

Review

A “Metasurvey” analysis in Operations Research and Management Science: A survey of literature reviews



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ARTICLE INFO

Article history:

Received 1 September 2015

Received in revised form

10 May 2016

Accepted 16 May 2016

ABSTRACT

This manuscript provides a survey of 343 literature reviews of the last 15 years (2000 through 2014) in Operations Research and Management Science. It provides information on journals that are publishing literature reviews, volume trends, geographic sources of literature reviews, and citation analysis for the surveys. It further provides an analysis of topical coverage and relationships between areas of research. Finally, it suggests subject areas that may be ripe for more extensive survey coverage.

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1. Introduction

Literature reviews (or surveys) play an important role in the Operations Research/Management Science (OR/MS) literature. They serve a useful purpose for researchers and students to stay abreast and up-to-date in broad subject areas without delving deeply into specific technical details or methodological advances. They can add value by providing new perspectives and taxonomies of the literature for experienced researchers, and valuable introductions and sources of reference and tutorials for novices. Further, they identify under-researched areas within specific areas of research that can create avenues to new areas of research. As such, they provide valuable structure and updates to the constantly changing field of OR/MS.

This manuscript sets out to describe the coverage provided by a sample of 343 literature reviews over the last 15 years (2000–2014) as a way to characterize OR/MS literature, evaluate the coverage of such reviews, and potential over-coverage or gaps in that coverage. Such coverage provides a mosaic of these articles which, as a collection, would provide valuable insight into the shifting landscape of the OR/MS literature to a wide spectrum of researchers. Editors will benefit from the visualization of the coverage of literature reviews in OR/MS and where more or less coverage is in need. Experienced researchers can develop a sense of how their fields of expertise are (under) represented. Novice researchers can begin to understand how the OR/MS field is structured and interrelated, and perhaps see gaps in the structure that they can seek to fill.

The sample of surveys covered in this manuscript reveal broad and disparate coverage of the growing field of OR/MS, with a heavy concentration, and perhaps a disproportionate one, in just a few

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fields of research. Some burgeoning areas of OR/MS research may be underrepresented.

2. Literature review

Survey research has grown in volume over the last 15 years (as will be shown later in this manuscript). There could be a number of reasons for this growth. First, some existing journals have shown increased willingness to publish surveys. (As a testament to the importance of such literature reviews, this journal, *Surveys in Operations Research and Management Science* was created in 2011, in part as a result of this trend.) It could be that well written survey articles have a tendency to be widely cited; a researcher who wants to provide a solid and broad reference to an area of research can cite a recent survey that gives ample introduction, breadth of coverage, and background. Second, the field of OR/MS has generally grown in scope as new methods have been introduced to the field. For example, the broader (or at least slightly different, yet closely related) field of analytics has grown in popularity [1]. Topics such as machine learning, text analytics, soft or behavioral OR/MS, and empirical and statistical methods, among others, are more commonly appearing in the OR/MS literature as the field grows and evolves. New areas of research are developed and accepted (at least tangentially) under the OR/MS umbrella, so does the need for surveys and tutorials describing the methods and pointing to the best sources for recent coverage of these approaches. Third, in general, more is being published in the field of OR/MS, so it is hardly surprising that surveys have grown with the rising tide of OR/MS literature, which provides a broader and deeper research fodder from which to develop surveys.

It is important to understand what is being covered in these surveys and to evaluate coverage needs in the literature. Until 2007, a series of coordinated literature reviews known as *Handbook of Operations Research* was printed with concentration areas in topics such as transportation, discrete optimization, and the like (See, for examples, [2,3]). This series has been discontinued to allow for more frequent and timely releases of surveys (with a more standard journal format in *Surveys in Operations Research and Management Science* taking its place), so the remaining sources for literature reviews are journal articles rather than organized handbooks. This format has the potential advantage of being timelier, on narrower topics, and more specialized, but are less coordinated, as individual authors typically choose topics and rarely, if ever coordinate coverage. Even prior to the termination of the *Handbook* series, there were a large number of surveys in journals that had no coordinated topical coverage. There are examples of special journal issues containing solely literature reviews, but the topics are not organized or coordinated in any way (such as Bouyssou, Martello and Plastria [4], and Waller [5]). In short, similar to primary research in OR/MS, survey research is a function of author and editor interest in a topic, with no coordination, and little assurance of consistent, nonduplicative or complete coverage.

Thus, there is a growing need to take account of what literature is being reviewed. However, to the author's knowledge, very little, if any, research has been conducted which evaluates the coverage and linkages of these surveys. Only one article, [6], conducts a review of literature reviews in the supply chain management (SCM) literature reviews from 1989 to 2012. The article is limited to SCM and logistics journals, and focuses on the linkages between supply chain collaboration and supply chain performance. To the author's knowledge, there are no other surveys of literature reviews.

The objective here is to canvas the OR/MS (and closely related) literature to evaluate what research areas are being covered by literature reviews, and how the topics are related. By extension, this research will also help to identify which areas of research are active, but are not being covered in a literature review format.

3. Methodology

Google Scholar was used as the method of search for literature review articles. Any article with "literature review" or "survey" in the title or keywords from a journal that is generally recognized as an OR/MS journal was included. The set of journals was limited to those found in OR/MS journal quality study by Gorman and Kanet [7], which covered journals that previous OR/MS journal quality articles had covered, thus the list is considered journals that are generally considered OR/MS journals. Articles were reviewed to ensure that they were, in fact, a literature review. For example, in some cases, "survey" resulted in finding empirical articles which included surveys of organizations, and these were excluded.

