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Supply Chain Management 1982-2015: a review

Abstract

Organizations need to better design, manage, and improve their supply chains as these become global and more complex. To do this, they need to learn from other organizations and sectors, preempt problems before they occur, and understand the future challenges they may face. Although over 40,000 articles and books have been published on supply chain management since coining the term in 1982, a clear understanding of the emerging trends, current knowledge gaps, and potential areas for future development does not exist. Our bibliometric analysis of the existing literature suggests we still need to better understand how to manage security, insourcing, sustainability, competition, risk and disruption, and human behaviour within supply chains. Equally, there is still a lack of research within healthcare, disaster and humanitarian supply chains, as well as within small and medium enterprises.

Keywords: supply chain management; research; surveys; bibliometrics.

1. Introduction

The term ‘supply chain’ (SC) was first coined in 1982 by Oliver and Webber, two professional consultants, who described it as a “network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer” (Christopher, 2005; Stadtler and Kilger, 2011). Since then, many researchers have tried to understand and explain how organizations should integrate activities across their chain and coordinate the flow of material, information and money to better support market needs and improve the overall competitiveness of the chain (Stadtler and Kilger, 2011; Hill and Hill, 2012). However, a clear understanding of the emerging trends, gaps within our existing knowledge and potential future developments does not exist.

Previous supply chain management (SCM) literature reviews and surveys (see Table 1 for a selection) tend to look at just one aspect of SCM (such as information sharing, inventory management, network design, or SC integration) and a narrow range of academic journals. As a result, some topics and industries have not been explored even though they become more relevant as different business environments, practices, and challenges emerge. Creating a unified overview of SCM trends, gaps and future developments is a worthwhile, but challenging task as the SCM

literature comprises over 40,000 journal articles and books on a diverse range of topics with a vast number of research methodologies. Therefore, this paper looks at all the SCM books and journal articles published over 1982-2015 to identify a set of guidelines for SCM academics and professionals to help them focus their research and practice on the most significant issues and areas in the future.

Table 1. A selection of supply chain literature reviews and surveys (1997-2015)

Subject(s)	Reference(s)
Global supply chain	Vidai and Goetschalckx (1997) Meixell and Gargeya (2005) Hammami <i>et al.</i> (2008) Zeng <i>et al.</i> (2012)
Supply chain management in different countries	Pyke <i>et al.</i> (2000) Lorentz and Hilmolla (2008) Tyagi and Agarwal (2014)
E-supply chain management	Johnson and Whang (2002) Zou and Seo (2006) Alvarez-Rodríguez <i>et al.</i> (2014)
RFID and supply chains	Coyle (2003) Garfinkel <i>et al.</i> (2005) Juels (2006) Mehrerdi (2008) Kumar <i>et al.</i> (2009) Sarac <i>et al.</i> (2010) Peppas <i>et al.</i> (2013)
Information sharing in supply chain	Huang <i>et al.</i> (2003) Zhonghua and Ling (2013)
Third party logistics	Selviaridis and Spring (2007) Marasco (2008) Aguezoul (2014)
Vendor managed inventory	Tyan and Wee (2003) Marquès <i>et al.</i> (2010) Govindan (2013)
Supply chain integration	Nurmilaakso and Kotinurmi (2004) Power (2005) van der Vaart and Dong (2008) Chen (2010) Melnyk <i>et al.</i> (2014) Tyagi and Agarwal (2014) Cao <i>et al.</i> (2015)
Production planning and scheduling in supply chain	Kreipl and Pinedo (2004) Sahin <i>et al.</i> (2013) Pahl and Voß (2014) Panahifar <i>et al.</i> (2015) Pereira and Costa (2015)
Simulation in supply chain	Terzi and Cavalieri (2004)
Supply chain networks	Mills <i>et al.</i> (2004) Melo <i>et al.</i> (2009) Eskandarpour <i>et al.</i> (2015)
Supply chain architecture	Walker (2005) Melnyk <i>et al.</i> (2014)
Supply chain management in different industries	Miles and Breen (2005) Mondragon <i>et al.</i> (2006) Ahumada and Villalobos (2009) González-Benitoa <i>et al.</i> (2013) Denham <i>et al.</i> (2015)

Subject(s)	Reference(s)
	Sel and Bilgen (2015)
Customer satisfaction in supply chain	Kocakoc and Sen (2006)
General review on supply chain management	Croom <i>et al.</i> (2000) Rungtusanatham <i>et al.</i> (2003) Sachan and Datta (2005) Kouvelis <i>et al.</i> (2006) Gupta <i>et al.</i> (2006) Burgess <i>et al.</i> (2006) Storey <i>et al.</i> (2006) Giunipero <i>et al.</i> (2006) Alfalla-Luque and Medina-López (2009) Daugherty (2011) Seuring and Gold (2012)
Supply chain communication systems	Cutting–Decelle <i>et al.</i> (2006)
Supply chain performance	Huan <i>et al.</i> (2004) Chan <i>et al.</i> (2006) Shepherd and Günter (2006) Gunasekaran and Kobu (2007) Wong and Wong (2008) Akyuz and Erkan (2010) Ntabe <i>et al.</i> (2015)
Supply chain dynamics	Geary <i>et al.</i> (2006) Fayezi <i>et al.</i> (2012)
Flexibility in supply chains	Stevenson and Spring (2007) More and Babu (2009) Fatemi (2010) Seebacher and Winkler (2013) Esmailikia <i>et al.</i> (2014)
Sustainable supply chain management	Fleischmann <i>et al.</i> (1997) Browne <i>et al.</i> (2005) Meade <i>et al.</i> (2007) Srivastava (2007) Carter and Rogers (2008) Seuring and Müller (2008) Bekkering (2010) Ilgin and Gupta (2010) Carter and Easton (2011) Sarkis <i>et al.</i> (2011) Gimenez and Tachizawa (2012) Abbasi and Nilsson (2012) Ashby <i>et al.</i> (2012) Morgan and Gagnon (2013) Lin <i>et al.</i> (2014) Stindt and Sahamie (2014) Eskandarpour <i>et al.</i> (2015) Fahiminia <i>et al.</i> (2015) Ntabe <i>et al.</i> (2015)
Humanitarian/disaster logistics	Apte (2009)
Supply chain management technology (Information/Logistics/Operations)	Boone <i>et al.</i> (2007) Jede and Teuteberg (2015)
Supply chain optimization	Hassini (2008)
Supply chain in crisis	Tang (2006)
Supply chain security	Khan and Burnes (2007)
Supply chain risk/uncertainty	Williams <i>et al.</i> (2008) Rao and Goldsby (2009) Natarajarathinam <i>et al.</i> (2009) Hintsä <i>et al.</i> (2009) Olson and Wu (2010) Tang and Musa (2011)

