Advances in Green Supply Chain, Resource Optimization Management, Risk Control and Integrated Project Management Based on the Eleventh ICMSEM Proceedings

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Abstract. Management Science and Engineering Management (MSEM) have significantly contributed to developments in society and economy, especially in management and control processes. In this paper, we first describe the basic concepts covered in the eleventh ICMSEM proceedings Volume II. We then conduct a review of engineering management (EM) research to identify the key areas, from which green supply chain, resource optimization management, risk control and integrated project management were found to be the most widely discussed research areas. After a summary of the key research achievements in the four areas, the high frequency EM keywords in the proceedings volume II are identified using NodeXL. The research trends both from MSEM journals and the ICMSEM are then summarized using the CiteSpace tool. As always, we are committed to providing an international forum for academic exchange and communication through the ICMSEM and plan to continue our innovative MSEM progress in the future.

Keywords: Green supply chain · Resource optimization management · Risk control · Integrated project management

1 Introduction

Management Science and Engineering Management, which emphasizes the theories, methods and engineering practice of complex management decision making, has been playing a vital role in both scientific endeavor and societal development. The increase in MSEM research in the past few decades has brought new vitality to management and engineering practice. At the same time, through the continuing and expanding development of innovative managerial tools, MSEM has significantly contributed to advancements in domestic and international economic development and increased general scientific management consciousness. MSEM is a complex synthesis with a broad research focus that combines complex management theories and practical engineering solutions to successfully solve management practice problems. This kind of cross-functional,

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multidisciplinary research supports real world management execution, improves management efficiency, and contributes to energy conservation.

MSEM research is widely applied to management problems that involve extensive engineering concepts. In proceedings volume I, the focus is on management science (MS) and its future development trends. Engineering management (EM) is therefore the main focus of proceedings volume II. Kocaolgu's defined EM as a field that examines engineering management using comprehensive scientific research to develop innovative engineering solutions that can improve technical organization, technical resources, and technical systems [5], in areas such as manufacturing, construction, design engineering, and industrial engineering. The ICMSEM proceedings Volume II focuses on four key EM areas; the green supply chain, resource optimization management, risk control, and integrated project management.

2 Literature Review

To better analyze the pertinent research fields and possible research directions, we reviewed the most popular research areas in the most recent EM research. What emerged was that the green supply chain, resource optimization management, risk control, and integrated project management have been the most widely studied in recent years. In this section, we review the related literature to analyze the developmental tracks in these four areas.

2.1 Green Supply Chain

The supply chain management concept emerged in the early 1980s, with the green supply chain (GSC) being first proposed by Michigan State University Manufacturing Research Association in 1996. Lambert et al. defined supply chain management as the integration of key business processes from the end user to the original suppliers to provide products, services, and information to add value for customers and other stakeholders [8]. Brazil Sarkis examined the social and cultural dimensions in green supply chain management and found that cultural boundaries govern the type of management skills and control processes used [7]. To empirically investigate the construction and scale of green supply chain management (GSCM) implementation by manufacturers, Zhu et al. tested two GSCM implementation measurement models and compared them using confirmatory factor analysis [19]. As a supply chain grows in scale and operation, its structure becomes more complicated. Some scholars have taken a fresh look at integrated green supply chain management [4, 13, 14] to ensure continuing sustainability.

2.2 Resource Optimization Management

Resource optimization management (ROM) is the efficient and effective deployment and allocation of an organization's resources when and where they are needed. Such resources may include financial resources, inventory, human skills, production resources, or information technology. Resources and energy shortages have become the main factors restricting the sustainable development of national economies, as low resource efficiency and high energy consumption can result in a serious waste of resources putting significant pressure on resources and environmental governance. Vadenbo presented a general multi-objective mixed-integer linear programming (MILP) optimization model aimed at providing decision support for waste and resource management in industrial networks [15]. Further, energy resource shortage problems associated with rapid social and economic development have been of critical concern to both national and local governments worldwide for many decades [9]. Water, as one of the most important resources on earth has therefore received a great deal of research attention, with water optimization management being a major focus in the past few years [1, 12, 18]. ROM involves all aspects of social life, so research strives to further develop this area using modern computer technology.

