, Germany — Alexander Tsipoulanidis
Dresden, Germany — Jörn Schönberger
September 2018

Companion Web Site

This book is accompanied by a free Website www.global-supply-chain-management.de. On this Website, you will find a lot of up-to-date complementary material such as video streams, case studies, Excel spreadsheet templates, tasks and answers, figures from the book, and simulation games. This area will be extended continuously.

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About the Authors

Dmitry Ivanov is professor of supply chain management at the Berlin School of Economics and Law (HWR Berlin), member of Institute for Logistics at HWR Berlin, and director of the master program in Global Supply Chain and Operations Management at HWR Berlin.

He has been teaching classes for 20 years in operations management, production and supply management, supply chain management, logistics, management information systems, and strategic management at undergraduate, master's, PhD, and executive MBA levels at different universities worldwide in English, German, and Russian. He has given guest lectures, presented scholarly papers, and has been a visiting professor at numerous universities in Asia, Europe, and North America.

His research explores supply chain structural dynamics and control, with an emphasis on global supply chain design with disruption consideration, dynamic rescheduling, and supply chain risk analytics. He is coauthor of structural dynamics control methods for supply chain management. He applies mathematical programming, simulation, control, and fuzzy theoretic methods. Based upon triangle "process-model-technology," he investigates the dynamics of complex networks in production, logistics, and supply chains. Most of his courses and research focus on the interface of supply chain management, operations research, industrial engineering, and analytics.

His academic background includes industrial engineering, operations research, and applied control theory. He studied industrial engineering and production management in St. Petersburg and Chemnitz and graduated with distinction. He gained his PhD (Dr.rer.pol.), Doctor of Science (ScD), and Habilitation degrees in 2006 (TU Chemnitz), 2008 (FINEC St. Petersburg), and 2011 (TU Chemnitz), respectively. In 2005, he was awarded the German Chancellor Scholarship.

Prior to becoming an academic, he was mainly engaged in industry and consulting, especially for process optimization in manufacturing and logistics and ERP systems. His practical expertise includes numerous projects on the application of operations research and process optimization methods for operations design, logistics, scheduling, and supply chain optimization. Prior to joining the Berlin School of Economics and Law, he was professor and acting chair of Operations Management at the University of Hamburg.

He is the (co)-author of more than 300 publications, including three textbooks and monographs *Structural Dynamics and Resilience in Supply Chain Risk Management* and *Adaptive Supply Chain Management* published with Springer. Professor Ivanov's research has been published in various academic journals, including *Annals of Operations Research*, *Annual Reviews in Control, Computers and Industrial Engineering*, *European Journal of Operational Research*, *IEEE Transactions on Engineering Management*, *International Journal of Production Research*, *International Journal of Production Economics*, *International Journal of Technology Management*, *International Journal of Systems Science*, *Journal of Scheduling, Omega—International Journal of Management Science* and *Transportation Research: Part E*.

He has been guest editor of special issues in different journals, including the *Annals of Operations Research*, *International Journal of Production Research*, *International Transactions on Operations Research*, and the *International Journal of Integrated Supply Management*. He co-edits the *International Journal of Integrated Supply Management*. He is an associate editor of the *International Journal of Systems Science* and Editorial Board member of several international and national journals, e.g., the *International Journal of Systems Science: Operations and Logistics* and the *International Journal of Inventory Research*. He is Chairman of IFAC TC 5.2 "Manufacturing Modelling for Management and Control" and Co-Chairman of the IFAC TC 5.2 Working group "Supply Network Engineering." He has been member of numerous associations, including Production and Operations Management Society (POMS), Council of Supply Chain Management Professionals (CSCMP), the German Academic Association for Business Research (VHB), and the German Operations Research Society (GOR).

He has regularly presented his research results and has been co-chairman and IPC member of many international conferences where he has organized numerous tracks and sessions (including IFAC MIM, INCOM, EURO, INFORMS, POMS, IFORS, OR, IFAC World Congress, IFIP PRO-VE).