Subject(s)	Reference(s)
	Colicchia and Strozzi (2012) Simangunsong <i>et al.</i> (2012) Sodhi <i>et al.</i> (2012) Ho <i>et al.</i> (2015)
Soft computing in supply chain management Complexity of supply chain	Ko <i>et al.</i> (2010) Wang and Fu (2010)

The first section of the paper describes the methodology and scope of the research. Trends in the content of the SCM over the last thirty years are then analysed by looking at the content of SCM textbooks published, the topics covered within peer-reviewed academic journals, popular quantitative tools and management techniques used in SCM studies, and types of industries that have been investigated. Gaps within the literature and research to date are identified to help propose future trends and identify future research directions. Finally, the conclusions and limitations of the research are discussed.

2. Research Methodology and Scope

In this study, we use bibliometrics as the foundation of our research methodology. In this method, quantitative and statistical measures are used to analyze the literature and create a better systematic understanding of literature (OECD, 2002). This method has already been applied for quantitative literature reviews of the SCM areas (e.g., see González-Benito *et al.* (2013) for a review of SCM in automotive industry and see Fahiminia *et al.* (2015) for a review of green SCM). Consequently, this study would differ from similar studies, because our study aims to create a comprehensive overview of the whole SCM field using quantitative data, while previous study usually pertains to only a specific area within SCM.

In this study, online databases were used to identify textbooks and journal papers with the keyword ‘SCM’ or ‘supply chain’ or ‘supply chains’ in their title, abstract or keywords. We found that Google Scholar and the Web of Science (ISI database) had the most comprehensive sources of citations with the Web of Science focusing on a selected number of journals and conference proceedings whilst Google Scholar includes a wider range of journals, books, conference proceedings, theses, dissertations, technical reports, handbooks and library guides (Mingersm 2009). However, SCOPUS offered greater flexibility when searching for specific words or phrases within document abstracts and keywords. Therefore, all three databases were used in our research, which is consistent with other studies such as Saad (2006) and Meho and Yang (2007).

Table 2 shows the types of documents that we identified. Given the objectives of this paper, we chose to focus on peer-reviewed journal articles (54.95% of the documents) and books (0.41% of the documents) published between 1982 and 2015 (relevant data retrieved on January 25, 2016). As

such, it ignores other publications such as conference papers and technical reports and books. It also focuses on articles and books published in English, which represents 94.5% of the documents published to date.

3. SCM Textbooks

Textbooks are a good starting point for academics or practitioners wishing to learn about SCM whilst journal articles tend to be more useful for those wishing to research or apply a particular technique within a certain context.

Table 2. Type of SCM documents published as a percent of total (1982-2015)

Document Type	# Papers	%
Article	37920	54.95
Conference Paper	22474	32.57
Review	3408	4.94
Book Chapter	1806	2.62
Short Survey	917	1.33
Note	855	1.24
Conference Review	743	1.08
Editorial	362	0.52
Book	283	0.41
Business Article	85	0.12
Erratum	59	0.09
Letter	28	0.04
Abstract Report	9	0.01
Report	6	0.01
Undefined	54	0.08

3.1. Popular textbooks

Google Scholar (scholar.google.com) is the only one of our three databases that includes textbooks. A search on January 25, 2016 identified a list of top 10 most-cited SCM textbooks via Google Scholar as shown in Table 3. It should be noted that these figures are the total number of citations for all the editions of a book if that book had more than one edition.

Next leading SCM textbook publishers were also contacted (including Pearson and Cengage) to help identify which textbooks seem to be having an impact both in terms of sales and lecturer adoption as the core text for their modules. The four identified textbooks are Lysons and Farrington (2006), van Weele (2010), Christopher (2011), and Monczka et al. (2015).

3.2 Content of popular textbooks

Table 4 compares the content of the popular SCM textbooks identified in Section 3.1. This table shows that classical topics such as SCM strategies, performance measurement, network design,

inventory management, procurement and purchasing, supply and demand planning, supplier relationship management, global SCM, and product design are covered in most textbooks. However, some advanced and relatively newer topics such as SC risk management, sustainability, and pricing and revenue management are treated less frequently. In addition, some important topics such as competition and applications of SCM in non-commercial environments (such as humanitarian and military logistics) are not covered in any of the popular textbooks.

