# Developments in Management Science in Engineering 2017

# Developments in Management Science in Engineering 2017:

*Perspectives from Scientific Journal Reports*

By

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# Chapter 1
# Introduction

With the progress of human society, the construction of projects is becoming more and more complicated and their management increasingly dependent on modern scientific methods. Management science in engineering (MSE) is playing an increasingly important role in modern society. In particular, the development of efficient innovative, managerial tools has significantly influenced the research progress of management science in engineering management. As research is vital for the propagation of leading-edge methods, journal evaluation and classification are critical for scientists, researchers, engineers, practitioners, and graduate students.

The aim of this report is to identify the main research categories of MSE, and evaluate and classify each MSE journal. In this report, an integrated methodology made up of literature mining, cluster analysis and expert systems is proposed. The data used for the proposed methodology came primarily from the Web of Science and Journal Citation Reports (JCR). This report was put together through the joint efforts of scientific board members, many of whom are editor-in-chiefs of the most related journals, academicians, fellows from different countries, and members of professional societies. We would like to express our sincere appreciation for their contributions during the report writing.

The results from the proposed methodology identified the seven categories most related to MSE: engineering management, civil engineering, industrial engineering, environmental engineering, energy engineering, information engineering, and agricultural engineering. The most related journals in each category were identified from literature mining that utilized NoteExpress and the Cite Space software, from which it was found that there were 95, 89, 41, 101, 75, 28, and 16 journals, respectively, for each of the seven categories. In each category, all identified journals were graded into four levels labeled A to D, with A being journals that had the most significant influence on subject development, B being journals with high-quality papers, high submissions and low acceptance rates, C being well-recognized journals but having limited impact, and D being journals with good papers but having a less important role, lightly referred papers.

Some journals were not included for two main reasons. First, while some journals were quite comprehensive and had published some MSE papers, the MSE ratio was too low for entry into any category. Typical examples were Nature and its subordinate academic series and Science and its subordinate academic series. Here, we select 11 journals that are leading the development of MSE, as listed in Tab. 1.1

**Table 1.1** Frontier Journal for MSEM

| Rank | Full Journal Title | ISSN | JCR Data | | | | | | Eigenfactor Metrics | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Cites | Impact Factor | 5-Year Impact Factor | Immediacy Index | Articles | Cited Half-life | Eigenfactor Score | Article Influence Score |
| 1 | Nature | 0028-0836 | 627846 | 38.138 | 41.458 | 9.518 | 897 | 10.0 | 1.44256 | 22.215 |
| 2 | Science | 0036-8075 | 568210 | 34.661 | 34.921 | 8.961 | 828 | 10.0 | 1.15367 | 18.018 |
| 3 | Energy & Environmental Science | 1754-5692 | 48,114 | 25.427 | 22.118 | 6.142 | 317 | 3.3 | 0.164740 | 5.575 |
| 4 | Nature Climate Change | 1758-678X | 9,526 | 17.184 | 19.257 | 4.287 | 150 | 2.6 | 0.067510 | 9.704 |
| 5 | Nature Communications | 2041-1723 | 75139 | 11.329 | 12.001 | 2.078 | 3192 | 2.2 | 0.47684 | 5.543 |
| 6 | Proceedings of the National Academy of Sciences | 0027-8424 | 56855 | 9.423 | 12.28 | 5.785 | 3100 | 2.6 | 1.33 | 16.71 |
| 7 | Frontiers in Ecology and the Environment | 1540-9295 | 7,340 | 8.504 | 9.993 | 1.585 | 65 | 6.7 | 0.018760 | 4.164 |
| 8 | Journal of Management | 0149-2063 | 12,419 | 6.051 | 10.480 | 1.206 | 86.760 | 10.0 | 0.021450 | 4.697 |
| 9 | MIS Quarterly | 0276-7783 | 11,320 | 5.384 | 9.510 | 0.977 | 97.670 | 10.0 | 0.011360 | 2.879 |
| 10 | Scientific Reports | 2045-2322 | 46918 | 5.228 | 5.525 | 0.559 | 10642 | 2.1 | 0.20894 | 1.863 |
| 11 | Nature Energy | 2058-7546 | - | - | - | - | - | 2.2 | - | - |

The second reason is that this report focuses on the 5-year impact factor and a 5-year article influence, which means that journals with impact factors or article influences less than five years could not be directly evaluated. Such journals were also very competitive, and we believe that in the following years, they will have more influence on MSE development. Tab. 1.2 shows examples of seven such journals.

