

# Preface

The objective of engineering management is to apply engineering principles to managerial problems. Engineering management handles complex managerial and organizational problems with the engineering problem solving tools and techniques. Both management and engineering knowledge are necessary for successful application of engineering management. Along with engineering characteristics, system thinking, systematic approach, modeling, and human orientation are the main dimensions of the engineering management discipline. Engineering management has a wide range of areas of implementation from quality management to financial management and from human resource management to production management. Engineering management professionals should combine engineering knowledge with problem solving techniques effectively and efficiently.

The contents of this book have been constituted by considering classical engineering management books. The aim of the book is to gather intelligent applications suitable to this content. In recent years, intelligent techniques are widely used in the solution of complex problems that cannot be solved by classical solution techniques. Complex problems in engineering management such as risk management, material management, or quality management have been recently solved using intelligent techniques such as neural networks, genetic algorithms, or fuzzy logic. 27 chapters have been collected from various countries, namely Turkey, Spain, Finland, Romania, South Africa, Germany, Brazil, India, China, Belgium, Netherlands, Iran, Algeria, Serbia, Colombia, and Italy.

Chapter 1 exhibits the relations between engineering management and intelligence and illustrates usage frequencies of intelligent systems in engineering management. It classifies the intelligent techniques. This chapter summarizes the application of intelligent techniques to engineering management areas such as human resources management, quality management, and strategic management.

Chapter 2 focuses on risk situations described by fuzzy numbers. It defines and characterizes possibilistic risk aversion and studies some of its indicators. It also studies two possibilistic models of risk management: a coinsurance problem and an investment portfolio problem. Chapter 3 proposes a novel intelligent technique called evidence-based morphological analysis model based on Dempster–Shafer

theory of evidence and morphological analysis methodology to quantify the likelihood of intentional events as threats by identifying them.

Chapter 4 conducts a comprehensive literature review from the years between 2000 and 2014. The motivation for the chapter is to contribute to the literature by presenting an extensive literature review and making a synthesis with regard to intelligent systems in research and development. Chapter 5 concentrates on the conceptual model that reveals the determinants of innovation strategy. It explains the factors and their relations with each other based on the literature survey and experts' opinion. It uses fuzzy cognitive mapping approach which can utilize network models. Chapter 6 adopts a multi-agent system approach-assisted intelligent conceptual design platform for miniature in-pipe inspection robot design synthesizing. The demo case study shows that the proposed MAS-ICD can outperform human designers in many perspectives.

Chapter 7 offers a first exploration of the general potential of Artificial intelligence techniques in human resource management. A brief foundation elaborates on the central functionalities of artificial intelligence techniques and the central requirements of human resource management based on the task technology fit approach. Chapter 8 proposes a fuzzy cognitive map-based model to overcome the modeling difficulty. The factors related to dynamic capabilities, which are collected from an extensive literature review, are defined as concepts and their fuzzy relations are represented as causal links in a graph structure. Chapter 9 uses data envelopment analysis and fuzzy Logic on partners' selection process complying particularly with the risks involved in virtual organizations formation process.

Chapter 10 uses hybrid methods combining more than one algorithm efficiently for maintenance planning. It applies both data-driven and mathematical models but data-driven methods are becoming more practical as computation is increasingly more feasible. Chapter 11 formulates a fuzzy inventory model for deteriorating items with shortages under fully backlogged condition by utilizing uncertain, vague, and imprecise data. Fuzzy set theory is used for handling the uncertainty in the data. Chapter 12 pays attention to economic load dispatch problem (ELDP). The ultimate goal of ELDP is to schedule the output of the committed generating units in a reliable and efficient manner. Artificial bee colony algorithm is employed as an effective approach to optimize the system structure within nonsmooth cost functions due to its simplicity and flexibility than most optimization algorithms in terms of algorithm structure. Chapter 13 is on intelligent technologies and systems of material management. Material management is the engine that drives its supply chain and logistics of manufacturing enterprise or any other organization. Material management is applied to the latest ICT and intelligent technologies or systems, like barcode, RFID, IoT (Internet of Things), GPS/BeiDou navigation satellite system, cloud computing, big data, and parallel control and management, to realize its transformation and upgrade coordinately with its supply chain and logistics.