Table 3. Top 10 most cited SCM textbooks

Author(s)	Title	Year Published	# Citations
Chopra and Meindl	Supply Chain Management: Strategy, Planning & Operation	2012	5498
M. Christopher	Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Services	1992	5013
Simchi-Levi, Kaminsky, and Simchi-Levi	Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies (3 rd ed.)	2008	4449
Handfield and Nichols	Introduction to Supply Chain Management	1999	2175
Christopher	Logistics and Supply Chain Management: Creating Value-Added Networks	2005	2198
Bowersox and Closs	Supply Chain Logistics Management	2009	1509
Monczka, Handfield, Giunipero, and Patterson	Purchasing and Supply Chain Management	2015	1714
van Weele	Purchasing and Supply Chain Management: Analysis, Strategy, Planning and Practice (5 th ed.)	2010	1129
Shapiro	Modeling the Supply Chain	2007	992
Tayur, Ganeshan and Magazine	Quantitative Models for Supply Chain Management	1999	661

Table 4. Content of popular SCM textbooks

Topics	Lysons and Farrington (2006)	van Weele (2010)	Simchi-Levi, Kaminsky and Simchi-Levi (2008)	Bowersox and Closs (2002)	Monczka, Handfield, Giunipero and Patterson (2015)	Christopher (2011)*	Chopra and Meindl (2012)
SC Principles, Drivers, Metric, and Capabilities			✓	✓		✓	✓
SC Performance Measurement		✓		✓	✓	✓	✓
SC Strategic Management		✓	✓	✓	✓		✓
Information Technology for SCM			✓	✓	✓		✓
SCM Strategies and Paradigms	✓			✓	✓	✓	
SC Coordination						✓	✓
SC Integration				✓	✓	✓	
Procurement, Purchasing, and Outsourcing in SC	✓	✓		✓	✓		
Distribution Network	✓		✓	✓			✓
SC Network Design			✓				✓
Forecasting							✓
Advanced Aggregate Planning and Scheduling				✓			✓
Inventory Management and Control	✓		✓	✓	✓	✓	✓
Supply and Demand Planning	✓		✓			✓	✓
Transportation				✓			✓
Supplier Relationship Management	✓	✓			✓	✓	✓

Topics	Lysons and Farrington (2006)	van Weele (2010)	Simchi-Levi, Kaminsky and Simchi-Levi (2008)	Bowersox and Closs (2002)	Monczka, Handfield, Giunpero and Patterson (2015)	Christopher (2011)*	Chopra and Meindl (2012)
Warehousing, Packaging, and Material Handling				✓			
Customer Relationship Management				✓			
Pricing and Revenue Management				✓			
Sustainability and Green SCM	✓					✓	✓
SC Risk and Disruption Management		✓				✓	✓
Uncertainty in SC						✓	✓
Global SCM			✓		✓	✓	✓
Product Design for SC	✓	✓	✓			✓	
Competition in SCM							
SCM in Non-Commercial Environments							

* This column includes a union of Christopher (2005) and Christopher (2011) contents.

4. SCM Journal Articles

Figure 1 shows the number of SCM articles published in peer-reviewed academic journals from 1982 to 2015. This shows the limited interest in the topic until the late 1990s followed by a dramatic increase in popularity in the 2000s, which has stabilized since 2010. This would suggest SCM is starting to reach the mature phase of its lifecycle and new SCM ideas and concepts need to be explored and published to ensure that it does not start to decline in popularity and become a ‘management fad’. Table 5 shows the top 20 peer-reviewed academic journals that have published the highest number articles on SCM since 1982. As one would expect, most of these journals have either a strong SCM or Operations Management (OM) focus (12 journals and eight of the top ten). However, the quantitative research methodologies that are often used to investigate SCM issues and problems mean that another major outlet for SCM research is journals with a focus on operations research and management science (eight journals).

4.1. Popular and emerging subject areas

Table 6 summarizes the subject areas (and relevant sub-areas) covered within the SCM articles published to date, whilst Figure 2 shows the change in popularity of these different topics over the last twenty years grouped by their level of popularity. The popularity is measured using the yearly ratio of papers published in each area of SCM (counting appearance of corresponding keywords) with respect to the total number of papers published on SCM. Based on these figure, one could categorize SCM areas into five categories as follows:

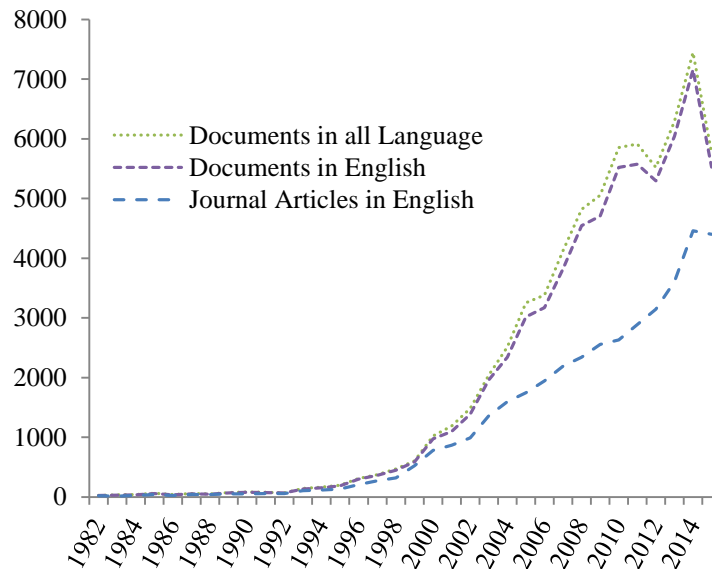


Figure 1. Number of SCM documents published each year (1982-2015)

Table 5. SCM articles published within academic journals (1982-2015)

Rank	Journal	# Papers
1	International Journal of Production Economics	1350
2	International Journal of Production Research	940
3	European Journal of Operational Research	824
4	Supply Chain Management	656
5	International Journal of Physical Distribution and Logistics Management	430
6	Journal of Cleaner Production	369
7	Production Planning and Control	332
8	International Journal of Logistics Systems and Management	327
9	Computers and Industrial Engineering	303
10	Production and Operations Management	296
11	Computer Aided Chemical Engineering	286
12	International Journal of Operations and Production Management	272
13	Expert Systems with Applications	255
14	International Journal of Advanced Manufacturing Technology	249
15	Journal of Operations Management	244
16	Management Science	216
17	Transportation Research Part E Logistics and Transportation Review	207
18	Manufacturing Computer Solutions	196
19	Industrial Management and Data Systems	190
20	Automotive Industries AI	181

Strong growth: The most prominent areas in this category are risk management and sustainability areas with a strong and steady growth since 2001 and 1995, respectively (see Figure 2, lines g and d). In addition, global SC and safety issues have received increasing attention over the past decade. These observations are strongly related to the world-wide concerns over globalization, environmental issues, and business uncertainty in today's economy.