The essential difference between this journal report and other journal rankings are as follows: (1) a connected and dynamic relationship is identified between the six MSE journal categories and frontier and emerging

**Table 1.2** Emerging Journals in MSEM

| Rank | Full Journal Title | ISSN | JCR Data | | | | | | Eigenfactor Metrics | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Cites | Impact Factor | 5-Year Impact Factor | Immediacy Index | Articles | Cited Half-life | Eigenfactor Score | Article Influence Score |
| 1 | International Journal of Concrete Structures and Materials | 1976-0485 | 197 | 1.411 | - | 0.25 | 100 | 3.2 | 0.00075 | - |
| 2 | Petroleum Exploration and Development | 1000-0747 | 1055 | 1.377 | - | 0.292 | 99.06 | 4.6 | 0.00214 | - |
| 3 | Sustainability | 2071-1050 | 2,301 | 1.343 | - | 0.361 | 832 | 2.5 | 0.006590 | - |
| 4 | Advances in Production Engineering & Management | 1854-6250 | 98 | 1.125 | - | 0.118 | 100.000 | - | 0.000230 | - |
| 5 | Water Science and Technology-Water Supply | 1606-9749 | 808 | 0.532 | - | 0.046 | 97.69 | 7.8 | 0.0013 | - |
| 6 | Journal of Service Theory and Practice | 2055-6225 | 6 | - | - | 0.167 | 100.000 | - | 0.000000 | - |
| 7 | International Journal of Management Science and Engineering Management | 1750-9653 | 265 | 0.241 | - | - | 156 | - | 0.000480 | 0.012 |

journal categories; (2) a 5-year journal performance index is introduced as an journal evaluation measure; and (3) this is the first time MSE journal categories have been defined and classified. The main advantages of this report are that it adjusts for the differences in journal impact across subject areas as well as citation changes over a long-term period. However, no journal report is ever definitive. We hope that this report represents the start of a new process in journal rating in the MSE academic community.

# Chapter 2
# Support Resource

Support for this proposed MSE journal report can be roughly divided into two categories: expert support and organizational support. In the expert support group, three levels worked together: expert in chief, professional expert board and the working group. The expert in chief, Prof. Jiuping Xu, who worked on behalf of the whole group, is a distinguished MSE researcher; the professional expert board was made up of fellows from different national academies of sciences and editors from international journals and the main members of the working group were PhD candidates with MSE majors. An introduction to the expert support is detailed in the following sections.

## 2.1 Experts Support

The expert support for this journal report came from the expert in chief and the professional expert board.

### *2.1.1 Expert in Chief*

**Jiuping Xu**
Assistant Vice-President of Sichuan University & Dean of Business School;

Honorary Academician, Academy of Sciences of Moldova, 2016;
Academician, Mongolian National Academy of Sciences, 2016;
Lifetime Academician, International Academy for Systems and Cybernetic Sciences (IASCYS), 2010;
President, International Society for Management Science and Engineering Management (ISMSEM), 2007-present;

### *2.1.2 Professional Expert Board*

**Baldev Raj**
Director, National Institute of Advanced Studies;
Past President, Indian National Academy of Engineering;
President, International Council of Academies of Engineering & Technological Sciences;
Chairman, Board of Governors, Indian Institute of Technology, Gandhinagar;
Hon. Member, International Committee on NDT;
Hon. Fellow, International Medical Sciences Academy;
Member, German National Academy of Sciences.

**Asaf Hajiyev**
Secretary General of Parliamentary Assembly of the Black Sea Cooperation (PABSEC);
Academician of Azerbaijan National Academy of Sciences.

**Gheorghe DUCA**
President, academician, the Academy of Sciences of Moldova;
Chemist, founder of the Research School on Ecological Chemistry.

**Mitsuo Gen**
Tokyo University of Science, Research Institution for Science and Technology Fuzzy Logic Systems Institute, Japan.

**Mohamed Abdou**
Distinguished Professor and Director of the Center for Energy Science and Technology, UCLA;
Founding President, Council of Energy Research and Education Leaders (CEREL), USA.

**Tapan K. Nayak**
Fellow of the American Statistical Association;
Elected member of the International Statistical Institute;
Professor, Department of Statistics, George Washington University, Washington, DC 20052;

**Nozer D. Singpurwalla**
Chair Professor of Risk Analysis and Management Science at The City University of Hong.

**Shibli Rubayat Ul Islam**
Professor and Chairman, Department of Banking & Insurance;
Dean, Faculty of Business Studies, Faculty of Business Studies University of Dhaka.

### *2.1.3 Working Group*

Yi Lu, Liming Yao, Ziqiang Zeng, Zongmin Li, Zhimiao Tao, Zhibin Wu, Chengwei Lv, Meihui Li, Siwei Zhao, Ning Ma, Fengjuan Wang, Shuhua Hou, Weiyao Tang, Na Luo, Yan Wang, Rongwei Sun, et. al.

## 2.2 Organizations Support

**The International Academy for Systems and Cybernetic Sciences** (IASCYS);
**International Society of Management Science and Engineering Man-**

**agement** (ISMSEM);
**Sichuan University**

# Chapter 3
# General Methodology

Academic journals are one of the most important vehicles for academic exchange. Studying the co-citation relationships across academic journals can help us understand the relationship between subject development and the discipline. To determine the co-citation relationships, systematic theoretical analyses are applied to examine the methods and principles associated with a certain branch of knowledge. As periodical evaluations are systematic and scientific, the analyses typically encompass concepts such as paradigms, theoretical models, phases, and quantitative or qualitative techniques [12]. To ascertain a classification method able to accurately evaluate journals, a systematic and general methodology for identifying the journal categories, ranking, and classifying is proposed. The methodology is based on a specific literature analysis approach in which (a) the Web of Science database is employed for literature analysis, and (b) CiteSpace is used to visualize the scientific literature patterns and trends. Compared to purely qualitative methods, this classification method is fairer and more objective so it can more accurately reflect the actual situation.

