Lecture Notes in Electrical Engineering 241

Jiuping Xu
John A. Fry
Benjamin Lev
Asaf Hajiyev *Editors*

Proceedings of the Seventh International Conference on Management Science and Engineering Management

Focused on Electrical and Information Technology

Volume 1

Springer

Lecture Notes in Electrical Engineering

Volume 241

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Editors

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Focused on Electrical and Information Technology (Volume 1)

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ISSN 1876-1100 ISSN 1876-1119 (electronic)
ISBN 978-3-642-40077-3 ISBN 978-3-642-40078-0 (eBook)
DOI 10.1007/978-3-642-40078-0
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013946219

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Welcome to the proceedings of the Seventh International Conference on Management Science and Engineering Management (ICMSEM2013) held from November 7 to 9, 2013 at Drexel University, Philadelphia, Pennsylvania, USA.

International Conference on Management Science and Engineering Management is the annual conference organized by the International Society of Management Science and Engineering Management (ISMSEM). The goals of the Conference are to foster international research collaborations in Management Science and Engineering Management as well as to provide a forum to present current research results in the forms of technical sessions, round table discussions during the conference period in a relax and enjoyable atmosphere. 1420 papers from 35 countries were received and 130 papers from 12 countries were accepted for presentation or poster display at the conference after a serious review. These papers are from countries including USA, UK, Japan, Germany, Spain, Portugal, Turkey, China, Azerbaijan, Pakistan, Saudi Arabia and Australia. They are classified into 8 parts in the proceedings which are Computer and Networks, Information Technology, Decision Support System, Manufacturing, Supply Chain Management, Project Management, Ecological Engineering and Industrial Engineering. The key issues of the seventh ICMSEM cover various areas in MSEM, such as Decision Support System, Computational Mathematics, Information Systems, Logistics and Supply Chain Management, Relationship Management, Scheduling and Control, Data Warehousing and Data Mining, Electronic Commerce, Neural Networks, Stochastic models and Simulation, Heuristics Algorithms, Risk Control, and Carbon Credits. In order to further encourage the state-of-the-art research in the field of Management Science and Engineering Management, ISMSEM Advancement Prize for MSEM will be awarded at the conference for these researchers.

The conference also provides a suitable environment for discussions and exchanges of research ideas among participants during its well-organized post conference tours. Although we will present our research results in technical sessions, participate in round table discussions during the conference period, we will have extra and fruitful occasions to exchange research ideas with colleagues in this relaxed and enjoyable atmosphere of sightseeing.

We want to take this opportunity to thank all participants who have worked hard to make this conference a success. We appreciate the help from Drexel University and Sichuan University in conference organization. We also appreciate Springer-Verlag London for the wonderful publication of the proceedings. We are also grateful to all members of Organizing Committee, Local Arrangement Committee and Program Committee as well as all participants who have worked hard to make this conference a success. Finally we want to appreciate all authors for their excellent papers to this conference. Due to these excellent papers, ISMSEM Advancement Prize for MSEM will be awarded again at the conference for the papers which describe a practical application of Management Science and Engineering Management.

7-9 November 2013
Philadelphia, Pennsylvania, USA

ICMSEM General and Program Chairs

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ICMSEM 2013 was organized by International Society of Management Science and Engineering Management, Sichuan University (Chengdu, China), Drexel University (Philadelphia, Pennsylvania, USA). It was held in cooperation with Lecture Notes in Electrical Engineering (LNEE) of Springer.

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Chapter 1
Advancements of Engineering Management Based on Electrical and Information Technology for the Seventh ICMSEM

Jiuping Xu

Abstract Computers, networks, information technology, project management, decision support systems, industrial engineering, supply chain management, manufacturing, and ecological engineering are all parts of engineering management based on electrical and information technology (EMEI), which is an interdisciplinary subject that focuses on solving engineering management problems. The goal of the ICMSEM is to foster international research collaboration in EMEI. In this paper, we first give an overview of the former six ICMSEMs. Then, following the technology development trend, we present the central issues of the seventh ICMSEM. Third, by investigating EMEI development, we highlight its important influence on academic research and practical guidance. EMEI's continuous development has brought an upsurge in research and has shown increasing development. The ICMSEM from 2007 to 2013 are closely concerned with the EMEI development trends and reflects the EMEI advancements. After this, Computer-based Research Methodology, a unique research idea,is proposed to interpret the ICMSEM and promote EMEI development. Further, to give prominence to EMEI progress, an evaluation of the seventh conference is conducted. The ICMSEM offers a breakthrough in conference organization as it provides a convenient platform for academic exchange and communication and continues to play a role in promoting EMEI advancements into the future. Finally, we express our thanks to all those concerned and consider prospects for the coming year's conference.