Table 6. SCM subject areas and sub-areas

General area	Sub-areas	
1. Inventory	<ul style="list-style-type: none"> • Management • Control • Replenishment • Lot sizing • EOQ 	<ul style="list-style-type: none"> • Batch • Lead time • Backordering • Demand/Order/Capacity
2. Performance	<ul style="list-style-type: none"> • Evaluation • Benchmarking • Assessment 	<ul style="list-style-type: none"> • Measurement • Auditing
3. Information (supply chain communication system)	<ul style="list-style-type: none"> • Information Sharing • RFID (Technology, ...) • Communication technologies • Traceability • E-commerce • B2B • E-business • Information asymmetry • E-procurement • Information exchange • DSS 	<ul style="list-style-type: none"> • Knowledge sharing • web-based • Internet • Tracking • Monitoring • Value of information • Data mining • Decentralized • Electronic commerce • Virtual • Visibility
4. Processes	<ul style="list-style-type: none"> • Production • Manufacturing • Distribution • Ordering • Sales • Procurement 	<ul style="list-style-type: none"> • Purchasing • Transportation • Maintenance • Vehicle Routing • Shipment
5. Supply-side	<ul style="list-style-type: none"> • Supplier • Outsourcing • Supplier selection • Sourcing • Vendor 	<ul style="list-style-type: none"> • Supplier evaluation • Vendor selection • 3PL (Third-Party Logistics) • Warehousing/ Warehouse
6. Supply chain design	<ul style="list-style-type: none"> • Network Design • 	<ul style="list-style-type: none"> • Location
7. Coordination/Coordinated	-	
8. Integration/Integrated	<ul style="list-style-type: none"> • Leadership 	
9. Strategy/Strategies	-	
10. Global supply chain	<ul style="list-style-type: none"> • Global • International 	<ul style="list-style-type: none"> • Globalization/
11. SC Risk management	<ul style="list-style-type: none"> • Uncertainty • Stochastic • Robust 	<ul style="list-style-type: none"> • Fuzzy • Disruption
12. Quality/Quality assurance	-	
13. Sales	<ul style="list-style-type: none"> • Pricing • Bargaining • Auction • Negotiation • Discount 	<ul style="list-style-type: none"> • Forecasting • Market • Customer satisfaction • Advertising • Revenue management
14. Service	-	
15. Flexibility	-	
16. Negotiation	<ul style="list-style-type: none"> • Contracts • Trust 	<ul style="list-style-type: none"> • Contracting
17. Scheduling	<ul style="list-style-type: none"> • Scheduling 	<ul style="list-style-type: none"> • Sequencing
18. Dynamics	<ul style="list-style-type: none"> • Bullwhip effect • Control Theory 	<ul style="list-style-type: none"> • System Dynamics
19. Collaboration/Cooperation/Relationships	<ul style="list-style-type: none"> • Supplier relationship • Buyer-supplier 	<ul style="list-style-type: none"> • Inter-organizational • Buyer-Supplier

	relationships	• Incentives
	• Buyer-Seller	• Partnership
	• Manufacturer-retailer	• Alliances
	• Production-distribution	• Production-inventory
20. Sustainability	• Reverse logistics	• Environmental management
	• Sustainable	• Recovery
	• Social	• Return
	• Closed-loop	• Environment/ Environmental
	• Green	• Perishable
	• Remanufacturing	
21. Competition/Competing	-	
22. Implementation	-	
23. Safety/Emergency/Security	-	
24. Small to medium-sized enterprises	-	
25. Humanitarian	• Relief	• Humanitarian
	• Disasters	
26. Decision-Making Level	• Operational	• Strategic
	• Tactical	