## 3.1 Method Overview

In this part, the relevant technologies and software packages used in the journal rank analyses are briefly introduced. Data acquisition and data analysis were the two main procedures, the specific processes for which are described in the next section, and Web of Science (WoS) and CiteSpace were the relevant software packages. The data acquisition module was used to obtain the most relevant information from the initial literature database and the data analysis module gave a specific visual process description for the journal rank.

### *3.1.1 Data Acquisition*

The WoS was developed by Thomson Scientific, a part of the Thomson Corporation, and dominates the field of academic reference, mainly because of its annual release of journal impact factors, a tool for evaluating the importance and influence of specific publications. While the impact factor has been criticized, it remains the most widely used index available as it gives access to multiple databases that reference cross-disciplinary research, which allows for an in-depth exploration of specialized subfields within an academic or scientific discipline [10, 23]. The WoS consists of several online databases [20], as shown in Fig. 3.1.

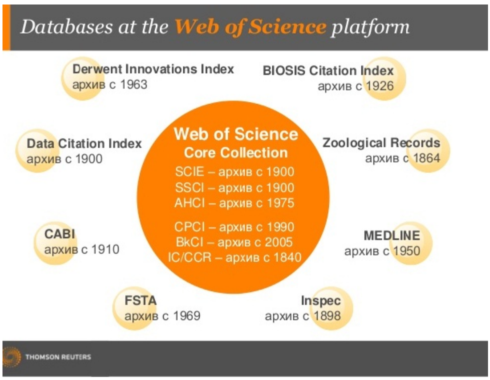



**Fig. 3.1** Databases in Web of Science$^{TM}$.

The CiteSpace data format is based on the standard WoS database, and updates with data format changes in the ISI (Institute for Scientific Information) database [6]. The WoS, a comprehensive multidisciplinary citation index database covering manuscripts dating back to 1900, is the worlds leading citation index database and includes three libraries: The Science Citation Index Expanded (SCI-Expanded), the Social Sciences Citation Index (SSCI) and the Arts and Humanities Citation Index (A-&HCI) [10]. To increase the accuracy of the analyses, the WoS Core Collection Indexes were chosen as they include the most influential core journals [1]. As it has a strong retrieval and analysis function, the WoS can guarantee full and accurate information retrieval, discover hidden trends in a research field and identify the latest developments [2, 15].

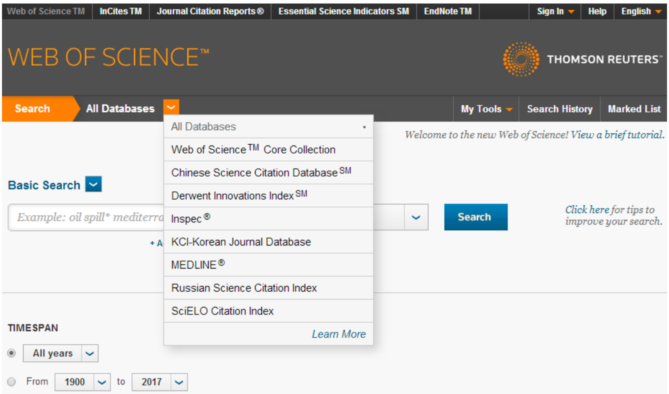



**Fig. 3.2** Core Collection Indexes in Web of Science$^{TM}$.

1. Advanced Search

The WoS has basic search (by entering a topic), author search, cited reference search, structure search, and advanced search functions. Help is also offered for all searches by author, group authors and full source titles as well as by abbreviations. In cited reference searches, the search can be limited by cited author, cited work and cited years, and a cited author index and work index can be presented if required. The advanced search is a basic search but without the limits and the author search and allows for more operators and codes.

To improve on the more conventional finite state algorithms, the WoS advanced search was chosen as it involves a finite state pattern-matching algorithm in a library bibliographic search program that can find all titles satisfying Boolean keywords and phrases in a citation index; Fig.3.3 shows a schematic diagram for the advanced search. An Advanced Search query consists of one or more field tags and a search string, with Booleans and wildcards allowed. Records are searched for using field tags, set combinations or a combination of both. The steps required for the Advanced Search are as follows:

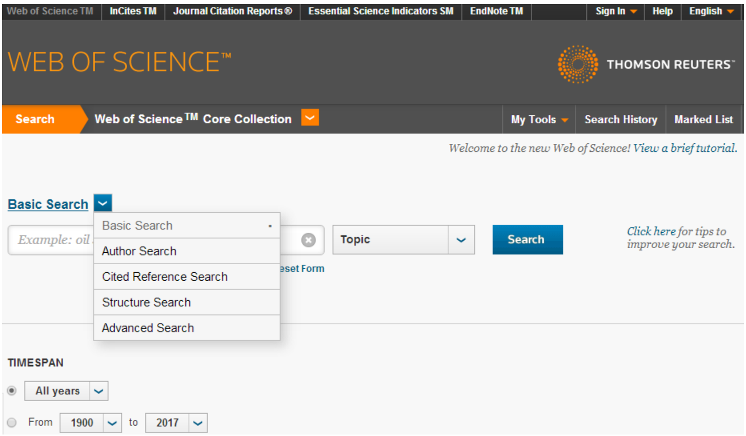



**Fig. 3.3** Advanced Search in Web of Science$^{TM}$.

(1) Go to the Current Limits section of the page to select a timespan and/or database to search.