Clearly, not all surveys will be captured with this search; capturing all surveys is not feasible. Some examples I found of missed articles were in the special issues in *Annals of Operations Research* issue described in [4] and *International Journal of Logistics Management* described in [5] which contain exclusively survey articles, many of which do not contain those search terms. However, for expediency and consistency of method, the search was limited to those articles described as surveys or reviews in the title or keywords. This approach will not capture the population of survey articles, but will return a random sample with a clear and simple search criteria from which to base the analysis. There is no reason to think that any article types or journals will be systematically omitted. Though we cannot assure of no bias, the large sample and large cross section of journals helps to mitigate that risk.

3.1. Article Count by Year

The time horizon is from the years 2000 to 2014, or the most recent 15 years of data. The time frame was chosen to get a reasonable time frame to discuss trends, but recent enough to capture recent surveys. Somewhat arbitrarily, the cutoff year of 2000 was chosen to capture a full 15 years of data and surveys solely from this century. Fig. 1 shows that there is a strong upward trend in the number of literature reviews each year. The trend is strong and pronounced; the last three years in the sample average four times the number of survey articles than the first three years in the sample. This upward trend could be a function of Google Scholar's coverage, which may be more complete in more recent years. It could also be a function of higher publication rates in general over time as new journals have come into existence over the time period; it cannot be claimed that surveys constitute a greater portion of the total literature. However, it is unlikely that there are approximately four times as many articles being produced now than 15 years ago (especially among this set of journals), yet the frequency of surveys as nearly quadrupled. However, because the trend is so strong, it is very likely that literature reviews have grown in relative frequency over the last 15 years.

3.2. Article Count by Journal

Table 1 reports the frequencies of articles by journal. Journals with only one review article over the time frame are summarized into "other" for brevity.¹ (Abbreviations used in this article for

¹ "Other Journals" include: International Journal of Operations Research, Journal of Supply Chain and Operations Management, California Journal of Operations Management, Logistics Research, Project Management Journal, Mathematical and Computer Modeling, Journal of Purchasing and Supply Management, International Journal of Logistics Research and Applications, International Journal of Logistics Research and Applications, International Journal of Operations and Logistics Management, Transportation Research Part F, and Journal of Production Economics.

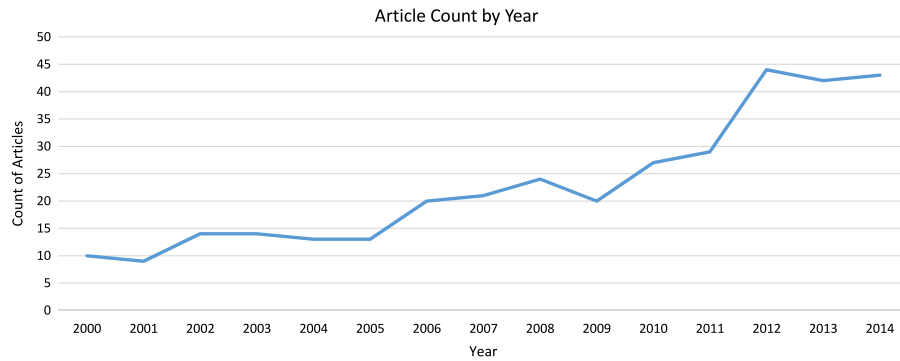


Fig. 1. Survey Article Count by Year.

Table 1
Article Count by Journal.

Count	Abbreviation	Journal name
87	EJOR	European Journal of Operations Research
24	IJPE	International Journal of Production Economics
24	AOR	Annals of Operations Research
23	JORS	Journal of the Operational Research Society
20	IJPR	International Journal of Production Research
20	COR	Computers and Operations Research
19	SORMS	Surveys in Operations Research and Management Science
16	SCM	Supply Chain Management Journal
15	IJOPM	International Journal of Operations Management
12	Omega	Omega
9	Other	Other journals with a single survey (see footnote 1)
7	DS	Decision Science
7	IJPDLM	International Journal of Physical Distribution & Logistics Management
6	IJLM	International Journal of Logistics Management
6	IIE	IIE Transactions
6	MSOM	Manufacturing and Services Operations Management
6	TS	Transportation Science
5	MS	Management Science
5	JOM	Journal of Operations Management
5	OR	Operations Research
4	POM	Production and Operations Management Journal
4	NRL	Naval Research Logistics
5	INT	Interfaces
4	IJSOM	International Journal of Services Operations Management
2	JSCM	Journal of Supply Chain Management
2	IJSCM	International Journal of Supply Chain Management

journals are also listed in Table 1.) By far the most prolific journal source for literature reviews is EJOR, with more than a quarter of literature reviews being found in that journal. There is considerable concentration of surveys, with the top five most frequent journals accounting for over 50% of the articles, and the top 10 accounting for 76%. Though not shown, consistent with the general trend of increasing surveys over time, the most prolific journals have, in general, been increasing their survey coverage over the last 15 years.

3.3. Article Count by Author country of origin

Author countries of origin were garnered from articles where available. All authors' affiliations in the articles are included. Country is not the nationality of authors, but rather the country with which they were affiliated when the survey article was published. In total, it was possible to discern author geographic location in 300 of the articles in the sample, for a total of 404 authors with country of origins. Table 2 summarizes countries of origin for authors of literature reviews.