Keywords Computer and networks · Information technology · Project management · Decision support system · Industrial engineering · Supply chain management · Manufacturing · Ecological engineering

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J. Xu et al. (eds.), *Proceedings of the Seventh International Conference on Management Science and Engineering Management (Volume 1)*,
Lecture Notes in Electrical Engineering 241, DOI: 10.1007/978-3-642-40078-0_1,

1.1 Overview of the Previous Six ICMSEMs

The International Conference on Management Science and Engineering Management (ICMSEM) is an annual conference organized by the International Society of Management Science and Engineering Management (ISMSEM) to foster international research collaboration and to provide a forum for the presentation of current research at technical sessions, and round table discussions in a relaxed and enjoyable atmosphere. Management Science (MS) and Engineering Management (EM), because of their focus on computer networks and information technology, have a significant influence on engineering project management, decision making, evaluation and forecasting, supply chain management, risk management and ecological engineering management. MSEM and EMEI have experienced significant international development in recent years and have become increasingly popular topics in management and operations research.

Since 2007, ICMSEM has been successfully held six times in Chengdu, Chongqing, Bangkok (Thailand), Taiwan, Macau and Islamabad (Pakistan). Except for the Fifth conference, all the proceedings of the previous ICMSEMs have been archived by ISTP retrieval and the proceedings of the First, the Third and the Sixth ICMSEMs have been archived by EI retrieval. The Seventh conference is scheduled to be held at Drexel University, Philadelphia, USA on November 7-9, 2013. The total number of received and accepted papers for all seven ICMSEMs is shown in Fig. 1.1.

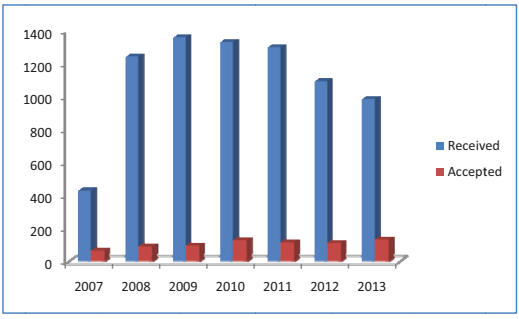

Fig. 1.1 The total number of received and accepted papers for all seven ICMSEMs

The previous six ICMSEMs received more than 6729 papers received from nearly 40 countries and nearly 480 papers were accepted for presentation or poster display at the conference after a thorough referee review [40, 41]. The accepted papers were from more than 20 countries, including Germany, Spain, Portugal, Australia, the UK, the USA, Japan, Korea, Brazil, Turkey, India, Azerbaijan, Pakistan, China and Thailand. Papers in the previous six ICMSEMs focused on various MSEM fields, such as Uncertainty Decision-Making, Logistics and Supply Chain Management, Operations Management, Engineering Project Management, Industry Engineering, Industrial Value Chains, Financial Management, Enterprise Management, Environ-

ment Resources Management, Knowledge Management, Risk and Emergency Management, and Service Management. Fig. 1.2 shows a group picture of the sixth ICMSEM.

Fig. 1.2 A group picture of the sixth ICMSEM

1.2 Key Issues of the Seventh ICMSEM

The Seventh ICMSEM is scheduled to be held from November 7 to 9, 2013 in Philadelphia, USA and is accepted to be a further development of the previous six year. This year, 1420 papers from 35 countries have been received and 130 papers from 12 countries have been accepted for presentation or poster display at the conference. The papers accepted are from many countries including USA, UK, Japan, Germany, Spain, Portugal, Turkey, China, Azerbaijan, Pakistan, Saudi Arabia and Australia. They have been classified into 8 sections in the proceedings: Computers and Networks, Information Technology, Decision Support Systems, Manufacturing, Supply Chain Management, Project Management, and Ecological Engineering and Industrial Engineering. The key issues of the seventh ICMSEM cover various areas of EMEI, such as Decision Support Systems, Computational Mathematics, Information Systems, Logistics and Supply Chain Management, Relationship Management, Scheduling and Control, Data Warehousing and Data Mining, Electronic Commerce, Neural Networks, Stochastic models and Simulation, Heuristic Algorithms, Risk Control, and Carbon Credits. 85 of these papers have been sponsored by national funds, 55 by provincial funds and 13 by school funds. All papers in the proceedings have been published by Springer and delivered to ISTP and EI Compendex for retrieval. In order to further encourage state-of-the-art research in Man-

agement Science and Engineering Management, the ISMSEM Advancement Prize for EMEI will be awarded at the conference. Papers sponsored by funding have increased year by year. Figs. 1.1 and 1.3 show the total number of papers and funding support for the ICMSEM over the first seven years, respectively, which shows an upsurge in the ICMSEM in not only the total number of received and accepted papers, but also the funding support on all levels of the ICMSEM over the first seven years.