2.3 Risk Control

Risk control (RC) is the coordinated and economic application of resources to minimize, monitor and control the impact probability of unfortunate events, or to maximize the realization of opportunities after the identification, assessment and prioritization of risks. Muriana and Vizzinib presented a deterministic technique for assessing and preventing project risks by determining the risk of the Work Progress Status [10]. Valtonen et al. studied public risk management related to the use of public land development by analyzing case studies in Finland and the Netherlands, both of which have strong public land development traditions [16]. By identifying risks, specific state support and special project management measures have been developed to limit the negative influence of the possible project risks [17]. Therefore, developing a general framework to analyze corporate risk management policies and ensure risk control is vital [6]. In brief, RC includes transferring risk to another party by avoiding risk, reducing the negative effects of risk, and accepting some or all of the consequences of a particular risk.

2.4 Integrated Project Management

Integrated project management (IPM) is a philosophy that recognizes the different elements involved in projects to apply strong team leadership and encourage a collaborative ethos with clear purposes and strategies to ensure success. Planning, organizing, securing, and managing resources to successfully complete specific project goals and objectives are the main IPM research areas, the applications for which have been used in manufacturing, construction, design engineering, industrial engineering, technology, production and many other areas. Atkinson provided some thoughts about the success criteria for project management in which cost, time, and quality have become inextricably linked to project management success over the last 60 years [2]. An integrated methodology was developed for planning construction projects under uncertainty that relied on a computer supported risk management system to identify the risk factors in the integrated project [11]. IPM has also been applied to integrated waste management systems to identify the optimal breakdown between materials and energy recovery from municipal solid waste [3]. In all, integrated project management is a complex subject and needs to be examined from several perspectives.

3 Central Issues in the Proceedings Volume II

Keywords are an important index for the identification of essential content in research articles. The keywords in the 75 articles in Volume II were extracted to a database to allow for a tendency analysis. The keywords were sorted using the Keywords Match software that matched the keywords that were uniform or similar. Finally, the matched keywords were imported into NodeXL software to obtain the initial visual image shown in Fig. 1.

Fig. 1. DAS literature mining

With EM as the key component, the open source software tool NodeXL was used to facilitate the learning of the concepts and methods. To begin with, some key words were processed to unify expressions and keywords with the same meaning. This preliminary process reduced the number of keywords, making it possible to develop an efficient network. At the same time, the vertices' shapes were set to determine the betweenness and closeness centrality. When the degree of a vertex's betweenness and closeness centrality was more than five, the shape of this vertex was a red diamond in the resulting figure. The aim of this analysis was to determine the key EM concepts that connected with other research topics through the primary nodes. After calculating, clustering and filtrating, the results in Fig. 2 illustrate the important research relationships.

The above analysis highlighted the key areas focused on in the proceedings volume II; green supply chain management, resource optimization management, risk control and integrated project management problems related to green and pro-environment concepts. Tao focuses on a simplified manufacturing and distribution supply chain planning network focused on carbon emission constraints, for which a bilevel programming model was mathematically formulated. Through the study of related emissions policies, Lu finds that under different carbon policies, revenue sharing contracts are able to coordinate the supply chain with the manufacturer's revenue sharing proportion under