His personal homepage is blog.hwr-berlin.de/Ivanov

Alexander Tsipoulanidis, MBA is professor of supply chain and operations management at the Berlin School of Economics and Law (HWR Berlin) lecturing on supply chain and operations management in various programs leading to bachelor's, master's, or MBA degrees. Alexander is mechanical engineer and industrial engineer with a focus on factory, layout, and material flow planning. At the Engineering Faculty of the University of Bristol (UK), he proceeded with his doctorate (PhD) in which he explored the significant influence of Lean Engineering and product development as a part of the Lean Enterprise. He holds an MBA in strategic management from Anglia Ruskin University Cambridge (UK), where he concentrated on competitive strategies at times of global hyper-competition.

During a Federal Ministry of Education and Research (BMBF) project that was scientifically supported by the Institute for Machine Tools and Factory Management (IWF) of the TU Berlin and the Fraunhofer Institute for Material Flow and Logistics (IML) in Dortmund, Alexander contributed to the "Production 2000" project regarding assembly-controlled logistics and value-added network works (Entwicklung von montagegesteuerten, integrierten Logistik- und Wertschöpfungsketten; Rahmenkonzept

Produktion 2000 des Bundesministeriums für Bildung und Forschung) from a materials logistics perspective. As such, he developed practical solutions for process synchronization and performance improvements within a network of small series producers.

Alexander Tsipoulanidis has been working approximately 20 years for international enterprises (e.g., ABB, DaimlerChrysler, and Bombardier Transportation). There, he had different roles at various production sites, but also had executive positions at the global headquarters. His responsibilities have been related to capacity management of a European production network, planning of new factories, or the redesign of shop-floor layouts. Globally, he was conducting "Lean Operations Assessments" of production facilities, developed site continuous improvement plans, and implemented the related supply chain strategies. Furthermore, he defined lean and manufacturing-oriented product development processes and was involved in a restructuring initiative aiming to make the respective enterprise lean, efficient, attractive, and profitable.

His current research focuses on the fundamentals of Lean Thinking in combination with the usage of the Internet of Things/Machine to Machine (M2M) technology in various value-added domains. Recently, he has analyzed the development of lean and sustainable supply chain strategies in strong connection with the abovementioned technologies. Furthermore, the connection of Lean Thinking and Industry 4.0 has been researched, and respective publications have been issued. Thus, Alexander's primary research objective is to explore the generation of competitive advantage by utilizing the Internet of Things in order to sustain Supply Chain and Operational Excellence at times of digitalization.

Jörn Schönberger is professor of business management at the Technical University of Dresden. He positions the Chair of Transport Services and Logistics, as part of the Friedrich List Faculty of Transportation and Traffic Science. Prior to his current position, he was professor of operations and supply chain management at the Berlin School of Economics and Law (BSEL) and senior researcher at the University of Bremen. For several years, he was a guest professor at the University of Rennes 1 for IT and logistics. In 2010, he was a temporary professor (sine spe) of operations research and supply chain management at RWTH Aachen.

Jörn Schönberger was visiting professor at the University of Vienna and visiting researcher at Copenhagen Business School. In addition, he is/was involved in several academic programs on different study levels at the University of Bremen, Technical University of Berlin, RWTH Aachen, University of Vienna, University of Rennes 1, European Business School, FOM University of Applied Sciences, University of Applied Sciences Bremen, Hamburg Distance University of Applied Sciences, as well as University of Applied Sciences HIWL. Most of his courses address topics at the interface between engineering and business management.

His research interests comprise model-based optimization and control of complex logistics systems. Furthermore, he investigates the synchronization of information and material flows. Another research direction covers the dynamics of complex logistics systems. Based on methodologies from mathematics, operations research,

artificial intelligence, and information systems, he investigates applications from the fields of logistics, transportation, and traffic, manufacturing, and sports management.

Jörn Schönberger received a diploma in mathematics in 2000 and a PhD (2004) in business management from the University of Bremen. His doctoral thesis was awarded by the German Operations Research Society. He gained his Habilitation degree for business management also from the University of Bremen in 2010.

He is author of two monographs and three textbooks as well as editor of several books. He (co-)authored several journal papers and numerous other publications. He regularly presents his research results at international scientific meetings. His service to the scientific community comprises the organization of several conferences as well as his work as a regular reviewer for the Deutsche Forschungsgemeinschaft (German Research Foundation) and several scientific journals as well as conferences. Jörn Schönberger is member of several scientific communities like the German Academic Association for Business Research (VHB) and the German Operations Research Society (GOR).

Besides his academic career, he regularly works as a freelance consultant. He is/was involved in projects related to information management, information processing, database development and application, as well as process optimization.