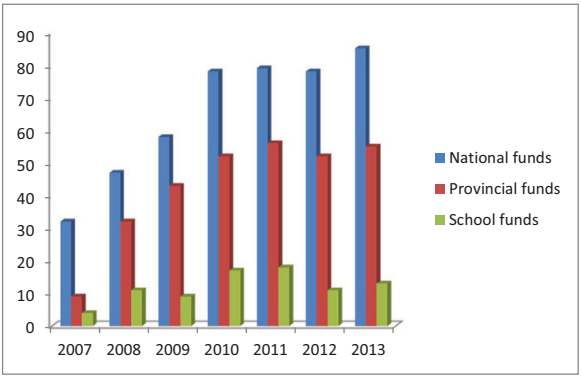

Fig. 1.3 The total number of funding supports on all levels of the ICMSEM over the first seven years

In accordance with the proceedings of the sixth ICMSEM, the proceedings of the seventh ICMSEM focus on solving management problems associated with engineering problems and computer-based research methodology. In this study, the NODEXL was used to determine the research focus of the ICMSEM seventh proceedings. Fig. 1.4 shows that the papers accepted by the seventh ICMSEM are divided into 8 sections covering the most popular issues of the day. It should be noted that the section classifications depend on the key words in all the accepted papers and small revisions were made to express the same meanings. For example, "fuzzy environments" and "uncertain environments" were adjusted to "decision environments" when integrated into NODEXL.

1.2.1 The Focus Area of the Seventh ICMSEM

To begin with, computers and networks are the basic EMEI tools as they provide a foundation for the discussion of practical management problems. In this part, Mehmet Kurt et al presents an optimization of Bandpass lengths in a Multi-Bandpass problem and smoothly implement it. Jae et al explores the determinants of knowledge sharing in a social network. Building on social cognitive theory, social capital theory, and technology acceptance theory, this research-in-progress pa-

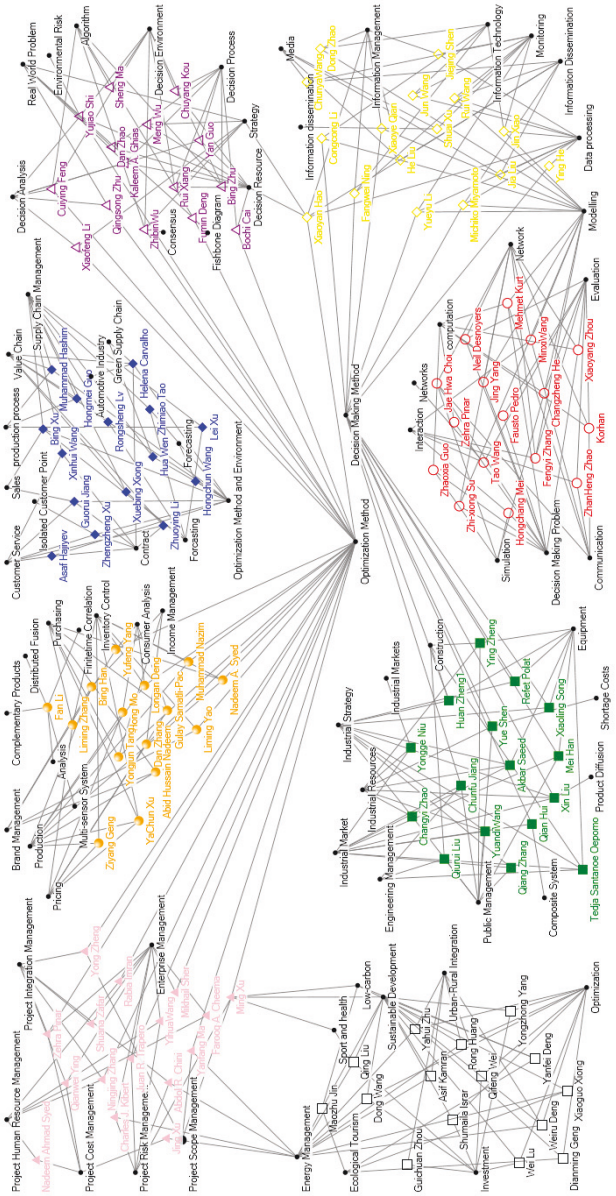

Fig. 1.4 The distribution of the articles in the seventh ICMSEM

per aims to explore how personal cognition, social capital, and technology acceptance attitudes affect knowledge sharing in social networking. Fengyi Zhang and Zhigao Liao forecast prices based on PCA and RBF neural networks by employ-

ing a hybrid fuzzy clustering algorithm. Mikhail and Avijit propose a procedure for modeling and solving large scale unit commitment problems using a parallel computing approach. The research in this section shows an excellent combination of computer-based techniques and practical guidance.