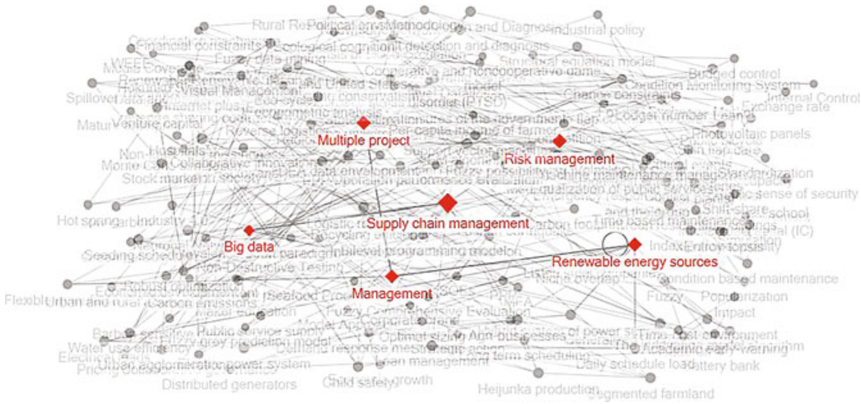

Fig. 2. Research topics in EM for the Eleventh ICMSEM

a cap-and-trade being always less than a situation in which there is no carbon emissions constraint. Machado and Duarte present an overview of Industry 4.0, a new developing concept in the field of industrial engineering, and lean and green supply chain management, for which a conceptual model is developed. Wang et al. concludes that when big data suppliers are part of the supply chain competition and one party gains a dominant supply chain position, collaborative decision-making is the key to enhancing overall supply chain profitability. These studies highlight the many new characteristics involved in green supply chains, such as big data and carbon emissions reductions.

Resource optimization management primarily covers resource processing, exploitation, production, and consumption. Arifjanov and Zakhidov consider an issue for the development of methods for the estimation of electrical loads for various electricity customers in residential and public buildings, and address issues related to the integration of distributed generators to the UES to ensure the optimal management of technological modes. Gómez Munoz et al. develops an optimal maintenance strategy that includes the NDT system to reduce costs and increase the competitiveness of renewable energy sources. For water resource optimization, Tu et al. proposes an equity and sustainability based model that considers equity, economic benefit, and ecological environment and Liu et al. uses a DEA method to establish an evaluation model to empirically study the urban agglomeration of Chengdu city from 2008–2014. Because of the wide use and serious shortage of some resources around the world, scientific research into resource optimization management has increased to assist governments and enterprises around the world.

Risk control is important in all organizations and enterprises. In this section, Zhou et al. presents a model to mitigate the risk of budget overruns during raw materials procurement, and Chen et al. provides a risk allocation model using a fuzzy comprehensive evaluation method aimed at optimizing risk allocations, reducing transaction costs, and enhancing comprehensive benefits from the perspective of state-owned enterprises. Beside these studies, to better control risks occurring in financial markets, Shibli et al. investigates the link between the foreign exchange markets and the stock market in

Bangladesh by examining the volatility spillover between the markets, volatility persistence, and the asymmetric effect of information on the volatility of these two financial markets. In addition, Zhang et al. studies a projection pursuit risk assessment model using a combined method to model PPP risk under the background of Big Data. Effective risk control can reduce potential risk factors and assist managers gain increased benefits.

The last section in Volume II focuses on the developments in integrated project management. Elchan defines the scientific problems associated with management at the beginning stages of an innovation project in the departments of a technology park at a higher education school in Azerbaijan. Based on principal-agent theory and game theory, a theoretical framework for a knowledge network conflict coordination mechanism is constructed by Wei, which divides the conflict coordination mechanism into three levels; contract mechanism, self-implementation mechanism, and a third-party conflict coordination mechanism. Sheng et al. proposes suggestions and countermeasures for the equalization of public services in urban and rural areas from three integrated project aspects and Tu et al. develops two staged fuzzy DEA models with undesirable outputs to evaluate the banking system. The overall process of leading, organizing, staffing, planning, and controlling activities requires managers to use systems viewpoints, methods, and theories to optimize the work involved when seeking effective integrated project management under limited resource constraints.