The United States is by far the most common origin for authors of literature reviews, accounting for approximately 29% of the author countries of affiliation. Of the 45 different countries identified, the top 10 account for approximately 72% of the represented countries.

3.4. Citations

The number of citations as reported by Google Scholar at the time the article was retrieved (in 2014 and early 2015) and is shown in Table 3. Though reported google citations can be challenged in terms of both their count, quality, and accuracy, they are reported here as an indicator of relative impact of the survey articles. The citation average of articles is approximately 105 times in this sample.

Of course, newer articles are disadvantaged by this metric of total citations. Table 4 reports the total citations by five-year groupings of data of publication. Older articles have a much higher total citation rate by virtue of their age. The oldest articles average more than 270 citations each (approximately 20 cites per year based on 12.5 years average age), the mid-range articles average 135 (again, approximately 20 cites per year based on 7.5 years), while the newest articles average only 35 citations (just less than 20 cites per year on a 2.5 year average). In any case, literature review articles are generally well-cited.

3.5. Subject matter coverage

An analysis of keywords as provided by the authors was undertaken as a first attempt at understanding topical coverage. There

Table 2
Author country of origin.

Author country	Frequency
USA	116
England	41
Canada	28
Germany	25
Netherlands	18
France	16
Spain	15
Italy	13
China	12
Belgium	8
Brazil	8
Hong Kong	8
Australia	7
Norway	7
Sweden	6
Switzerland	6
Turkey	6
Denmark	5
Greece	5
Japan	5
Chile	5
India	4
Singapore	4
Iran	3
Poland	3
South Africa	3
Taiwan	3
Belarus	2
Columbia	2
Malaysia	2
Mexico	2
Portugal	2
Saudi Arabia	2
Austria	1
Bulgaria	1
German	1
Israel	1
Kuwait	1
Malaysia	1
Nepal	1
Netherlands	1
New Zealand	1
Pakistan	1
Puerto Rico	1
Tunisia	1

were 267 articles with keywords provided. Fig. 2 is a word cloud of those terms appearing at least five times. Such a word cloud is interesting as a starting point for topical analysis but misses some key things. First, word combinations such as “math programming” and “supply chain management” are treated as individual words, not as single logical topics. Second, authors may not submit keywords with any consistency such as “DEA” and “Data Envelopment Analysis”. Though keywords such as “survey” and “literature review” which are essential keywords for a search of the literature are included in the word cloud.

Thus, a more careful analysis of keywords is required. An analysis of the exact keywords provided by authors creates few insights; there was no standardization or consistency between how keywords were entered. In order to evaluate keyword patterns, some standardization in the handling of synonymous words and acronyms was required. Further, some aggregation of those keywords into logical groupings provides insight into literature review coverage of various subject area domains, technical methodologies, and topical coverage. Even with creating keyword “groups” to create some density in each category, many keyword groups appeared only one time and are omitted from the tables. After removing some keywords (such as “survey”) and grouping others into logical groups, there were still 197 different keyword groups based on a total of 757 keywords. There were 73 keyword groups that occurred only one time in the sample.

Table 5 reports the most common keyword areas of application (or domains), covered in this sample of literature reviews. E-business and agriculture are the most commonly covered domains in literature review. E-business includes topics such as electronic markets and auctions, electronic data interchange, e-procurement, and the like. Agriculture covers individual surveys of dairy, pork, vegetables and others. Health care covers emergency, operating rooms, outpatient, and others. Of the 687 keywords retained that appeared more than once, 101 of them were based on the domain or area of application.

Table 6 reports commonly reported methods and problem types in the literature. Math programming is the most commonly surveyed method (includes mixed integer, linear, non-linear, semidefinite, and others). Metaheuristics of all kinds (genetics, ant colony optimization, tabu, annealing, etc.) follows it closely. Of the 687 keywords, 130 were based on the methodology covered in the paper.

Table 7 summarizes the most commonly occurring subject area topics covered in the literature reviews. Topical keywords are far more common than methodology or domain keywords; they are used three or four times more often by authors to describe their work. Of the 687 keywords that appeared more than once, 456 of the keywords were based on the problem type or topic rather than the method or domain. By far, the most common topic is supply chain management and related keywords. Scheduling, inventory, and sustainability also received heavy coverage.

This keyword analysis serves as the basis for the coding of the abstracts of these articles and subsequent text mining analysis. In determining the key nodes that served as the centroids of the textual analysis, primary focus was given to most common topics (not domains or methodologies).

3.6. Abstract classification

Textual analysis of the abstracts required some classification of the information to create more standardized text classifications. In order to evaluate the abstracts of the papers, each was coded with one to five classifiers that captured (and standardized) key concepts and themes found within articles' abstracts.

Author coding of abstracts created similar frequencies of the most commonly-occurring topics, but not identical values. Differences between the keyword and classification frequencies can be easily understood. Both the keyword grouping and the abstract classification is subject to interpretation so difference between keywords reported by authors and codes assigned to abstracts are likely to vary. Coding was also done for the full complement of 329 literature reviews, resulting in 70 additional survey articles being included in classification analysis where keywords were not available. In any case, neither approach is meant to be definitive, but rather directional in characterizing topical coverage in literature reviews. The purpose of classification coding was to find the frequency of the interactions between topics.

