

Contents

<i>Preface</i>	v
<i>About the Author</i>	vii
1. A Great Awakening	1
1.1 Introduction	1
1.2 World War II Aftermath	1
1.3 The Cold War and Its Impact on Global Supply Chains	4
1.4 Post-Cold War Era and Its Impact on Global Supply Chains	6
1.5 The Impact of COVID-19 on the Supply Chain . . .	7
1.5.1 Supply chain vulnerabilities exposed	8
1.5.2 Proposed solutions	9
1.5.3 The effects of COVID-19 on the supply chain are ongoing	10
1.6 The Russia–Ukraine War	10
1.7 Middle East Conflict	11
1.8 China’s Belt and Road Initiative	11
1.9 Cyber Threats	12
1.10 Conclusions	13
Bibliography	14

2.	Brief History of Supply Chain Management and Traditional Technologies	17
2.1	Introduction	17
2.2	Supply Chain Management — The Management of Flows	18
2.2.1	Effective information flow	18
2.2.2	Amazon example	19
2.2.3	Walmart example	19
2.2.4	Avoiding the bullwhip effect	20
2.2.5	Product flow in supply chain management	20
2.2.6	Financial flow in a supply chain	22
2.2.7	Case study — Boston Scientific's supply chain financing	23
2.3	Tools for Supply Chain Management and Execution	24
2.3.1	Warehouse management system (WMS)	25
2.3.2	Distributed order management (DOM) system	26
2.3.3	Transportation management	27
2.3.4	The three As for supply chain excellence	28
2.4	Logistics vs. Supply Chain Management	29
2.4.1	Characteristics of logistics	29
2.4.2	Military logistics	30
2.5	Notable Associations in SCM	30
2.6	Traditional Technologies in SCM and Logistics	31
2.6.1	Kanban	31
2.6.2	Implications of Kanban on the global supply chain	31
2.6.3	Case studies — Toyota and Spotify	32
2.6.4	Quick response in supply chain management	33
2.6.5	Total quality management (TQM) in supply chain	34
2.6.6	Total quality logistics (TQL)	35
2.6.7	Six Sigma in supply chain management	35

2.6.8	In supply chain management, Six Sigma is used in several ways	36
2.6.9	Case study — GE	36
2.6.10	Theory of constraints (TOC) in supply chain management	37
2.7	Transportation Nodes and Supply Chain Bottlenecks	38
2.7.1	Here are some reasons why bottlenecks may occur at transportation nodes	39
2.7.2	Port congestion in Long Beach and Los Angeles	40
2.8	Chapter Summary	41
	Bibliography	42
3.	Artificial Intelligence (AI) and Data Analytics (DA)	45
3.1	Introduction	45
3.2	Explanation of AI	46
3.2.1	AI timeline and evolution	46
3.2.2	The recent AI explosion	49
3.3	AI, Neural Networks, and Machine Learning — Definitions and Types	50
3.4	Neural Networks	54
3.4.1	How our brains work	55
3.4.2	Deep neural networks	60
3.4.3	How many connections are there in our digit example?	66
3.4.4	Backpropagation teaching the neural network to learn	66
3.4.5	Convolutional neural networks (CNNs)	67
3.4.6	Amazon use case — AI to optimize its supply chain	70
3.4.7	Alibaba cloud AI use case	71
3.5	AI, the COVID-19 Vaccine, and Supply Chains	71
3.5.1	Moderna AI use case	71
3.6	Natural Language Processing (NLP)	73
3.6.1	UPS chatbot use case	76
3.6.2	Ernest & Young use case	77

3.7	Business Analytics (BA), Data Analytics (DA), Business Intelligence (BI), and Big Data Analytics (BDA)	77
3.7.1	Business intelligence (BI)	78
3.7.2	Business analytics (BA)	79
3.7.3	Data analytics (DA)	80
3.7.4	In supply chain management (SCM), BI, DA, and BA play a critical role	80
3.7.5	Case study — United parcel services (UPS)	82
3.8	Chapter Summary	85
	Bibliography	85
4.	Convergence of Emerging Technologies with AI — IoT, Digital Twins, and Autonomous Vehicles	87
4.1	Introduction	87
4.2	Convergence of AI with the Internet of Things (IoT)	88
4.2.1	The Internet of Things (IoT)	88
4.2.2	Integrating artificial intelligence (AI) with the Internet of Things (IoT)	89
4.2.3	IoT and warehouse management	91
4.2.4	IoT and delivery services	93
4.3	Convergence of Digital Twins (DT), AI, and IoT . .	96
4.3.1	Evolution into a continuous learning model	97
4.3.2	Impact on logistics infrastructures	97
4.4	Digital Twins with AI and IoT in Supply Chain Management	101
4.4.1	Case study of Singapore port	102
4.4.2	Case study of Unilever	103
4.4.3	Case study of Kraft Heinz	104
4.4.4	Smart cities	105
4.4.5	Energy and utilities	106
4.4.6	Role of AI and digital twins in electrical grids	107