4 Evaluation of EM and ICMSEM Development Trends

In this section, we evaluate the ICMSEM to validate that the research trends are in line with the trends emerging in current MSEM journals. At first, CiteSpace, an information visualization technology developed by Chen, was utilized to draw the a scientific knowledge map that display the development trends in a discipline or knowledge domain over a certain period, and identifies the possible evolution through an analysis of the research frontiers.

"Advanced search" with "engineering management" was used as the identifier in the "web of science" database with a timespan from 2000 to 2017. Initially, 42499 published articles were identified and after the final screening using TI = (engineering management) 2963 articles were reviewed.

4.1 The Development Trends of EM

The statistics from the 2963 articles recorded output were saved and converted into CiteSpace which transformed the data into a format that could be identified by the software to allow for parameter selection. In this operation, the time span was from 2000 to 2017 with the time slice set at one year and the theme selection based on the titles, abstract subject words, identifiers, and keywords to allow for node selection. Then, each zone with the 30 highest keyword records were clustered and analyzed, from which a map was drawn for the minimum spanning tree. As shown in Fig. 3, by setting the

"Threshold = 30", a total of 348 nodes were obtained, with the overall network density being 0.0098. Therefore, the system frequency identified green supply chain management, environmental management, project management, risk management, and models and systems as the highest ranked areas. This not only displayed the most popular research fields in engineering management but also implied the future EM development trends.

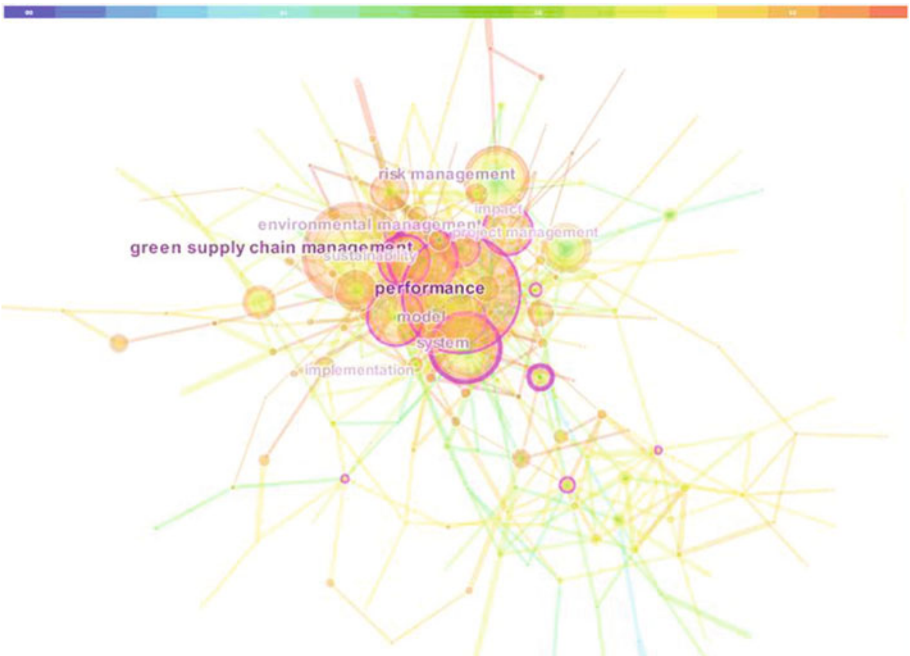

Fig. 3. The results of co-occurring keywords in EM

With a reference frequency running from high to low, the top thirty were analyzed from the 348 keywords. As shown in Table 1, the keywords such as green supply chain management, risk management, environmental performance and sustainability had a relatively high centrality.

Using the keyword with the label title clustering, 40 categories were identified; however, only the top 10 categories are shown in Fig. 4. The other topics were relatively dispersed so are not displayed, which indicated that scientific engineering management research was relatively loose. In particular, the new keywords for 2015 and 2016 have not resulted in significant research attention.