The coding resulted in 766 classification words, of which 327 were unique. Of the 327, 124 appeared more than once. Table 8 summarizes the abstract classifiers with multiple appearances. Supply Chain Management (SCM) is by far the most common topic (61 articles), followed by Scheduling (38), and Green/Sustainability (20). Measurement appears often, but is not a “central” OR/MS research topic, but rather a common “support” topic for other core OR/MS topics.

3.7. Coincidence analysis

In order to understand patterns of how topics are covered in the literature in combination, a coincident analysis was conducted

Table 4
Total citation Count by Year of publication.

Journal	Year of publication			Grand total
	2000–2004	2005–2009	2010–2014	
MS	704.40			704.40
MSOM	420.00			420.00
JOM	460.50	246.50	5.00	283.80
TS	308.50	430.00	49.67	201.30
EJOR	309.38	203.18	58.00	152.03
POM	216.00		37.50	126.75
IJOPM	373.00	254.50	8.67	104.93
IJPR	327.67	120.50	54.64	104.68
IIE	63.50	153.67	8.00	99.33
COR		134.08	39.57	99.26
OR	86.00	13.00	53.00	90.00
IJPE	161.00	115.60	37.07	74.08
NRL		93.33	–	70.00
SCM		330.50	19.93	58.75
DS	182.00	51.75	8.50	58.00
Omega	344.00	55.00	23.44	55.42
AOR	105.00	52.33	33.50	53.96
INT		64.00	46.67	53.60
JORS	47.20	61.83	23.75	51.10
IJLM		42.00	14.00	36.40
SORMS			19.32	19.32
JSCM		33.00	–	16.50
IJPDLM			15.29	15.29
Other			9.56	9.56
IJSOM		9.00	5.33	6.25
IJSCM			0.50	0.50
Grand total	273.88	129.67	23.79	105.23

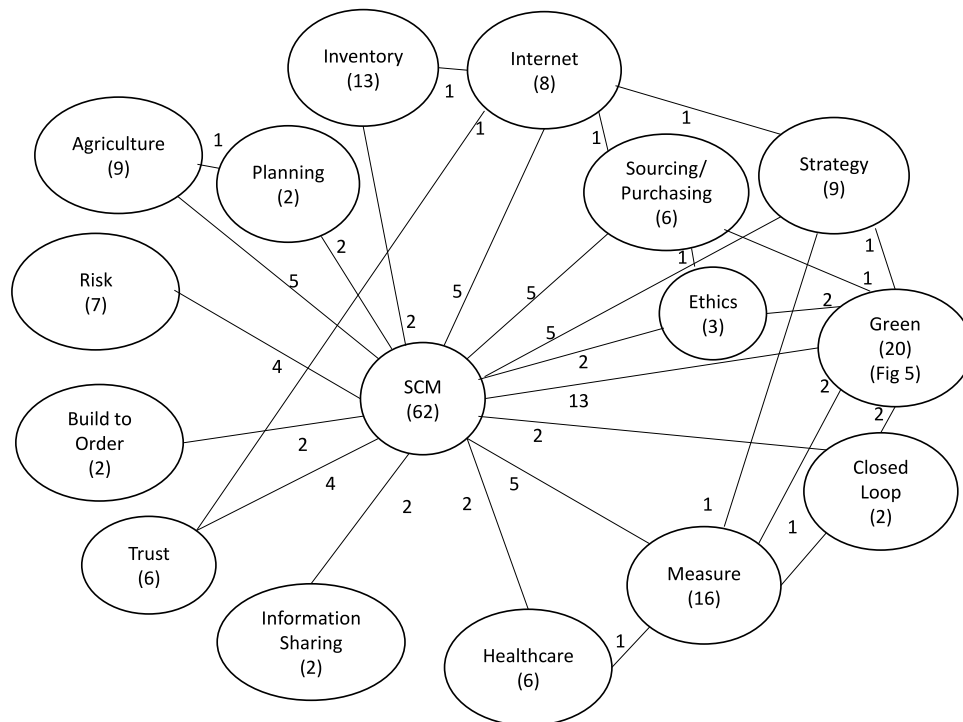


Fig. 3. Supply chain management topical constellation.

(4% of the entire sample). Viewed another way, 21% of SCM review articles had a green focus, and 65% of green reviews had a supply chain focus. Topics such as Ethics, Sourcing, Closed Loop and Strategy appeared in conjunction with the SCM and Green pairing to various lesser degrees.

As far as other strong patterns emerging from Fig. 3, SCM appears five times with each of internet, sourcing, and measurement. SCM appears multiple times with Trust (4) and Information Sharing (2), which are closely related topics. Healthcare (2) and Agriculture

(4) are the only specific verticals which both occur multiple times with supply chain. Topics such as Risk and Build to Order had little interrelationship with other SCM topics, though they were tightly interconnected to SCM, with 4/7 of Risk surveys and 2/2 of Build to Order surveys being also SCM surveys.