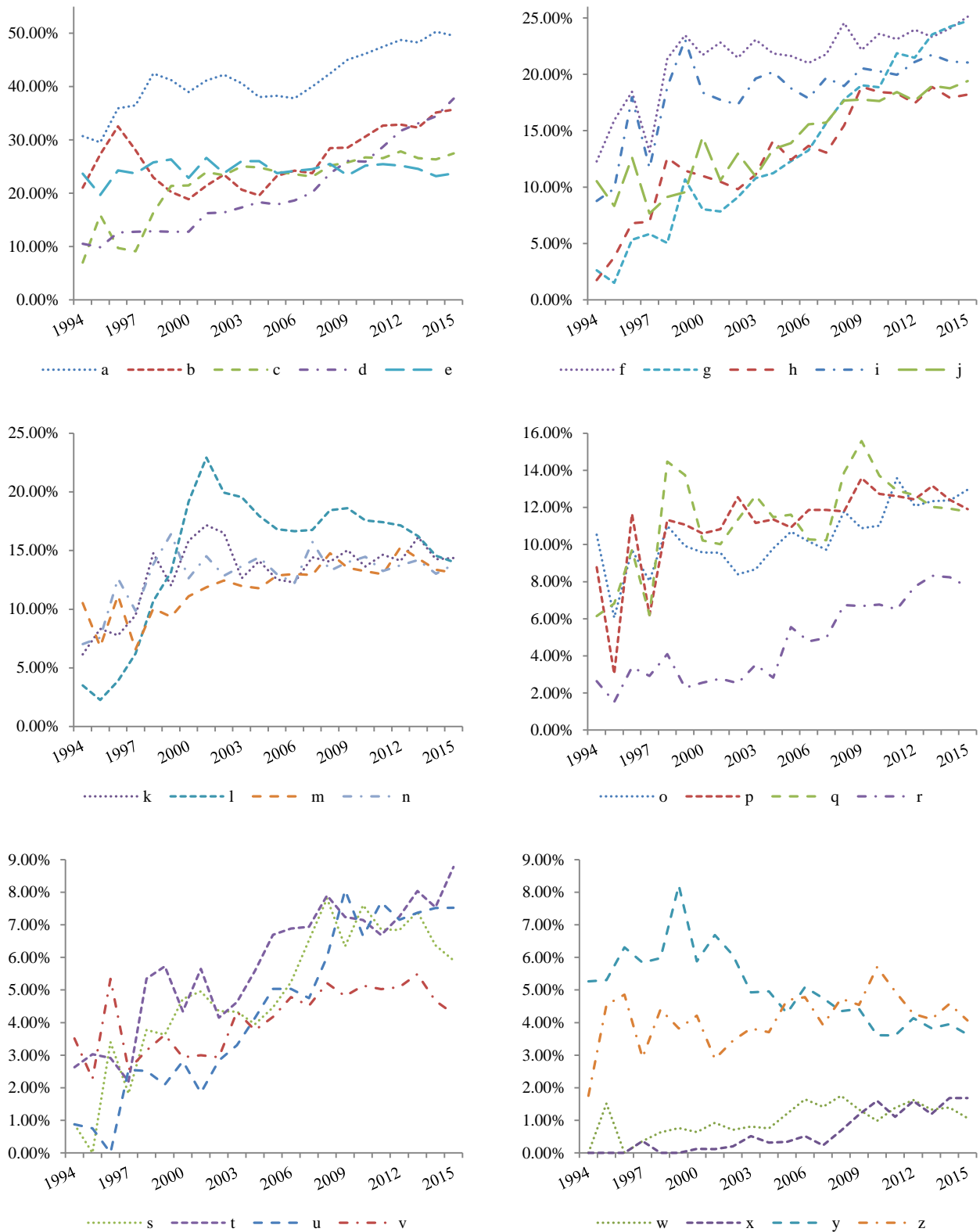


Figure 2. Trends of different areas within SCM between 1994 and 2015: a) Processes, b) Performance, c) Sales, d) Sustainability, e) Inventory, f) Supply-Side, g) Risk Management, h) Global SCM, i) Strategy, j) Implementation, k) Integration, l) Information, m) Collaboration, n) Decision-Making Level, o) Quality, p) Service, q) Competition, r) SC Design, s) Coordination, t) Negotiation, u) Safety, v) Dynamics, w) SME, x) Humanitarian, y) Scheduling, z) Flexibility

Slight growth: Seven areas of performance, SC implementation, SC design, coordination, negotiation, dynamics, and humanitarian logistics have received positive attention from researchers

over the past decade. While some these areas such as SC design, coordination, and performance could be considered matured research areas, others such as humanitarian logistics and SC dynamics are of high importance that requires more attention over the next years.

Steady: This category includes various areas such as processes, collaboration, decision making, quality, service, competition, small- and medium-sized enterprises (SMEs), and flexibility.

Slight decline: Multiple areas including sales, inventory, supply-side, strategy, integration, and information have received less attention during the past decade.

Strong decline: The only area in SCM with clearly strong decline is scheduling in SCM. This decline could be attributed to the fact that most of scheduling-related decisions are operational-level decisions that are usually made independently by each SC member, while other supply chain decisions are interconnected by actions and behaviors of different SC members. Hence, a level of saturation has been research for the area of scheduling with SCM literature.

We have found another classification on subject areas of SCM. We searched SCOPUS for journal articles (including in-press article) including “Supply Chain”. Table 7 shows main subject areas of the papers with respect to SCOPUS classification. According to Table 7, SCM paper publications have the highest coverage in the engineering subject area. Figure 3 distinguishes the number of publications in the top three popular subject areas (namely, 1- business, management and accounting, 2- engineering, and 3- decision sciences) over the past 10 years.

Table 7. Main subject areas of Supply Chain publications (SCOPUS classification)

Subject area	# Papers	%
Engineering	16984	26.52
Business Management and Accounting	13691	21.37
Decision Sciences	8212	12.82
Computer Science	6966	10.88
Social Sciences	4076	6.36
Mathematics	3096	4.83
Economics Econometrics and Finance	3012	4.70
Environmental Science	2922	4.56
Others	5093	7.95

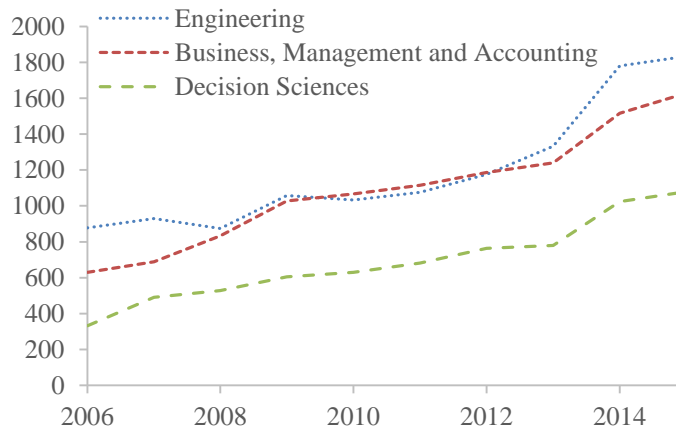


Figure 3. Supply Chain publication trends in the top 3 most popular subject areas

4.2. Popular and emerging research tools and techniques

As mentioned earlier, quantitative tools and techniques are often used to research SCM. Table 8 summarizes the ones most widely used to date based on their frequencies as a journal article keyword. This shows that optimization, simulation and fuzzy theory tools and techniques are the ones most often used. Optimization is used to help understand how to make better decisions within a SC, while simulation is used to evaluate the effects of uncertainty and/or test new ideas for managing complex supply chains. In addition, other techniques seem to be emerging in popularity. For example, game theory is being increasingly used to understand the cooperation and conflict between multiple agents within a SC. Also, multi-attribute decision making and multi-objective optimization techniques are starting to be used to better predict the impact of conflicting objectives and decisions within a SC, while systems dynamics is more frequently used to understand the behavior of supply chains over time.