Table 1. The top thirty hot keywords of EM

Frequency	Centrality	Year	Cited references
84	0.11	2010	Performance
77	0.03	2011	Green supply chain management
54	0.07	2002	Model
54	0.08	2002	Risk management
52	0.27	2007	System
48	0.21	2011	Environmental management
41	0.15	2007	Implementation
40	0.1	2012	Sustainability
39	0.05	2007	Project management
38	0.12	2011	Impact
36	0.11	2011	Industry
32	0.05	2011	Strategy
29	0.08	2010	Perspective
29	0.12	2010	China
25	0.04	2011	Green supply chain
24	0.05	2010	Framework
21	0.06	2011	Innovation
21	0.04	2009	Integration
20	0.05	2008	Firm
20	0.05	2011	Reverse logistics
20	0.05	2011	Design
17	0.01	2012	Capability
17	0.02	2013	Initiative
16	0.21	2004	Risk
16	0.05	2011	Pressure
16	0.01	2010	Environmental performance
15	0.1	2008	Quality
15	0.01	2013	Selection
15	0.06	2007	Uncertainty
15	0.05	2008	Optimization

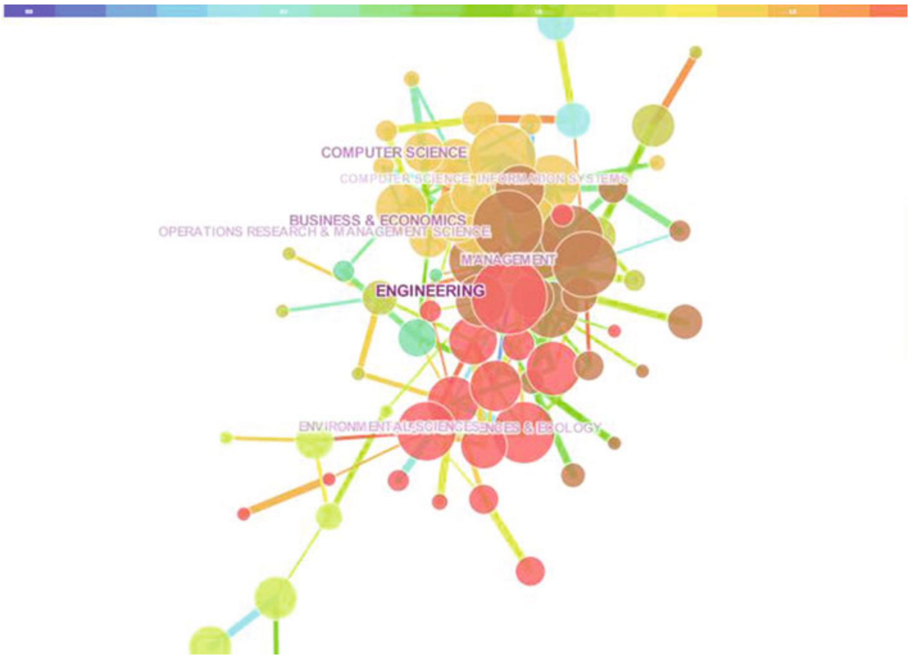

Fig. 4. The results of research fields clustering of EM

4.2 Future Development Predictions

To further understand the focused engineering management research areas, we examined each category to determine the common themes. At "Threshold = 30", the high fre-