Fig. 4 shows the constellation for Scheduling, the second most common topic of literature reviews (38 review articles; 11.5% of all surveys were scheduling related). The eight topics shown are the ones that appeared in scheduling related reviews more than

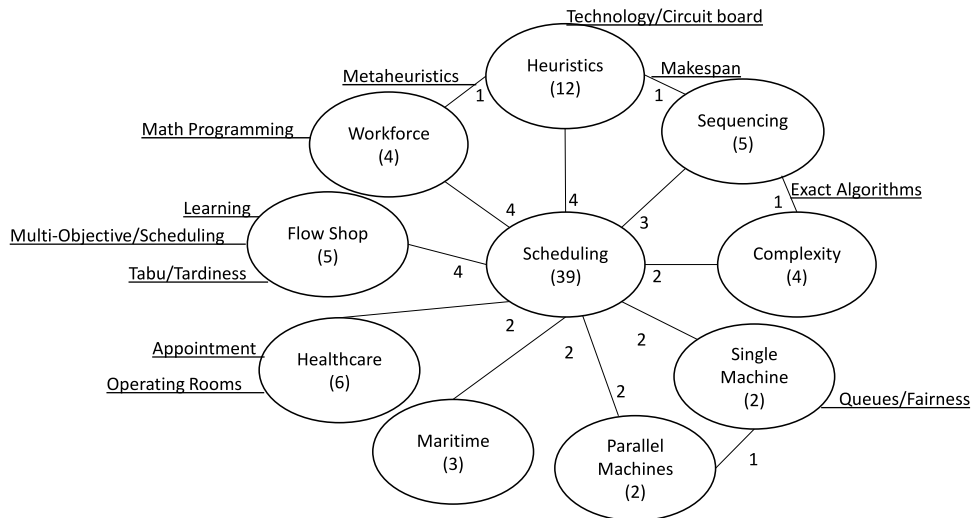


Fig. 4. Scheduling topical constellation.

Table 5
Most common domains of coverage in literature reviews.

Domain	Count
Agriculture	14
Ebusiness	13
Manufacturing	11
Health care	10
Service	9
Environment	6
Education	5
Snow	4
Government	4
Freight	3
Airline	3
Sports	3
Emergency medical services	3
Disaster	3
Waste management	2
Military	2
Container terminal	2
Public transportation	2
China	2

Table 6
Most commonly covered methodological groups.

Methods	Count
Math programming	24
Metaheuristics	18
DEA	9
Stochastic	8
Control theory	8
Heuristic	8
Classification	7
Combinatorial optimization	5
Artificial intelligence	5
Empirical	5
IP	5
Modeling	4
P-median	3
Methods	3
Convex programming	3
LP	2
Behavioral	2
Simulation	2
Newton equations	2
Game theory	2
Dynamic programming	2
Clustering	2

one time. Flow Shop and Workforce were the strongest coincident topics with four occurrences each. When these topics appear in a review, the review is usually scheduling related (which is also true of Single Machine and Parallel Machine). Heuristics also appeared with Scheduling four times, there were eight other articles that covered Heuristics that were not scheduling related. Healthcare and Maritime are two verticals, each with two literature reviews related to scheduling in the sample. Though Healthcare appears with Scheduling as well as SCM, the articles are not related; thus, SCM and Scheduling have no articles in common.

Because the Scheduling constellation is less dense than SCM (fewer nodes and lower frequencies), “secondary topics” are also shown in Fig. 4 as they relate to the primary topics (all secondary topics have a frequency of one within each constellation). For example, one Healthcare Scheduling literature survey focused on appointment scheduling, the other operating room scheduling.

Perhaps partially because of the lower density of Scheduling surveys, there was less interconnectedness between the Scheduling topics. One could posit as well that despite its broad applicability, the Scheduling literature tends to be more narrowly focused on the unique attributes of particular problem types and methodologies, where Supply Chain literature is more general and less specific in nature, even though it deals with a very specific construct; thus, the topics tend to be more interrelated.

There were 12 review articles of the 38 that did not fall into any of these categories. For the most part, they dealt with specific and unrelated scheduling problems, such as for automatically guided vehicles, cross docking, education, sports, and emergency response.

Fig. 5 shows the constellation for Green, the third most common topic of literature reviews (6% of all surveys were Green related). Of course, the same coincidence observed in Fig. 3 observed here between Green and SCM, and that connection extends to Measurement. Green articles that are not SCM related focus on topics such as organization, transportation, location, flexibility and social responsibility (e.g., Green issues in China). Counter to scheduling, the Green literature is highly interrelated, as most topical areas are coincident with one another.

Moving to Logistics, the next most frequent OR/MS classification, the density of the constellations falls off rapidly with the number of articles classified to a subject area. (Measurement is omitted from this analysis, as it is not “core” OR/MS and topics are largely unrelated.) The logistics area had 17 survey articles, but as shown in Fig. 6, a relatively small constellation of connections greater than one. Only one area occurs 4 times (Measurement) and four topic areas occur twice (Trust, Outsourcing and Warehouse