4.4.7	Examples of digital twins applied to electrical grids	108
4.4.8	City of Cordova, Alaska	109
4.4.9	Shell's offshore platform optimization	112
4.5	Healthcare Supply Chains	112
4.5.1	Technology integration — Human digital twins	113
4.5.2	Digital twin of the human heart	115
4.5.3	Personalized medicine introduces complexity into the healthcare supply chain	116
4.6	Autonomous Vehicles	117
4.6.1	Transportation — Autonomous vehicles	118
4.6.2	Autonomous vehicles provide business value	119
4.6.3	Key technologies driving autonomous vehicles	119
4.6.4	Examples of digital twins in the automotive sector	121
4.6.5	Autonomous vehicles in supply chain management	121
4.6.6	Options for autonomous self-driving trucks	123
4.6.7	The future of autonomous last-mile delivery	124
4.6.8	Fleets of autonomous vehicles and fleet management	125
4.6.9	Challenges of integrating autonomous vehicles into fleets (Collins, 2022)	126
4.6.10	The Rise of food delivery robots and drone delivery	127
4.6.11	The role of drones in the supply chain	128
4.6.12	FedEx drone delivery	129
4.6.13	Walgreens pioneers commercial drone delivery	130
4.6.14	UPS testing drone delivery	130
4.6.15	Amazon Prime Air drone	131

4.7	Chapter Summary	131
	Bibliography	132
5.	Robotics, Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) Impact the Supply Chain	135
5.1	Introduction	135
5.2	Robotics: Evolution and Innovation	135
5.2.1	Three laws of robotics	136
5.2.2	Historical milestones	136
5.2.3	2019: Self-repairing robots — A leap forward	137
5.2.4	Application in supply chain	138
5.3	Robotic Automation in Warehousing and Logistics	138
5.3.1	Amazon's innovations in robotics	139
5.3.2	Ocado — automated warehouse example	140
5.4	Integration of Robotics with Software Systems	141
5.4.1	Warehouse management systems (WMSs)	141
5.4.2	Benefits of integrating WMSs with AMRs	141
5.5	Fleet Management of Autonomous Mobile Robots (AMRs)	142
5.6	Robotic Process Automation (RPA)	143
5.6.1	Integrating AI into RPA	143
5.6.2	RPA use cases in supply chain	144
5.6.3	Additional robotics automation application — Robotics in construction	145
5.6.4	Doxel's construction automation	145
5.6.5	Doxel case study	146
5.7	Augmented, Virtual, and Mixed Reality	146
5.7.1	Definitions of and differences between AR, VR, and MR	147
5.7.2	How AR, VR, and MR can be used in supply chains and logistics	151
5.7.3	AR in warehouse operations and beyond	152
5.8	Wearables	154
5.8.1	Case study — BECHTLE	155
5.8.2	Case study — DHL	155
5.9	Summary	157
	Bibliography	158

6.	Securing Supply Chains from Vulnerabilities: Using Emerging Technologies Including Blockchain and Quantum Computing	161
6.1	Introduction	161
6.2	Cyberattacks and Cybersecurity	162
6.2.1	Some types and sources of cyberattacks . . .	162
6.2.2	Cybercriminals target the supply chain . . .	162
6.2.3	Types of cyberattacks on the supply chain . .	163
6.2.4	Case study — Third-party vendor attack of Target Corporation	163
6.2.5	Case study — SolarWinds's software supply chain attack	164
6.2.6	Phishing attack example	165
6.2.7	Cyber NotPetya virus	165
6.2.8	Case study of ransomware — Mondelez vs Zurich	166
6.2.9	Case study of ransomware — Pharmaceuticals company Merck	167
6.3	The Great Awakening: Protecting Against Cyberattacks	168
6.3.1	Role of AI and emerging technologies in protecting against cyberattacks	170
6.3.2	IBM software Q Radar	171
6.3.3	AI and emerging technology risks and challenges	172
6.4	Natural Disasters	172
6.4.1	Pandemics — COVID-19	175
6.4.2	Geopolitical influences	177
6.4.3	Electromagnetic pulse	177
6.4.4	Smaller electronics that do big things	179
6.5	Blockchain	180
6.5.1	Case study — Food supply chain by IBM and Walmart	184
6.5.2	Convergence of blockchain with AI — Benefits for supply chain	185
6.5.3	Healthcare	186
6.6	Quantum Computing	187
6.6.1	Types of quantum computing systems	189

6.6.2	Examples of applications for quantum computers	190
6.6.3	How will these systems change the way we approach cybersecurity?	191
6.7	Chapter Summary	192
	Bibliography	193
7.	The Way Forward	195
7.1	Introduction	195
7.2	The 4th Industrial Revolution	196
7.2.1	Impact on supply chain	198
7.3	Efficient Supply Chains Can Become Brittle	198
7.4	The Way Forward — Key Technologies and Strategies Shaping the Supply Chain	200
7.4.1	Technologies	201
7.4.2	Strategies	201
7.4.3	Sustainability and ethical concerns	202
7.4.4	Resilience and risk management	203
7.4.5	Methods to build resiliency and risk management	203
7.4.6	Moving supply chains	205
7.4.7	Digital twins for moving supply chains	206
7.4.8	A hybrid approach	207
7.5	Deglobalization — A Possible Direction for Global Supply Chains	207
7.5.1	Ongoing debate regarding deglobalization	209
7.5.2	Geopolitical and economic effects	209
7.6	Summary	210
	Bibliography	212
	<i>Index</i>	215