Information technology (IT), the second section, is an appropriate technical platform for solving practical management problems, and is defined as "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware", according to the Information Technology Association of America. IT is playing an increasingly dominant part in modern society. Using the MIT90s framework on Japanese enterprises, Miyamoto et al investigates a fit between strategy, organizational structure, management process, individual roles and skills, and IT, to gain competitive advantage. Korhan et al examines how to handle the extraction of learning concepts using support vector machines as a supervised learning algorithm.

The third part is focused on decision support systems. Decision support systems area class of computer-based information systems that support knowledge management, decision making, and management reporting and assist managers in making decisions in highly uncertain and complex environments. In this part, Asaf et al introduces a control function to reduce average customer waiting time. Li and Liu establish a Rough-ANN model for the dynamic risk measurement of technological enterprise innovation based on Rough set theory and the ANN method. Asif et al looks into empirical studies and theoretical frameworks to identify the explanatory variables that can have a considerable effect on the gold price, and explores these factors as determinants of the Pakistani gold prices.

Manufacturing is the use of machines, tools and labor to produce goods that meet a customer's expectations or specifications. In this part, Abid et al explores the important factors which affect the sustainable production of cotton in Pakistan. Gulay and Shen investigate pricing and customer return policies with loss-averse customers. The research highlights that the presence of a return policy and a consumer's loss-averse behavior directly affects the expected utility of the product. Zhang discusses indicator selection in a joint purchasing mode for small and medium-size enterprises. SMEs are shown to have a greater bargaining capacity in acquiring a lower price than when working independently.

The fifth part focuses on supply chain management (SCM). Helena et al identifies and provides a deeper understanding on the trade-offs that exist among Lean, Agile, Resilient and Green (LARG) SCM paradigms. Kurt and Avijit present guidance to determine an appropriate minimum commitment cost for a common situation, where the probability of obsolescence of the contracted part is known, or can be estimated prior to the joint optimization of the relevant policy variables. Juan et al explores a two-staged serially linked supply chain, where weekly data at the SKU level was collected from a manufacturer specialized in household products and a major UK grocery retailer.

Project management is the discipline of planning, organizing, securing and managing resources to bring about the successful completion of specific project goals and objectives. Scholars in this section tend to focus on the accomplishment of de-

sired goals and objectives by using restricted resources efficiently and effectively. Zehra et al explores exact solutions to a tsunami generation analytical model by investigating sub-marine landslides. Fausto et al puts forward a fault tree analysis (FTA) approach for decision making in maintenance management. Fault Tree Analysis (FTA) is proposed as a graphical representation of the logical relationships between the elements that comprise the decision making process in maintenance management. Jiang presents a strict definition for an efficient portfolio subset, and derives some equivalent conditions for determining this subset using a generalized inverse matrix.

Ecological engineering is the intent to integrate ecology and engineering sectors to focus on the design, monitoring and construction of ecosystems. Ecological engineering research is increasing in breadth and depth as more opportunities for the design and use of ecosystems as interfaces between technology and the environment are explored. Abdol and Sandeep establish a framework to explore energy saving measures during construction phases. This framework may also be used for collecting energy consumption data during construction to allow for a continuous update of the database and to increase accuracy in estimating future projects'energy consumption. Xiong and Tang develop a strategy for the BGEZ's marine industry in a low carbon economy. Zhu and Cai apply a stirpat model to a case study in Chinato, Chongqing city to identify the driving factors behind urban residential building energy consumption. This urbanization acceleration is useful as it allows governments to design and implement effective policy measure to promote building energy efficiency if the key factors influencing urban residential building energy consumption can be identified and the impact determined quantitatively.

The last part is Industrial engineering. Industrial engineering is the branch of engineering which deals with the optimization of complex processes or systems. In this part, Tedja puts forward a step by step method on how graph theory and topology can be utilized to construct a Z-loop matrix for the study of faulted 3 phase power systems. Nadeem et al develops a forecasting model to estimate the minimum electricity generating capacity required in Pakistan over the next 20 years. Wang and Shen discuss a joint purchasing alliance decision-making problem which looks at joint procurement in an allowable stock-out condition.

Of course, not all papers are mentioned here. Readers are strongly encouraged to peruse the proceedings for more information about current research on EMEI.