(2) Enter the search query in the text box using the two-character field tags.

(3) To restrict the search, one or more languages and/or document types can be selected.

(4) Click Search.

(5) In the Search History table, click the link in the Results column to view the results of the search.

Boolean Operators in Web of Science Advanced Search are as follows:

**AND**: To find records containing all terms.

**OR**: To find records containing any of the terms.

**NOT**: Exclude records containing certain words in your search.

**Near**: To find records containing all terms within a certain number (n) of each other.

**Same**: Search terms that must occur within the same sentence.

Truncation and wildcard characters are used for more control in retrieving plurals and different spellings.

*: To retrieve words with variant zero to many characters.

**?**: To retrieve words words with the replacement of 1 character.

**$**: Retrieves zero or one character.

**“”**: To search exact phrases.

Using search terms, field notations and Boolean, Wildcard and Truncation commands, a query can be structured that is easily replicable and editable, resulting in stronger searches. However, there are some specific requirements for the Advanced Search features in the Web of Science. First, each search term in the query must be identified and specified as a field tag. Some of the most common field tags are TI, TS, AD, AU, etc., with the search strings as shown in Fig. 3.4.

2. Data Export

A search history is a search query or multiple search queries saved to a server or hard drive. There is no limit to the number of search histories that can be saved, and combined search sets can be created from the Search and Advanced Search functions and are listed in the Search History table in reverse numerical order, with the most recently created set at the top. The operational steps for this are as follows; the schematic diagram is as follows in Fig. 3.5.

(1) Click the AND or the OR option.

(2) Select the check box for each set that is to be combined.

(3) Click the Combine button.

(4) Click the link in the Results column to view the results of your search.

The results of a search can be displayed as a list of 10-50 items per page, with the full title, author names and source being provided. When the full text is available, the option of view free full text appears. Related records can be found and sorted by the latest date, times cited, relevance, first author, publication year, and source title. The results can also be analyzed (i.e., by author, country/ territory or document type), and a citation report presented

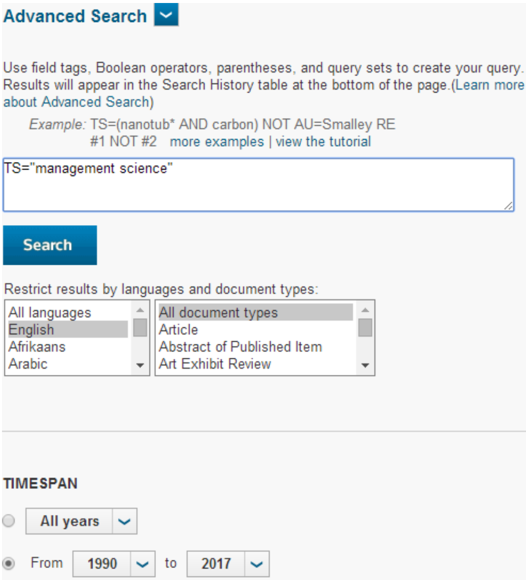



**Fig. 3.4** Search Strings in Web of Science$^{TM}$.

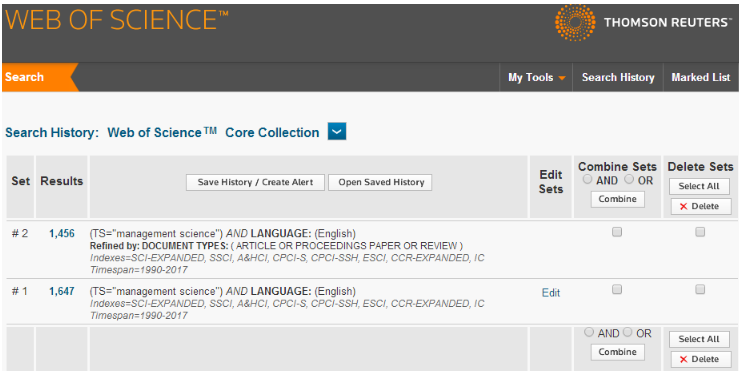



**Fig. 3.5** Search History in Web of Science$^{TM}$.

with a labeled bar chart. The results can also be further refined, and records viewed or excluded.

Output options are available from the Results and Full Record pages in all WoS databases. The options allow for the selection of all records on the Marked List (up to 500) or specific record(s) can be selected for the output, such as:

(1) Selected records on the page C Select the check box for each record.

(2) All records on page C Select a value in the Show 10, 25 or 50 per page list.