Table 8. Popular SCM research tools and techniques

Rank	Tool/Technique	# Papers
1	Optimization	2531
2	Simulation	1543
3	Fuzzy (theory)	891
4	Game theory	648
5	Forecasting	578
6	Heuristics, Metaheuristics. Matheuristics, and Hyper-Heuristics	552
7	Linear Programming	516
8	Multi-Attribute Decision Making (including all techniques)	508
9	Genetic and Evolutionary Algorithms	508
10	Multi-objective optimization	412
11	Approximation (algorithm)	220
12	Decomposition	230
13	Mixed-Integer Linear Programming (MILP)	214
14	Neural Network	155
15	Systems Dynamics	198
16	Dynamic Programming	229

17	DEA (Data Envelopment Analysis)	198
18	Simulated Annealing, Tabu Search, and Variable Neighborhood Search	179
19	Stochastic Programming and Robust Optimization	323
20	Nonlinear Programming	110

4.3. Popular and emerging management tools and techniques

Table 9 shows the most popular management tools and techniques investigated within the SCM research to date. This shows that coordination/synchronization is frequently investigated as an approach to help to coordinate ordering and lead time decisions across a SC. Just-in-Time (JIT), Vendor-Managed Inventory (VMI), Make-to-Order/Build-to-Order, and postponement have been studied as alternative methods for managing information, material and money flows across a SC and support market needs. Lean is used to understand how non-value added processes and practices can be eliminated within a SC, Agility to help it respond rapidly to changing market demands, Robustness to increase its resilience to external risks and uncertainties that it might face, and Stability to ensure it has the right relationships with partners and suppliers to maintain a sustainable flow of information, material and money across the SC. As a result, most of the SCM articles published to date are concerned with management tools and techniques that try to improve the overall performance of the SC by increasing sales, reducing costs and/or reducing inventory levels across the chain.

Table 9. Popular SCM management tools and techniques

Rank	Journal	# Papers
1	Coordination/Synchronization	2394
2	Lean (Production/Supply Chain)	524
3	Agility	520
4	Just-in-time	376
5	Reliability	321
6	Stability	313
7	VMI (Vendor-Managed Inventory)	308
8	Robustness	300
9	Make-to-order/Build-to-order	222
10	Postponement	136

4.4. Popular and emerging industries to study

Table 10 shows the different industries that have been studied over the last twenty years and Figure 4 shows how the popularity of these has changed over time grouped by their level of popularity. This shows that food, energy, and automotive industries are the most widely studied industries followed by agricultural, retail, and chemical. It is likely that these will remain popular in the future given the complexity of the supply chains that they manage, the challenges they face, and the sophisticated nature of the solutions that their analysts have developed to overcome these issues. However, it is interesting to see studies on aid agencies are emerging in recent years to understand

the social and environmental challenges and impact of different SCM practices on humanitarian logistics, which suggests that this might start to become an industry to explore further in the future.

Table 10. Comparison of the number of the reports on SCM application in different industries during 1982-2015.

Industry	# Papers	%
Food	608	20.39
Energy	566	18.98
Automotive	427	14.32
Agricultural	315	10.56
Retail	262	8.79
Chemical	225	7.55
Pharmaceutical	117	3.92
Textile	102	3.42
Aid agencies	74	2.48
Telecommunication	70	2.35
Defense	63	2.11
Semiconductor	60	2.01
Aerospace	55	1.84
Petroleum	38	1.27

5. Areas for Future SCM Research

Despite the significant amount of SCM research that has been conducted and the high number of published books and journal articles over the past decades, there are still some areas and applications that have not yet been explored or require further exploration as new business environments and industry trends emerge. Generally speaking, these areas could be divided into two separate categories of general and specific research areas. While, general research areas could be applicable to many types of SCs (i.e., manufacturing or service supply chains), specific research areas are devoted to specific supply chains that function as part of service industry. This categorization is mostly motivated by the recent emerging applications of SCM in the service industry. Next, we will discuss these research areas in sections 5.1 and 5.2 devoted to research trends within different SCM areas and research trends within application areas, respectively.

5.1. Future trends within subject areas

A number of gaps within the existing literature that present areas worthwhile for further exploration are now discussed.

Security. Although a significant amount of research has looked at the information and financial requirements to create effective collaboration and decision making across a SC (such as Cao et al.

2010 and Lehoux et al. 2014), no research to date has investigated the security issues that might present and how they can be overcome as organizations make planning, negotiation and pricing decisions more collaboratively across a SC (Hong et al. 2014). This is an increasingly important concern within businesses in general (Upton and Creese, 2014) and its implications for effective SCM need to be better understood.

Insourcing. Deciding whether to ‘make’ or ‘buy’ is one of the most important decisions an organization has to make (Hill and Hill, 2012). This topic needs to be continually investigated as markets become more dynamic, the world becomes more connected, business environments change and new industry trends emerge. After years of outsourcing, a trend for insourcing is starting to emerge as organizations attempt to reduce the level of risk and disruption within their SC, develop new capabilities so they can compete differently, respond to changes in government legislation. However, research needs to be conducted to understand the impact of these decisions and the best practices to pursue when making them.