1.2.2 The Focus Area, Management Methodologies and Engineering Practice in the First Seven ICMSEMs

Based on the first seven proceedings, the main research areas have focused on operations management, evaluation and forecasting, information technology, industry management, risk management, knowledge management and hydropower engineering. All these research areas are significant and common in EMEI. In effect, the EMEI development trend has broadened over time. Fig. 1.5 shows the proceedings

distribution according to the focus areas for EMEI in ICMSEM, all of which have been covered by the ICMSEM. Specifically, the area attracting the most attention has been operations management, followed by supply chain management, information technology, industrial engineering and project management.

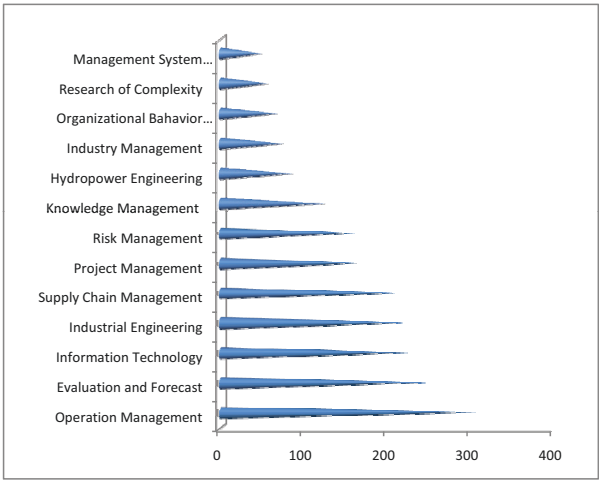

Fig. 1.5 The proceedings distribution according to the focusing area for EMEI in ICMSEM

EMEI has become more and more necessary in engineering practice. Therefore, it is crucial to understand which research methodologies have been most used. In fact, many methodologies have been used in electrical and information technology-based engineering management, which is reflected in the range of articles in the ICMSEM proceedings. The following methods are the most used: evaluation and simulation, optimization, mathematical modeling, decision making, data mining, exact algorithms, game theory, probability and statistics, Markov analysis, network analysis, queuing theory, heuristic methods, computer-aided technology, uncertainty theory, system dynamics, systems analysis, systems thinking, multi-methodology, interactive planning, strategic choice approaches and total system intervention. The top nine methods used in the ICMSEMs are depicted in Fig. 1.7. Among these, the most popular methods have been the optimization method and the mathematical model method. Evaluation and simulation,which are an imitation of real-world applications, states of affairs, or processes, has been used in many contexts, including the modeling of natural and human systems to gain insight into their function. Optimization, which is often used for problems in economics, design, and management,has been applied to choose the best elements from a set of available alternatives. A mathematical model is a representation of the essential aspects of an existing system (or a system to be constructed) in a form that is useful for possible analysis. Game theory is a sort of umbrella or unified field theory for the rational side of social science, where the social aspect is interpreted broadly to include hu-

man and non-human players. Network theory,a part of graph theory, is an area in computer science network design, which has been applied to many disciplines including particle physics, computer science, biology, economics, operations research, and sociology. Heuristics refers to experience-based techniques that assist in problem solving, learning and discovery. It can be shown from the ICMSEM proceedings that less exact algorithms have been used in recent years, and more intelligent and computer-aided technologies have been applied to solve practical engineering problems. Systems analysis is the study of the interacting entities of system sets, including computer systems. This field is closely related to operations research. In this research, an increasing number of articles have concentrated on solving practical engineering practices with computer-based technologies.

In the previous part, we described the main management methodologies used in engineering practice. In this part, the engineering fields which have received special management attention by are the core research focus. 20 engineering fields have been widely researched in the last seven ICMSEMs. The detailed distribution of these articles from EMEI engineering practice is shown in Fig. 1.6 It can be seen that more than 20 papers in the ICMSEM have been published in 9 distinct fields: construction engineering, logistics engineering, computer engineering, transportation engineering, systems engineering and industrial engineering.

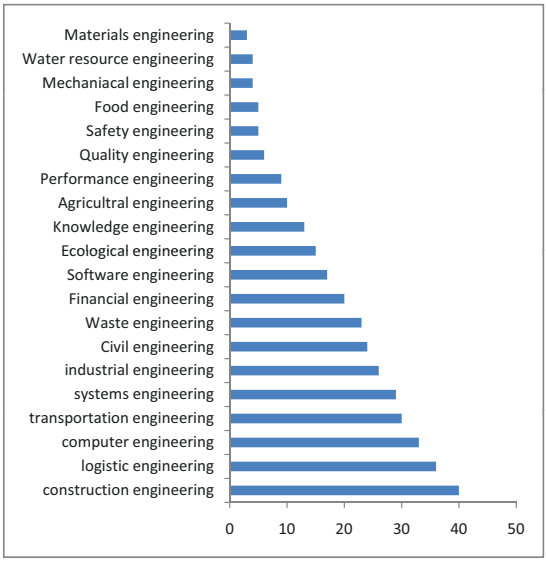

Fig. 1.6 The distribution of these articles in the last seven ICMSEMs based on the engineering practice in EMEI

In the following part, a computer-based research methodology is proposed and the development trends for computer-based RM in the EMEI are summarized, respectively.