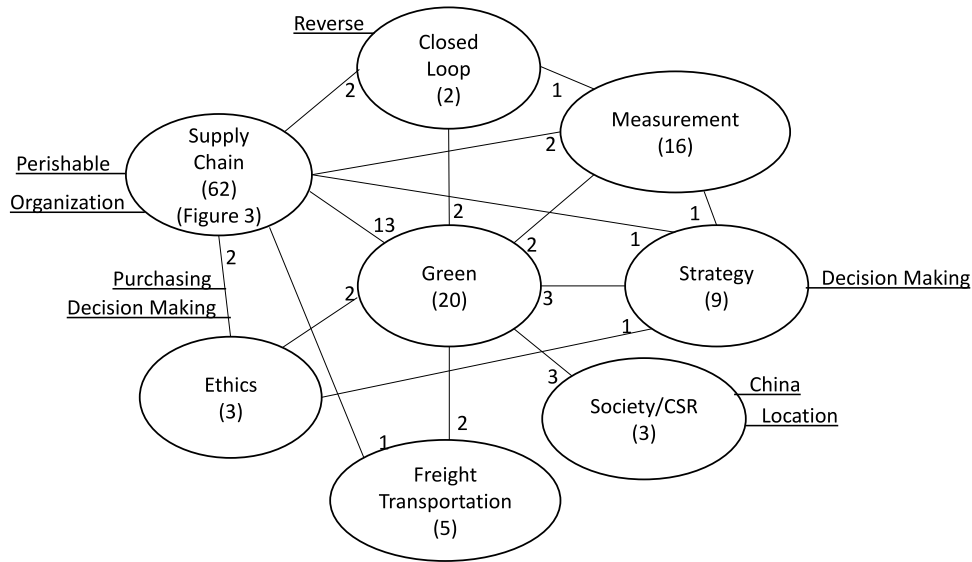


Fig. 5. Green topical constellation.

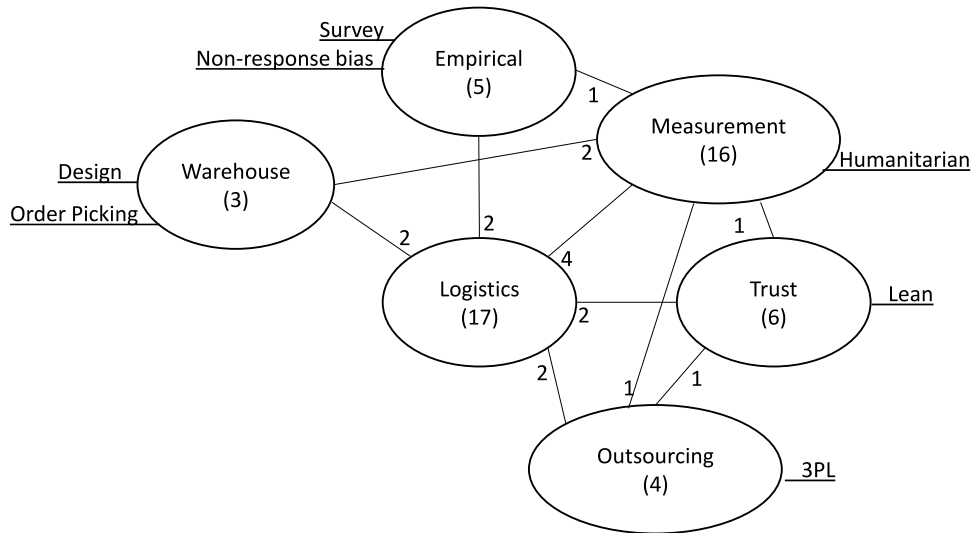


Fig. 6. Logistics topical constellation.

and data/empirical), and there are no common terms in the topic area.

Because of low frequency and interconnectedness, a table is more appropriate for representing these relationships. (Only 7 of 17 articles are represented by Fig. 6.) In Table 9, each row represents a single literature review article covering logistics, presenting the related topics in the article. It is interesting to note that although logistics and SCM are often perceived as closely-related topics (one could argue they are nearly synonymous and should be combined), based on the classification applied, the literature reviews in the two areas have little in common from a topical stand point. The logistics literature tends to be more often empirical, and more narrowly focused on industry verticals (maritime, military, food) or specific “links” in the supply chain (freight, warehouse, cross docking, etc.). The only classification terms the two areas of the literature had in common were “Trust”; of six times Trust occurred in the sample, 4 were with SCM, 2 were with Logistics, and “Measurement” (of 16 appearances in the sample, 4 times were in Logistics, and 5 times in SCM). One could argue that Sourcing/Purchasing (found in Supply Chain) and Outsourcing (found in Logistics) are closely related as well. But in

general, surprisingly, the two areas of Supply Chain and Logistics in the literature seem to be more independent than interrelated.

“Measurement”, which, while the next highest frequency in the literature review classification, is not a concentrated field of core OR/MS research, and therefore will be omitted from this analysis. In any case, 11 of the 16 occurrences of Measurement were included in three of the top four categories (SCM, Green and Logistics). A quick scan of the remaining topics revealed what might be expected, a wide variety of relatively unrelated topics. (The same logic was applied to the “Heuristic” classification, which is omitted from analysis.)

Table 10 shows classifications for the Inventory-related surveys. The repeated connection to SCM is apparent (from Fig. 3), and there are two examples each of forecasting surveys and lot sizing. Again, due to the low density (12 surveys with Inventory as a classification), there is little interrelationship between topics.

Finally, Table 11 shows Location related topics. (Three articles had only Location as their classification, thus they do not appear on this coincident matrix.) Routing is most commonly associated with location (3 of 10); these problems commonly go hand in hand.

Table 7
Most commonly occurring subject area topic groups.