(3) Records C Select a range of records.

There are several types of ways to save: Save to Endnote Online, Save to EndNote Desktop, Save to ResearcherID, and Save to Other File Formats. For the CiteSpace analysis, Save to Other File Formats was chosen. The following file formats are available for Saving to Other File Formats: Other Reference Software, HTML, Plain Text, Tab-delimited (Win), Tab-delimited (Mac), Tab-delimited (Win, UTF-8), and Tab-delimited (Mac, UTF-8). In this paper, Plain Text was chosen. Each field is prefaced by a two-character field tag and the system saves the document as a text file (for example, savedrecs.txt), and the data can be selected to include the following:

(1) Bibliographic Fields: Includes author, title and source information.

(2) Bibliographic plus Abstract: Includes bibliographic fields and author abstract.

(3) Full Record: Includes all data on the Full Record page.

(4) Full Record plus Cited Reference: Includes all data on the Full Record page as well as the cited references.

Here choose Full Record plus Cited Reference, and the schematic diagram is as follows in Fig. 3.6.

### *3.1.2 Data Analysis*

CiteSpace is Java language information visualization software based on the citation analysis theory developed by Dr. Chen [6]. CiteSpace is designed to answer questions about a knowledge domain, which is a broadly defined concept that covers a scientific field, a research area or a scientific discipline. A knowledge domain is typically represented by a set of bibliographic records from relevant publications.

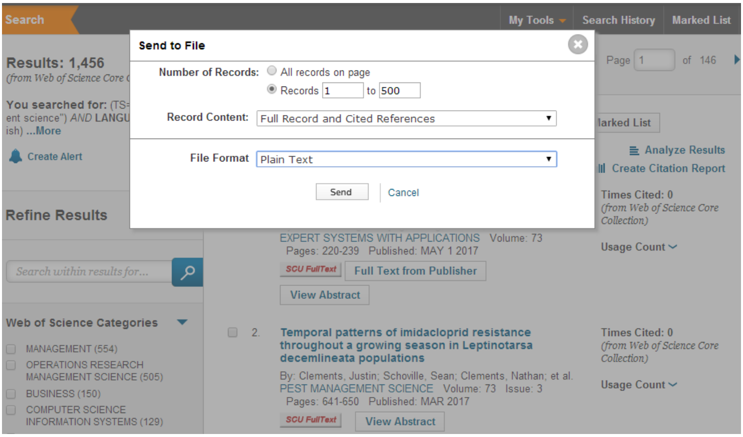



**Fig. 3.6** Data Export in Web of Science$^{TM}$ .

The design of CiteSpace was inspired by Thomas Kuhns structure for scientific revolutions, with the central idea being that research foci change over time, sometimes incrementally and sometimes drastically. Therefore, scientific developments can be traced by studying the footprints revealed in scholarly publications. As members of the contemporary scientific community make contributions, these form a dynamic, self-organizing knowledge system that embodies consensus, disputes, uncertainties, hypotheses, mysteries, unsolved problems, and unanswered questions, thereby providing a better understanding of how a specific topic is related to other topics.

The foundation of CiteSpace is network analysis and visualization. The main CiteSpace user interface is shown in Fig. 3.7. Network modeling and visualization can explore the intellectual landscape of a knowledge domain, discern what questions researchers have been trying to answer, and identify the methods and tools that have been developed to find solutions. The software integrates an information visualization method, a bibliometric method, a data mining algorithm, and a network algorithm, which allows for the research data to be transformed into a scientific knowledge map. Through the mapping, knowledge generation and interpretation, a critical evolutionary research field path and knowledge inflection points can be determined, allowing for a detailed exploration of the citations in management science journals [7, 5].

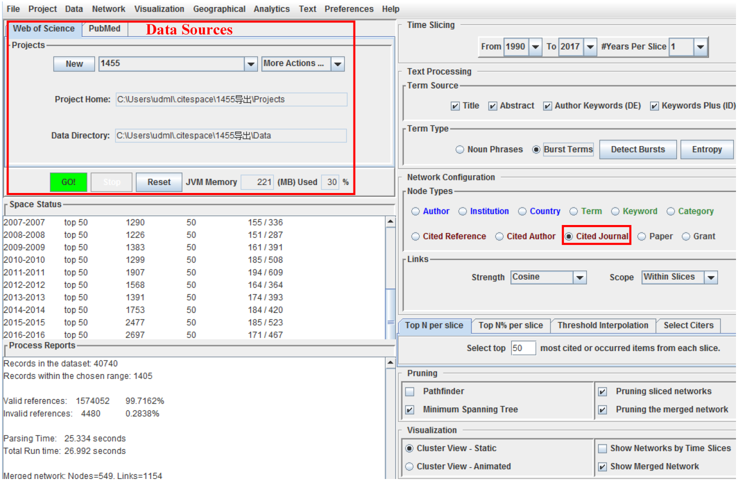



**Fig. 3.7** CiteSpace interface for configuring analysis.

1. Parameter settings.

The user interface is divided into left and right. The left-hand side contains the project controls (i.e. input datasets) and the progress report windows. The right-hand side contains several panels that allow the process to be configured using various parameters. Specifically, the CiteSpace process takes a current project input dataset, constructs network models of the bibliographic entities, and visualizes the trends and patterns identified from the dataset in networks.