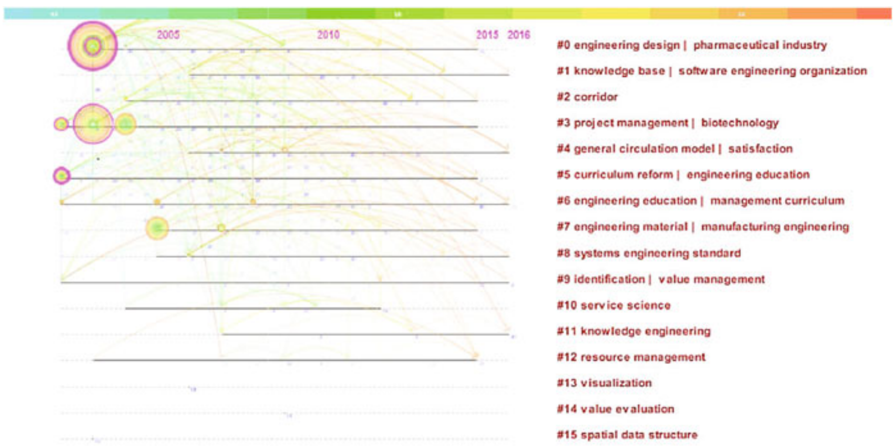

Fig. 5. The category clustering of EM timeline view

Table 2. The results of top thirty categories

Frequency	Centrality	Year	Cited references
307	0.21	2002	Engineering
185	0.01	2004	Business & Economics
176	0.01	2002	Computer Science
136	0.13	2005	Management
104	0.05	2002	Operations Research & Management Science
102	0.02	2002	Environmental Sciences & Ecology
95	0.22	2002	Environmental Sciences
73	0.12	2002	Computer Science, Information Systems
71	0.07	2002	Engineering, Electrical & Electronic
70	0.02	2005	Engineering, Industrial
68	0.13	2004	Business
60	0.02	2007	Engineering, Civil
51	0.17	2006	Economics
50	0.02	2007	Computer Science, Theory & Methods
50	0.1	2005	Computer Science, Interdisciplinary Applications
50	0.09	2002	Engineering, Environmental
47	0.23	2004	Water Resources
42	0.05	2006	Business, Finance
41	0.12	2010	Science & Technology - Other Topics
39	0	2002	Cardiovascular System & Cardiology
39	0.04	2007	Engineering, Manufacturing
38	0.06	2006	Computer Science, Artificial Intelligence
32	0	2013	Green & Sustainable Science & Technology
28	0.11	2005	Construction & Building Technology
28	0.04	2002	Telecommunications
27	0	2004	General & Internal Medicine
26	0.08	2004	Medicine, General & Internal
25	0	2002	Cardiac & Cardiovascular Systems
24	0.04	2010	Materials Science
23	0	2003	Peripheral Vascular Disease

quency research areas and timezone view diagram were identified, as shown in Fig. 5. Most of these high frequency words appeared in the early days, indicating that engineering management research has been focused around these topics for quite a long time. The analysis of the top 30 most frequent words (Table 2), found that engineering, business and economics, computer science, environmental science and operations research are currently the most popular research areas.

From Tables 1 and 2, the papers presented in this year's ICMSEM proceedings volume II closely reflect the most pertinent engineering management research areas; green supply chain (systems management, industry, green and environmental protection), resource optimization management (environmental sciences, water resources, engineering education), integrated project management (project management, industry, integrated project) and risk control (risk management, risk, design, information). In addition, the computer science and environmental science research highlights how high-tech can spur social progress and environmental protection.

We believe that EM should focus on the study of specific EM problems as well as popularizing MS knowledge. Excellent academic research can effect developments across the world, but a further focus on regional areas is also needed. To ensure a bright EM future, there is a need for inspiration, practical theories, effective methods, and extensive applications in future developments. To achieve this, EM knowledge needs to be popularized, which is the duty of all MSEM academics. In the future, more focus on low carbon emissions, environmental protection, big data, energy utilization, and other popular EM issues are needed.

5 Conclusion

Engineering management is a complex area that involves all engineering aspects. The open source software tool NodeXL identified the four areas covered in the eleventh ICMSEM proceedings Volume II, from which we summarized the key research in this year. To analyze the EM and ICMSEM development trends, we identified the main search terms and keywords using CiteSpace. Our key objective is to continue to improve the quality of papers in the proceedings and to ensure the ICMSEM organization is dynamic and appealing to EM researchers worldwide. EM research is continuously developing and new trends are appearing every year; however, more research is necessary so as to popularize EM developments and provide a more active research forum.

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