Subject area	Count	Subject area	Count
Supply Chain Management	61	Credit	3
Scheduling	32	Benchmark	3
Inventory	16	CSR	3
Sustainability	15	Reliability	3
Data	14	Cultural	3
Logistics	14	Facility Location	3
Staffing	12	Marketing	3
Operations	11	Customer satisfaction	4
Location	11	FMS	3
Application	10	Games	2
Decision	11	IC	2
Quality	9	Routing	2
Multi Objective	8	Composite indicators	2
Network	7	Mean/Var	2
Organization	7	Costing	2
Fuzziness	6	Risk	2
Decision Criteria	6	Analysis	2
OR	6	ERP	2
Strategy	6	Option Evaluation	2
Assembly	5	Statistics	2
Flowshop	5	Agile	2
Management Strategy	5	Measurement	2
Project Management	5	Inter Org	2
Ethics	5	Replacement	2
Packing	5	Lot Size	2
TSP/VRP	5	Robustness	2
Performance Measurement	5	Closed Loop	2
Maintenance	5	Safety	2
Warehouse	4	Portfolio	2
Dynamic Modeling	4	Sequencing	2
Transportation	4	Intl Biz	2
Forecasting	4	B2B	2
Lean/JIT	4	Engineering	2
Distribution	4	Mass Production	2
Knowledge	4	Qualitative Research	2
Reverse Logistics	4	Batching	2
Finance	3	EOQ	2
Process	3	Relationship	2
Systems	3	Design	2
Complexity	3	Framework	2
Shareholder	3	AGV	2
Advertising	3	Auctions	2
Optimization	3	Revenue Management	2
AHP	3		

The remaining topics had fewer than 10 occurrences; further analysis was (somewhat arbitrarily) cut off at that level of density.

4. Discussion

Clearly, there is considerable concentration in topical coverage in OR/MS literature reviews. The “Green” classification did not emerge until 2010, yet 20 literature reviews have been published based to some degree on that topic; that is an average of 5 per year, and 18 in the last three years alone. Similarly, 51 of the 61 Supply Chain surveys (which comprises 18.5% of the literature reviews, per author classification) were published in the second half of the sample since 2008. Logistics, a related topic, grew on average 1.5 survey articles per year, from 0.3 to 1.8 as well between the first and second half of the sample. To be fair, these two trends are not independent, as Green and SCM are often covered in tandem. Further, the growth of literature reviews in general (as described in Fig. 1) may be bolstering this growth, but if one considers approximately 18 more literature reviews per year on average since 2008 (from 13.25 up to 2007 to 31.85 since 2008 overall), SCM and Green account for almost half of that growth (8.3 more articles per year covering one or both of these topics, after controlling for double counting the 13 Green plus SCM articles). While SCM is clearly an important topic, and Green is new and trending,

13/18 of the growth in these areas implies some growth in the concentration on the coverage of these already well covered topics. While not wanting to disparage SC/Green surveys, it is unlikely the high quantity of these surveys are necessary, or that incremental surveys in this area will provide much marginal benefit to the OR/MS community.

What topics are being covered less than they should be, or not covered at all? This is a difficult question to answer for a number of reasons. First, trends are difficult to discern at lower volume levels, where “under covered” topics are by definition. Second, absence of a topic is exceedingly difficult to recognize. Third, this set of 329 articles is only a sample, so the absence of a topic here does not necessarily mean it has not been covered at all. Fourth, admittedly, the sample includes as many “Operations Management” centric journals as OR/MS centric journals, which could create an operations bias in the sample, but in general these two fields are closely related and often intertwined. Finally, low coverage may be a function of the lack of depth, breadth, or importance of a topic. Thus, no formal analysis can be conducted.

However, anecdotally, if one uses as a bell weather what is being published in *Management Science* as core OR/MS subjects and leading literature, there are a great number of topics and methods that are regularly discussed by authors that do not appear at all or with great frequency in this sample of literature reviews, thus could be underrepresented. Scanning the Gorman, “Management

Table 8
Abstract classification frequencies.

Abstract classification	Frequency	Abstract classification	Frequency	Abstract classification	Frequency
SCM	61	Network design	3	Banking	2
Scheduling	39	Tournaments	3	Classification	2
Green	20	Robustness	3	Maintenance	2
Measurement	16	Convexity	3	Survey	2
Logistics	15	Math programming	4	Makespan	2
Inventory	12	Decision making	3	Fuzzy set theory	2
Heuristic	12	Project management	3	Education	2
Location	10	Disaster	3	Product development	2
Strategy	9	China	3	3PL	2
MCDM	8	AHP	3	Project scheduling	2
Agriculture	9	Maritime	3	Agility	2
Internet	8	AI	3	Quality functional deployment	2
Application	8	Warehouse	3	Transportation	2
DEA	8	Ethics	3	replenishment	2
Risk	7	Organization	3	Build to order	2
Lean	7	Forecasting	3	Fleet	2
Queues	6	Reverse	3	Energy	2
Stochastic	6	Freight transportation	3	Credit scoring	2
Sourcing	6	Routing	3	AGV	2
Trust	6	Ant colony	3	Semidefinite programming	2
Healthcare	6	Sports	3	New products	2
Operations management	6	Assembly line	3	Sharing	2
Metaheuristic	6	Assembly line balancing	3	Bullwhip	2
Flow shop	5	VRP	3	Single machine	2
Sequencing	5	QFD	2	Optimization	2
CombOpt	5	CSF	2	Society	2
Manufacturing	6	Disruption	2	Finance	2
Empirical	5	Games	2	Closed loop	2
Emergency response	5	Advertising	2	Packing problem	2
Snow	4	Duality	2	Tardiness	2
Complexity	4	Revenue management	2	Parallel machines	2
Information	4	Dynamic programming	2	Telecommunication	2
DSS	5	Simulation	2	Planning	2
Uncertainty	4	Innovation	2	TQM	2
Lot sizing	4	Technology	2	Policy	2
Vehicle routing	4	Integer programming	2	Portfolio	2
Fuzzy	4	Fixed charge	2	MinMax	2
Game theory	4	Auction	2	Warranty	2
Outsourcing	4	Reliability	2	Public transportation	2
Design	4	IP	2		
Control	4	Flexibility	2		
MIP	4	Knowledge management	2		
Workforce	4	Service	2		

Table 9
Logistics related survey classification.