First, a new project needs to be built so that the relevant research is entered into CiteSpace, as shown in Fig. 3.8. Second, the basic parameters are set using the right-hand side panels and Node Types chosen for the cited journals based on the research object. CiteSpace has a variety of functions: a collaboration atlas (author, institution and country), a co-occurrence atlas (feature word, keyword, subject category), and a co-citation atlas (literature, author and journal). A cited journal refers to the journals cited in the same document and reflects the relevance of the various journals and disciplines. The knowledge base distribution in a research field can be obtained from a cited journal analysis to further reveal the classification for the cited periodicals. Pressing the green GO button starts the process. CiteSpace reads the data files in the current project (Demo) and reports the progress in the two windows on the left-hand side of the user interface. When the modeling process is complete, there are three options given: Visualize, Save As GraphML or Cancel. Visualize is selected, which moves the analysis to the visualization window for further interactive exploration.

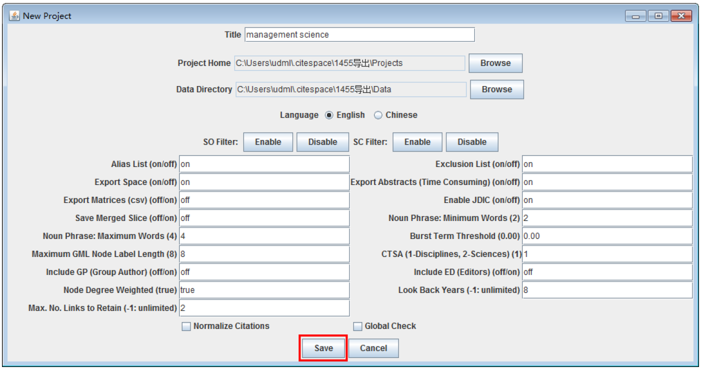



**Fig. 3.8** The establishment of the literature database into the CiteSpace.

2. Visualization results.

After clicking the Visualize button, the Visualization Window appears, which initially has movements on a black background. Once the movements have settled, the background color turns white. Here, the initial visualization is examined and the additional functions explained. First, CiteSpace gives a merged network visualization of developments in the field based on several networks that correspond to consecutive years from 1990 through 2017 and shows the most important footprints for the related research activities. Each dot represents a node or cited journals in the network. CiteSpace can also generate networks for other types of entities. The lines that connect the nodes are the co-citation links; again, CiteSpace can generate networks for other types of links. The line colors indicate when a connection was made for the first time.

Fig. 3.9 is the original graph, in which each node represents a different journal and the lines indicate the connections between the journals. The node size is related to the number of journals; that is, the greater the frequency, the larger the node. A control panel is shown on the right-hand side of the Visualization Window, in which the way the node labels are displayed can be changed using the sliders and a combination of threshold values; the node size can also be changed using the node size slider.

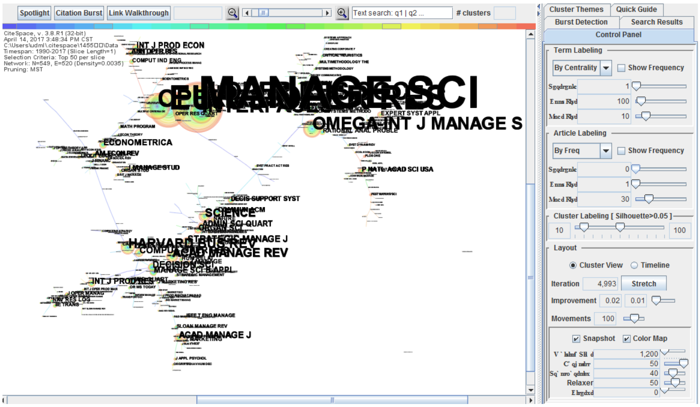



**Fig. 3.9** The visualization window: Journal cooperation and affiliations.

3. Clustering

Although it is possible to identify some prominent groupings by studying the visualized network, the clustering function in CiteSpace provides more precision to identify the groupings or clusters. To start the clustering function, the Find cluster icon is simply clicked. To characterize the nature of an identified cluster, CiteSpace extracts noun phrases from the titles (T in the following icon), keyword lists (K) or abstracts (A) of articles that cite the particular cluster; here, T was chosen. Once the process is finished, the chosen labels are displayed. By default, labels based on one of the three selection algorithms are shown; namely, TF*IDF. Cluster labels are displayed once the process is completed. ♯ Clusters on the upper right corner of the canvas will be seen. The clusters are numbered in the descending order of the cluster size, starting from the largest cluster ♯ 0, the second-largest ♯ 1, and so on.

Fig. 3.10 shows the clustering from an analysis of relevant literature from a cited management science journal, with each cluster corresponding to an underlying theme, a topic or a line of research. Kuhn's paradigm involves time period clustering, with the cluster colors indicating the average years for that cluster [16]. From this visualization, a deeper understanding as to how a cluster is connected to another cluster can be seen.