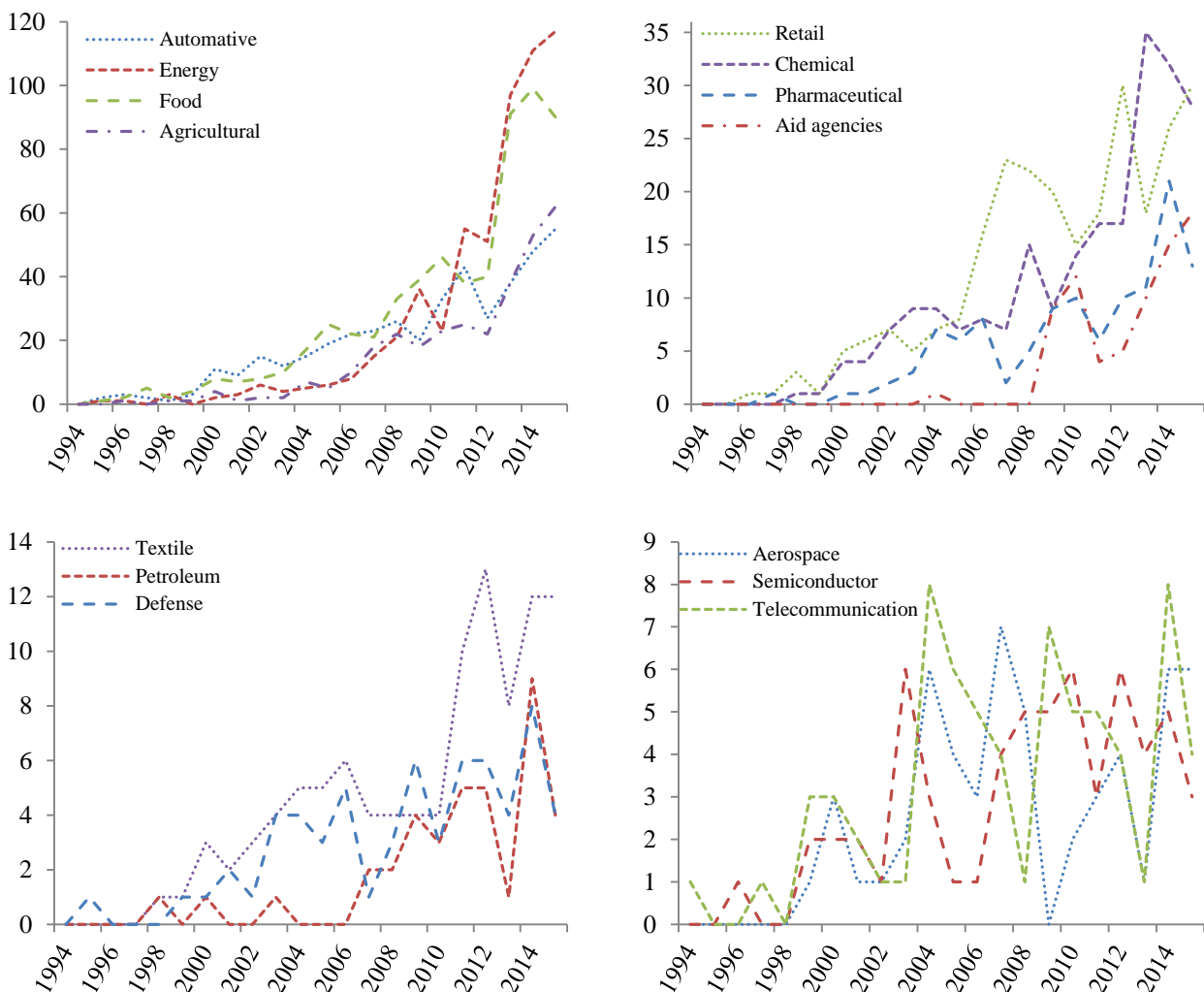


Figure 4. Trends of application of SCM in different industries during 1994-2015

Sustainability. A significant part of the social, economic, and environmental impact of an organization occurs within its supply chain (Nikbakhsh 2009; Brandenburg et al. 2014). This is an increasingly important area of SCM research and is likely to become more important in years to come as organizations have to respond to new governmental and international regulations, increased social and customer awareness, and changing market needs (New, 2010). While the SCM literature has made a great contribution to understanding the environmental aspects of sustainability and incorporating them into SCM theory and practice, there is still a considerable lack of effective attention to social issues. Understanding how best to do this requires a multidisciplinary framework that draws from various different academic disciplines (other than operations management, logistics, and purchasing) such as sociology, computing, economics, philosophy, political science, health, construction, and psychology to understand the impact that SC decisions can have on the societies and environments in which they operate.

Competition. Understanding where competition can emerge from, how to mitigate against it and how to respond to it are increasingly important questions as supply chains become more complex and global, new technologies emerge and resources become more accessible. Recent examples of competition emerging from within a supply chain (from a supplier or a customer) mean that previous research simply looking at competition between supply chains might be out-of-date and no longer enough for many organizations. Therefore new research needs to be completed to see if traditional competition theories are still relevant or if new ones need to be developed as the competitive landscape changes and evolves (Farahani et al. 2014; Rezapour et al. 2014). In addition, there are still important gaps in the literature regarding multi-criteria analysis of competition as well as randomness/uncertainty of competition parameters.

Risk and disruption management. As supply chains become more complex and global, the level of demand, supply, cost, and revenue uncertainty within them increases (Yang and Yang, 2010; Simangunsong et al. 2012; Hosseini et al. 2014), and so does the threat of risk and disruption across the chain (Nikbakhsh 2012). Understanding the factors that can create uncertainty and how to best mitigate against risk and disruption is an ongoing challenge as business environments change (Liberatore et al. 2013; Hasani et al. 2015; Farahani et al. 2014). Consequently, organizations continually look for ways to improve their performance under uncertainty (Hill et al. 2012) as they lean their processes and postpone decisions within the chain (Tang, 2006; Saghiri and Hill, 2014). Future research needs to understand both the impact of external (such as market, economic, political and technological forces) and internal (such as SC design, information sharing, forecasting and collaboration) factors that can potentially expose a SC to risks, disrupt its daily operations, or change how it needs to operate or perform. In addition over the past decade, improvement in computational facilities and optimization techniques have enabled SC managers to

deal with SC risk and disruptions via more sophisticated quantitative tools such as stochastic programming and robust optimizations. However, there is still a lot to do in this field as there are many newly problems introduced due to considering new issue in SCM such as disasters, global SC, sustainability, and competition (Liberatore et al. 2013; Hasani et al. 2015; Farahani et al. 2014).