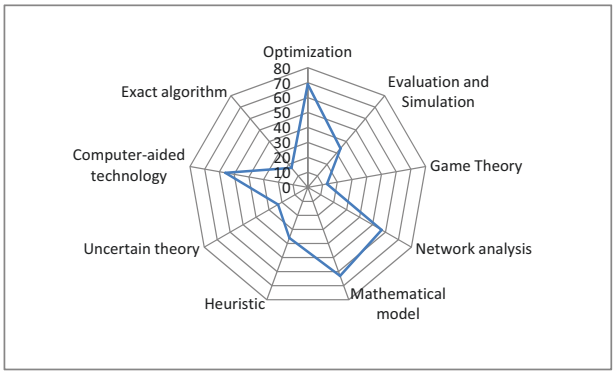

Fig. 1.7 The distribution of the articles in the first seven ICMSEMs based on the management methodologies for EMEI

1.3 Computer-based Research Methodology

EMEI is a multidisciplinary field with a wide range of research areas focusing on the solution of practical engineering background management problems using computer-based techniques to obtain feasible solutions. However, these techniques are often complex. How do we know a problem is significant and meaningful? How can we describe this problem using scientific language? How can an efficient algorithm be designed to solve a practical problem? And, finally, how can this integrated method be applied to engineering fields? For instance, one common phenomenon often found in recent conference proceedings is that some authors presented research which was of great practical significance, but failed to provide a model with a solution algorithm, which meant that the model was unable to solve problems using practical data. Some authors choose problems that are not connected to an urgent issue, and develop an effective and rapid algorithm. In other words, these authors have done a great research job, but some parts of their work could be improved. In excellent papers, all these questions, from determining the practical problems to solving them,are answered.

Future EMEI research must be closely related to practical engineering management problems using computer technology, such as simulations and programming. From the ICMSEM findings, construction engineering, ecological engineering, logistics engineering, financial engineering, and computer engineering have been appearing more regularly in the EMEI research fields, and computer-based methods for determining feasible solutions are becoming increasingly common. Xu [40] has presented a clear discussion about computer-based research methodology.

EMEI is a combination of EM and EI, and emphasizes practical management, effective theories and methods, and significant engineering practice. An excellent EMEI paper should integrate the background of the problem, a mathematical model, and an effective solution method with a significant application. This new methodology enables researchers to draw scientific conclusions, and plays a significant guid-

ing role in the conduct of further scientific research. An excellent paper is guided by Computer-based research methodology (C-based RM), which uses computer technology to express the essential relationships between the research, the model and the problem. C-based RM can also be used in EMEI research, such as in the use of computer-based methods to solve practical engineering management problems. In C-based RM, the specific 6MRP relationship presents a logic for solving practical engineering problems with computer-based methods. Here, R stands for research, which includes research specifics, research background, research base, research reality, research framework, and applied research; M refers to models, which includes concept models, physical models, physical mathematical models, mathematical physical models, algorithm designed models and specific description models, and P represents problems, which includes a particular problem, a class of problems, abstract problems, problem restoration, problem solution, and problem settlement. The specific relationship between Research, Model, and Problem and the detailed C-based RM process is shown in Fig. 1.8. The main steps for the C-based RM used in the seventh ICMSEM can be obtained from Xu [40].

Generally, C-based RM is understood to follow a certain structural process. Although the step orders may depend on the practical subject matter and researchers, the following key steps are usually applied during EMEI research:

- Select research topic: the subject to be addressed in your article should be worthy of investigation.
- Describe key problems: the problem to be investigated should be of significance.
- Present conceptual model: the information presented should be new.
- Establish physical model: this model should be a new and original contribution.
- Build a physical mathematical model: the mathematical model should be correct and helpful in practice.
- Verify the mathematical physical model: the proofs should be correct.
- Improve and innovate a computer-based algorithm: this part should make a valuable contribution to the field of knowledge or practice.