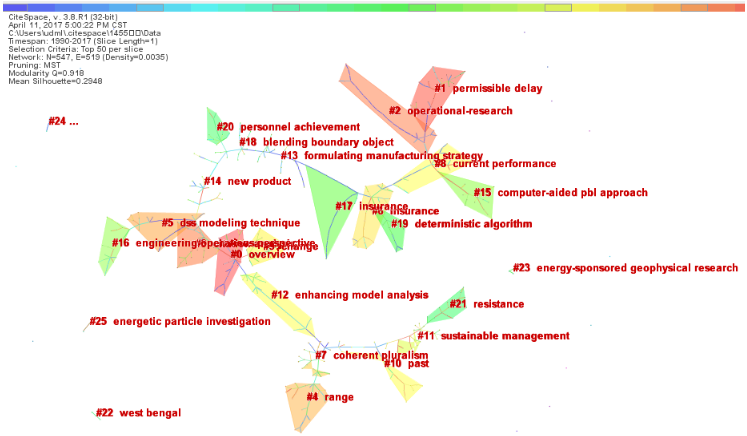
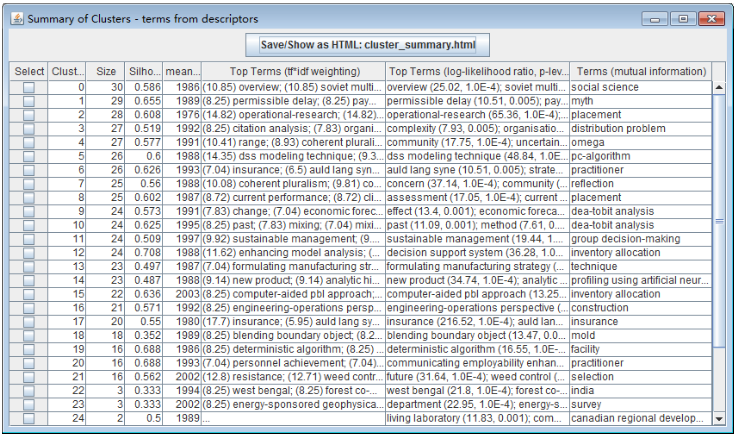



**Fig. 3.10** Members of different clusters are shown in different colors.

The network signature is shown in the upper left corner of the display. In particular, the modularity Q and the mean silhouette scores, two important metrics, describe the overall structural properties of the network. Generally speaking, a Q value in a (0.4-0.8) range indicates that the structural division is significant and the modularity Q is relatively high, which means that the network is reasonably divided into loosely coupled clusters. For an S value in a (0-1) range, the higher the silhouette score, the more consistent of the cluster members are, provided the clusters in comparison have similar sizes [8].

The various measures in each cluster can be inspected in a cluster summary table, as shown in Fig. 3.11, in which the Silhouette column displays cluster homogeneity. If the cluster size is small, however, a high homogeneity has little meaning. The average publication year of a cluster is a simple and useful measure that indicates whether the cluster consists of recent papers or older papers.