Logistics survey topics classification:	
Trust	Outsourcing
Trust	Lean
3PL	Outsourcing
Warehouse	Order picking
Warehouse	Design
Cross docking	Scheduling
Survey	Non-response bias
Empirical	Information
Reverse logistics	Vehicle
Innovation	
Maritime transport	Fleet
Technology	Freight transportation
Food	
Humanitarian	Measurement
FMS	Strategy
Theory	
Military	

Science Management Insights” ([8,9] and others) summaries of articles for the last few years (more than 200 article summaries) reveals a large number of under-represented topics in this sample (which presumably extends beyond this sample to some degree).

Topic areas or domains with considerable coverage in *Management Science* include:

- Finance: (beyond portfolio optimization, which has been well reviewed in the literature)
 - Financial innovation, insider behavior, merger analysis, exchange formation and trading rules, spinoffs, acquisitions and mergers, stock price behavior relative to news, fundamentals and investor expectations.
- Individual/Organizational Behavior:

Table 10

Inventory related survey classification.

Inventory literature review classifications:	
SCM	Assortment
SCM	Internet
Forecast	Classification
Forecast	System dynamics
Lot sizing	Backorder
Lot sizing	Maritime
Games	
Stochastic	Lot scheduling
Spares	Replenishment
Vehicle routing	
Perishable	
Convexity	

Table 11

Location related survey classification.

Location related classifications	
Society	Green
Routing	
Aggregation	
Agriculture	Application
Vehicle routing	Snow
Routing	Road freight
MIP	

- CEO attributes, pay structure and performance, Executive Team make-up and interaction, turnover/retention, (de)centralization, human capital transfer, team work and problem solving, agency theory and optimal incentives, wages/bonuses and effort level, advisory board structure and performance, workload and productivity, gender, negotiation and effort.
- Entrepreneurism:
 - New entity formation, financing structures, entrepreneurial behavior and turnover, research and development and funding first-stage production, venture capital structuring.
- Marketing:
 - New product roll-out and cannibalization, innovation, product bundling and pricing, on-line advertising, mobile device advertising, multi-channel advertising, turnover and customer retention, centralized and localized pricing and promotion, product branding.
- Market Structure, Mechanisms and Performance:
 - Auction structures, (dis)intermediation, competition and product variety.
- Social Networks:
 - Peer recommendations, bandwagon/conspicuous consumption effects, crowd funding, customer product design.
- Public Policy:
 - Firm social responsibility, reputation and regulation, optimal financial market regulation, Internet policy and human capital development, international nuclear weapon policy structure, copyright and patent protection.
- Information Technology:
 - Big data technology returns, web site (re)design, search engine design, information and productivity, database accessibility and security.
- Decision Making and Subjectivity/Bias:
 - Hindsight effect, attractiveness and employment, stardom and sports officiating.

Methods often used in *Management Science* are underrepresented in this sample as well:

- Empirical Methods: Data-based observation from field data.
 - On-line consumer behavior analysis, social network data, electronic markets pricing data, financial markets data, quarterly earnings reports, sales and cost data from restaurants, banks, movie sales.
- Experimental/Behavioral OR/MS: Data-based analysis from laboratory data.
 - Competition, social interaction, peer influence, different motivators (guilt, bandwagon, fear, influence, financial, etc.) all tested in a laboratory.
- Statistical Methods: Insights from data.
 - Estimation of peer influence on social networks, inference on customer preference, forecasting movie demand.
- Game Theory: Derived competitive behaviors.
 - Cournot–Nash modeling of price and product competition, product positioning and market heterogeneity, nuclear weapon proliferation and interdiction.

Topics that are well-surveyed in this sample, such as supply chain contracting, capacity allocation, sourcing, trust, information sharing, risk sharing, and the like are present in *Management Science* articles, but in fact, it seems apparent after an informal scan that the subjects and methods in *Management Science* are *not* covered in literature reviews more than they are covered. This could be that the topics are niche, or new; it could be that the authors writing these cutting-edge articles are not interested in literature review writing. In contrast, noticeably *absent* from *Management Science* is much, or any, coverage of “Green Supply Chain” or Scheduling. In any case, one could argue that *prima facie* evidence that the literature reviews typically found do not reflect leading research topics or methods in OR/MS as much as they could.

5. Conclusion

A survey of 329 survey articles in OR/MS reveals a number of trends. First, there is growth in literature reviews over the last 15 years as the breadth, depth and application of OR/MS continues to change and expand. Second, there is fair concentration of topical coverage in the broad field of OR/MS, focusing on supply chain and logistics, sustainability, and scheduling. Third, there seems to be some mismatch in what is being published in leading OR/MS outlets, and what literature is being surveyed and summarized. A reconciliation of these two streams would benefit the OR/MS community.

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