The first thing required is the observation and formation of the topic, which consists of focusing on the subject area of interest and conducting related research. The subject area specification requires the reading of a vast amount of literature on the topic to determine are search focus which has not yet been studied comprehensively. The research needs to be justified by combining its importance with existing knowledge on the topic. The specific requirements include: (1) finding new problems (significance of problem: academic and rational thinking); (2) establishing new model; (3) putting forward new algorithms; (4) solving the problem successfully; (5) indicating the new research direction or field. Secondly, a key problem statement and conceptual model definition should be provided: a description of a conceptual model related to practical concepts; and details regarding the definition of the variables and how they are to be measured/assessed in the study. Specific requirements include: (1) a proposal highlighting the significance of the conceptual model to the problem that must be solved; (2) a description of the significant contributions of the solution to the problem; (3) a review of previous research work and an appreciation of these

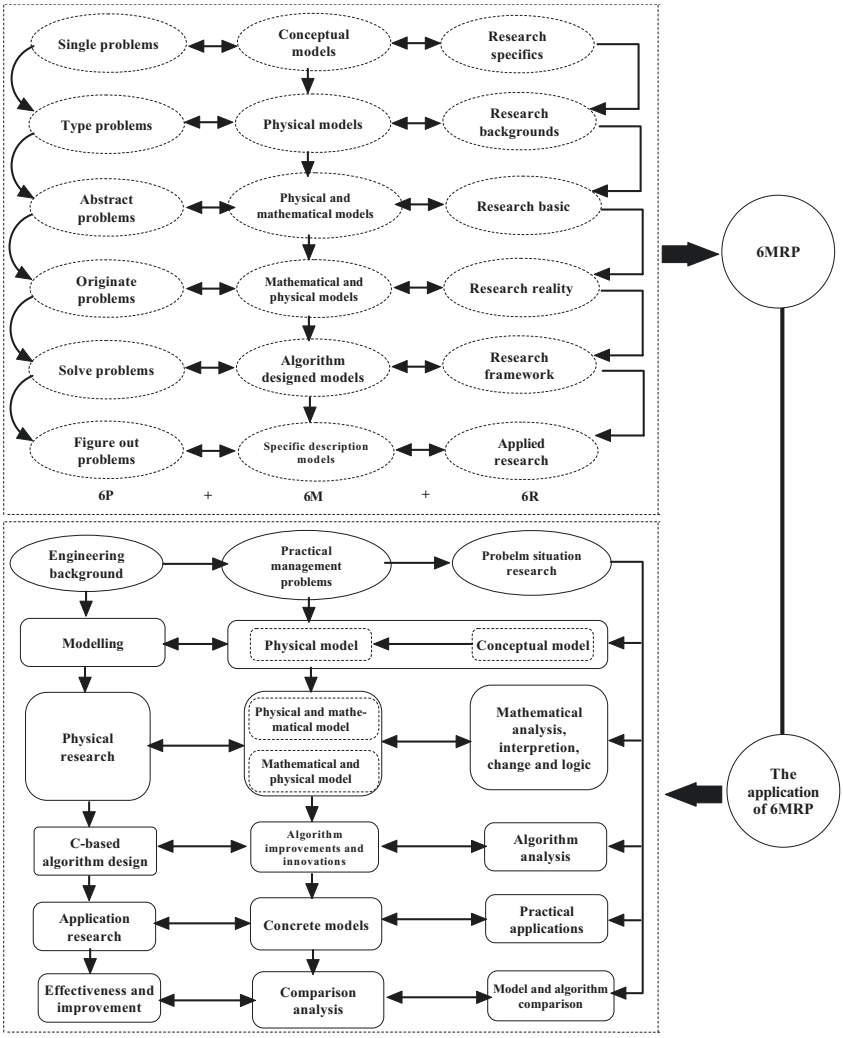

Fig. 1.8 Specific relationship of 6MRP and the detailed C-based RM process

contributions to the body of knowledge, and then an introduction of the new work and it's significant new point of departure; (4) a description of the motivation for solving this problem; (5) a description of the important contents in this work in a logical structure for the reader.

Based on the conceptual model presented above, the modeling of a physical model can then be implemented. The specific requirements include: (1) stating the reasoning behind the conceptual model in the first part; (2) describing the physical modeling; (3) using insight to determine the key element/s of the problem, for