Summary of Clusters - terms from descriptors

Save/Show as HTML: cluster_summary.html

| Select | Clust... | Size | Silho... | mean... | Top Terms (tf*idf weighting) | Top Terms (log-likelihood ratio, p-lev... | Terms (mutual information) |
|---|---|---|---|---|---|---|---|
| | 0 | 30 | 0.586 | 1986 | (10.85) overview; (10.85) soviet multi... | overview (25.02, 1.0E-4); soviet multi... | social science |
| | 1 | 29 | 0.655 | 1989 | (8.25) permissible delay; (8.25) pay... | permissible delay (10.51, 0.005); pay... | myth |
| | 2 | 28 | 0.608 | 1976 | (14.82) operational-research; (14.82)... | operational-research (65.36, 1.0E-4);... | placement |
| | 3 | 27 | 0.519 | 1992 | (8.25) citation analysis; (7.83) organi... | complexity (7.93, 0.005); organisatio... | distribution problem |
| | 4 | 27 | 0.577 | 1991 | (10.41) range; (8.93) coherent plurali... | community (17.75, 1.0E-4); uncertain... | omega |
| | 5 | 26 | 0.6 | 1988 | (14.35) dss modeling technique; (9.3... | dss modeling technique (48.84, 1.0E... | pc-algorithm |
| | 6 | 26 | 0.626 | 1993 | (7.04) insurance; (6.5) auld lang syn... | auld lang syne (10.51, 0.005); strate... | practitioner |
| | 7 | 25 | 0.56 | 1988 | (10.08) coherent pluralism; (9.81) co... | concern (37.14, 1.0E-4); community (... | reflection |
| | 8 | 25 | 0.602 | 1987 | (8.72) current performance; (8.72) cli... | assessment (17.05, 1.0E-4); current ... | placement |
| | 9 | 24 | 0.573 | 1991 | (7.83) change; (7.04) economic forec... | effect (13.4, 0.001); economic foreca... | dea-tobit analysis |
| | 10 | 24 | 0.625 | 1995 | (8.25) past; (7.83) mixing; (7.04) mixi... | past (11.09, 0.001); method (7.61, 0.... | dea-tobit analysis |
| | 11 | 24 | 0.509 | 1997 | (9.92) sustainable management; (9.... | sustainable management (19.44, 1.... | group decision-making |
| | 12 | 24 | 0.708 | 1988 | (11.62) enhancing model analysis; (... | decision support system (36.28, 1.0... | inventory allocation |
| | 13 | 23 | 0.497 | 1987 | (7.04) formulating manufacturing str... | formulating manufacturing strategy (... | technique |
| | 14 | 23 | 0.487 | 1988 | (9.14) new product; (9.14) analytic hi... | new product (34.74, 1.0E-4); analytic ... | profiling using artificial neur... |
| | 15 | 22 | 0.636 | 2003 | (8.25) computer-aided pbl approach;... | computer-aided pbl approach (13.25... | inventory allocation |
| | 16 | 21 | 0.571 | 1992 | (8.25) engineering-operations persp... | engineering-operations perspective (... | construction |
| | 17 | 20 | 0.55 | 1980 | (17.7) insurance; (5.95) auld lang sy... | insurance (216.52, 1.0E-4); auld lan... | insurance |
| | 18 | 18 | 0.352 | 1989 | (8.25) blending boundary object; (8.2... | blending boundary object (13.47, 0.0... | mold |
| | 19 | 16 | 0.688 | 1986 | (8.25) deterministic algorithm; (8.25) ... | deterministic algorithm (16.55, 1.0E-... | facility |
| | 20 | 16 | 0.688 | 1993 | (7.04) personnel achievement; (7.04)... | communicating employability enhan... | practitioner |
| | 21 | 16 | 0.562 | 2002 | (12.8) resistance; (12.71) weed contr... | future (31.64, 1.0E-4); weed control (... | selection |
| | 22 | 3 | 0.333 | 1994 | (8.25) west bengal; (8.25) forest co-... | west bengal (21.8, 1.0E-4); forest co-... | india |
| | 23 | 3 | 0.333 | 2002 | (8.25) energy-sponsored geophysica... | department (22.95, 1.0E-4); energy-s... | survey |
| | 24 | 2 | 0.5 | 1989 | ... | living laboratory (11.83, 0.001); com... | canadian regional develop... |

**Fig. 3.11** A summary table of clusters.

## 3.2 Process Description

A systematic literature review allows for current findings to be discussed in relation to a particular research question, as scientific knowledge based on text usually has its own life cycle evolution. By analyzing the evolutionary patterns, the foci and clusters in scientific literature can be determined, which has been an important text mining research direction in recent years [13, 14]. As the literature analysis expands the literature mining scope, it can be used to categorize the journals and journal rankings. Pang proposed a multi-feature co-occurrence and visualization research method in 2012. Through the above analysis, multidimensional research developments in scientific literature can be discovered and observed [18]. For this work, a data analysis system (DAS) was created to evaluate all relevant MSEM journals to achieve the above goals.

### *3.2.1 Category Identification*

The CiteSpace data format uses text data from the WoS database as standard, which allows for an easy identification of a subjects evolution and which targets to retrieve, and also provides data clustering and other forms of visual mapping, which gives more effective analyses and saves time [17]. In this way, research on the category identification of management science will use this kind of data retrieval and visual analysis method.

(1) DAS-A

To identify the most relevant categories, data-driven approaches using popular academic search engines were used, after which appropriate technology and software based on data flow were used to evaluate the extracted research papers [24]. Science mapping (theory) and CiteSpace (tool) were consecutively used to develop Data Analysis System A (DAS-A) to describe the research process and produce the visualization results. The DAS-A is shown in Fig. 3.12. As can be seen, this system is based on the consecutive use of the WoS for data collection and CiteSpace for the VISUALIZING PATTERNS AND CLUSTERS IN JOURNALS OF SCIENTIFIC LITERATURE; therefore, the DAS process forms a dynamic cycle.

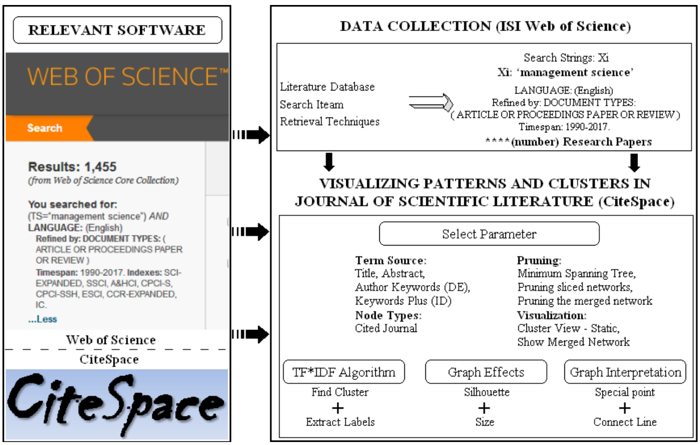



**Fig. 3.12** Data analysis system A (DAS-A) for category identification.