Human behavior. Previous research has focused on understand the role and impact of different structures, systems, and processes within a supply chain. As a result, the impact of the culture of the different organizations within the chain, the relationships and trust between them, and where power resides within a chain are not fully understood (Tokar 2010). For example, it would be useful to better understand the factors that influence how SC managers think, make decisions and negotiate with other organizations in the chain (Carter et al. 2007). Although some research has started to be published in the last three years, this is still an area that requires further exploration.

5.2. Future trends within application areas

SCM has traditionally been studied in a manufacturing context as manufacturing organizations were one of the first to outsource parts of their business and use suppliers in different parts of the world. Although many service organizations now also have complex and global supply chains, little research in these industries has been conducted to understand if they face different challenges or should use different approaches. Some service industries, which would be of top priority for deeper understanding, are now discussed.

Healthcare. The SCs used within healthcare organizations have changed significantly in recent years as markets open up, competition increases, lean initiatives are pursued, and government legislation changes (de Vries and Huijsman 2011). However, as with most professional services, the SCs within these industries are usually managed by medical professionals rather than SC professionals. As a result, this makes this an interesting industry to understand and one where research could significantly help practitioners.

Disaster and humanitarian. Even though considerable advances have been made in disaster and humanitarian supply chains in recent years, there are still many opportunities for further research (Nikbakhsh and Farahani, 2011). For example, most studies to date have focused on the preparation, mitigation, and response phases of humanitarian logistics and ignored the recovery phase, which is in many ways more important than the initial response (Leiras et al. 2014). There are also (often public) charities involved in humanitarian operations that have very different levels of access to resources, capabilities, and technologies and operate in very different business environments than the private organizations on which most previous research has been conducted. Therefore, further research needs to be conducted to understand the problems these organizations face, how they can be overcome and what they can learn from other industries (Leiras et al. 2014).

Small and medium-sized enterprises (SMEs). Most research to date has also been conducted in large organizations with access to a large amount of resources serving high volume markets and managing complex SCs. Although the SCs of SMEs are often simpler, they often serve more complex and dynamic markets with more specialist and complex products/services and have to operate with more limited access to resources and funds in comparison to large enterprises. This can make them reluctant to adopt SCM practices developed by large enterprises (Vaaland and Heide 2007). Instead, they have often developed export clusters, horizontal co-operations, vertical integrations, long-term partnerships and strategic collaborations to enable them to compete against large organizations (Lenny Koh et al. 2007; Vaalvand and Heide 2007). As a result, their SCs have very different structures to those of large organizations, which create different challenges and opportunities. Future research needs to better understand these if it is to develop theories and concepts that are relevant to the characteristics of their industry.

At the end of this section, it is worth mentioning that these three new applications of SCM are parts of the challenges in SCM that developing countries face due to the smaller economy size, lack of infrastructures, and inefficiencies of the healthcare and disaster operations systems. Consequently, there should be a focus on the needs and characteristics of these countries to develop more relevant and practical models and solutions. In addition, developing educational programs on SCM-related issues of these applications could help these countries with improving their systems efficiency and effectiveness. To achieve this, relevant success stories and case studies could be of interest (Mbohwa 2010; Ortuño et al. 2011; Abban et al. 2013. Sheppard et al. 2013; Pazirandeh and Norrman 2014).

6. Conclusions and Limitations of the Research

Supply chain management has been one of the most important management philosophies since 1982 as it has gained considerable attention from both practitioners and academics around the world. Although logistics is the main building block of every supply chain, supply chain management differs from logistics in requiring an integrated and coordinated approach to managing flows of a) material, b) information, and c) money in competitive environments.

In this paper, we present an overview of SCM trends between 1982 and 2015 and the possible promising future directions in three domains: textbooks, research, and implementation. After discussing the research scope, most-widely cited books and textbooks on SCM are introduced. Next, published peer-reviewed journal papers are analyzed using various criteria including important journals, trends of different areas within SCM, as well as most prominent techniques and philosophies in SCM research. Then, implementation of SCM concepts and practices around the world are investigated based on the relevant industries. Finally, some promising future research

areas with SCM are introduced. The first important issue is how organizations should manage security, insourcing, sustainability, competition, risk/disruption and human behavioral issues within their supply chains. In addition, it is necessary understand the particular practices, challenges and opportunities within newer applications of SCM such as healthcare, disaster and humanitarian and small and medium enterprises industries. These recommendations could be used by SCM academics and professionals to redefine the focus point of their research and application of SCM.

In the end, limitations of this paper are outlined. First, this study does not include papers in the pipeline (i.e., papers under review by the journals). Second, it does not cover conference papers not published in any journal. Other limitations of this study are as follows:

- Presence (absence) of a desired term in title, abstract, and keywords of a journal paper does not necessarily indicate that specific paper is (not) about that term. Therefore, there is possibility that some of the numbers given in this research are underestimation or overestimation of corresponding real numbers.
- We have searched over title, abstract, and keywords of thousands of journal papers. While in some cases, we have checked some of the papers carefully, we have not read all of these papers and relied on the descriptive statistics to derive facts and insights about supply chain management.
- Over the years, the number of publishing outlets for scientific research has increased considerably (Larsen and von Ins, 2010; Smart, 2014). This could possibly have a positive effect on the number of papers that has been published on SCM over the years (i.e., more journals, more papers accepted). In particular, the increase in the number of published paper could be partially encouraged by the exciting huge number of outlets, instead of the mere scientific and applied relevance of the field. Consequently, this phenomenon possibly could have created a bias in our analysis of trends and findings.

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