Chapter 14 shows a new decision support intelligent financial model over SOX compatibility based on artificial intelligent technology together with the theory of argumentation. The main aim of this model is to help and support private companies, auditors, executive boards, and regulatory bodies to take a SOX-compliant

decision over a specific process of a typical purchasing financial cycle. Chapter 15 aims at giving a general overview of the existing intelligent systems that can be used to support decision making in a variety of domains. For each category, the ideas behind these systems are explained and the operating principles are summarized. Practical applications and tools used for managerial purposes are also provided.

Chapter 16 implements fuzzy control charts for monitoring and analyzing process, and reducing the variability of process. An intelligent system is also developed to eliminate or reduce uncertainty on data by using a fuzzy approach. Chapter 17 tests a fuzzy process capability index. It also develops the operating characteristic (OC) curves for the fuzzy capability index in testing one-sided and two-sided hypotheses. Chapter 18 gives the main principles of engineering management with system-based intelligent methods.

Chapter 19 proposes a methodology based on computational intelligence techniques for market analysis. In the proposed approach, first customers' comments are collected automatically, then sentiment analysis is applied to each message using artificial neural networks. At the third phase, themes of messages are determined using text mining and clustering techniques. Chapter 20 uses cost-sensitive classification-based models to predict the customer segments. For this aim, classification and regression trees, logistic regression, and chi-squared automatic interaction detector techniques are utilized. In order to compare the performance of the models, new performance measures are promoted, which are hit, capture, and lift rates.

Chapter 21 discusses several applications of intelligent systems in project management practice. First, the relevant literature is reviewed and different applications of intelligent tools are categorized into seven problem types. This categorization provides the basis for analyzing the underlying problem types and prepares the ground for future research via a faster access to the relevant literature.

Chapter 22 proposes a model for evaluation of projects for business process quality improvement. The performances of the treated type of projects are analyzed in the scope of standard ISO 215000:2015 and the results of good practice. Chapter 23 proposes a new simulation approach to develop project progress time-series data, based on the complexity and specifications of the project as well as on the environment in which the project is executed. This simulator is capable of simulating fictitious projects, as well as real projects based on empirical data and helps project managers to monitor the project's execution, despite the lack of historical data.

Chapter 24 presents an application of fuzzy optimization models and methods to a logistic network design problem using linguistic information coming from multiple experts. Chapter 25 intends to provide the reader with an overview of different intelligent tools applicable to the issue of picking optimization. It shows how different types of intelligent algorithms can be used to optimize order picking operations in a warehouse, by decreasing the travel distance (and thus time) of pickers. Chapter 26 discusses several intelligent techniques to solve warehouse problems in uncertain environment. Analogous to chance constraints, real-life necessary and possibility constraints in the context of two warehouses multi-item dynamic production inventory control system with imprecise holding and

production costs are defined and defuzzified following fuzzy relations. Chapter 27 reviews supplier selection models based on individual and hybrid MCDM methodologies. A case study of an automobile company is presented to illustrate and propose three alternative supplier selection models based on analytic hierarchy process as an individual MCDM methodology and data envelopment analytic hierarchy process and fuzzy analytic hierarchy process as hybrid MCDM methodologies.

We hope that this book will provide a useful resource of ideas, techniques, and methods for research on the *Theory and Applications of Intelligent Techniques in Engineering Management*. Finally, we thank all the authors. This book would not have been possible without their contributions and efforts. We are grateful to the referees whose valuable and highly appreciated works contributed to select the high quality of chapters published in this book.

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