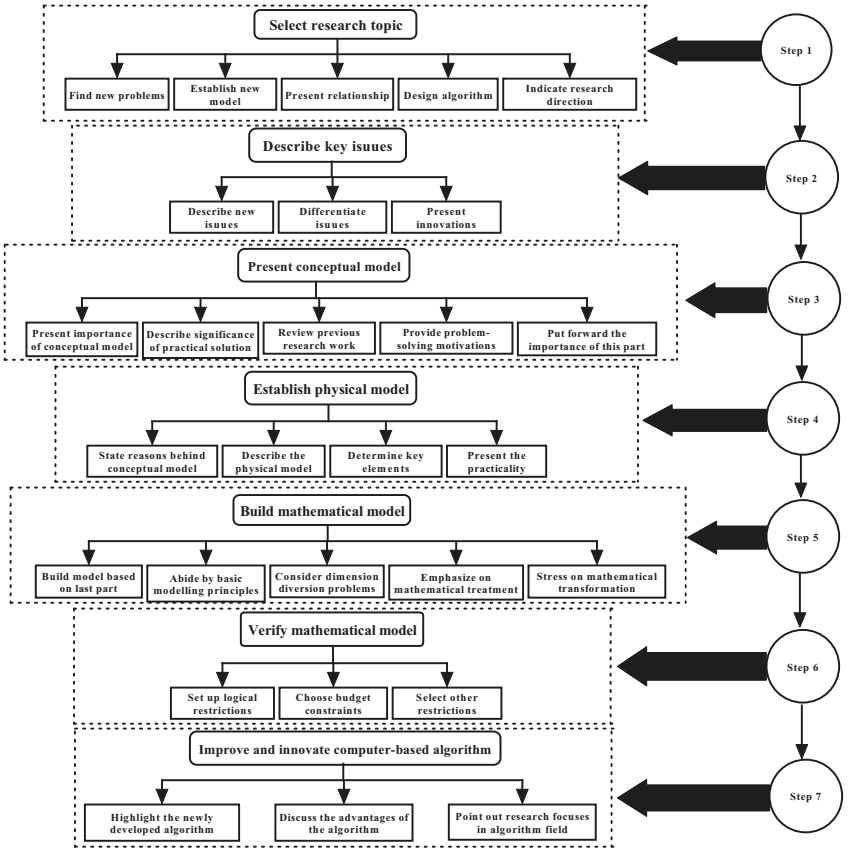

Fig. 1.9 The process of C-based RM

example, uncertainty, indetermination, unreliability, and at the same time ensuring specialization; (4) being easily understood.

After the physical modeling, a physical mathematical model is built and its physical significance explained. Specific requirements include: (1) in the second part modeling must be based on the physical model; (2) the modeling process must abide by basic physics principles, chemical principles, and behavior rules under a sense of probability; (3) dimension conservation must be considered in the mathematical equation; (4) the mathematical treatment must have mathematical sense; (5) the mathematical transformation must have a physical or chemical significance, otherwise, the mathematical reasoning process should be in appendix. Compared to physical mathematical models, mathematical physical models need to point to the physical significance under a mathematical form, in which the conversion of the mathematical equations can be recovered to the physical model.

Finally, an improved and innovative computer-based algorithm is developed to solve the model. Specific requirements include: (1) highlighting the newly developed innovative parts of the algorithm instead of elaborating an existing algorithm with old ideas; (2) clearly discussing the solution, the error estimation and the convergence speed.

Fig. 1.9 presents the details of the C-based RM, which is an effective methodology that can be widely used in various scientific research fields and can contribute to research in all areas in a standardized and efficient manner [40]. In EMEI scope, especially in management problems with engineering backgrounds, C-based RM is particularly useful because of its rigorous logical and effective applicability, and can play an outstanding role in guiding the practical side of research.

1.4 Development Trends for C-based RM in EMEI According to the First Seven ICMSEMs

In the above section, the C-based RM has been discussed. In this section, an overall review of EMEI, especially C-based RM in EMEI, is presented as a summary of past research with an attempt to understand the effect on research and practice. We are seeking to answer three research questions: (1) What are the EMEI C-based RM development trends showcased in the first seven ICMSEMs? (2) Does ICMSEM research coincide with the trends in the international EMEI journals? and (3) What is the future of C-based RM in EMEI?

For a systematic review, in this study, the research method used herein is similar to the one presented by Kitchenham [1], Kitchenham et al [2], with demands placed on research questions, identification of research, selection process, appraisal, synthesis, and inference.

1.4.1 Identification Procedure

The fundamental factor in distinguishing a systematic review from a traditional review of the literature is its comprehensive and unbiased search. In order to answer the three questions, this study reviews two sets of papers: all papers included in the proceedings of ICMSEM and the relevant research papers in EMEI journals.

In order to identify EMEI research, some related search terms and keywords have to be identified. This study starts with a systematic search to identify keywords and search terms. There are two basic keywords in EMEI: engineering management and electrical and information technology. On the basis of these keywords, for engineering management based on electrical and information technology, this study respectively chose 24 terms which are significant and common EMEI concerns as the main search terms. These terms are shown in Table 1.2, which are different to the EMEI keyword trends. It should be noted that a secondary search was executed based on