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Krishnendu Mukherjee

Supplier Selection

An MCDA-Based Approach

 Springer

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I would like to thank my mentors—Prabir Kumar Bose, Ardhendu Bhattacharaya, and Bijon Sarkar—who have taught me the value of decision making and its effect on human life. I am also grateful to my parents for their love and encouragement. Specifically, I am indebted to my mother for her continuous support to complete this work.

Finally, this entire work is dedicated to Lord Krishna and to my mother. Without their blessing it would be difficult for me to give my best during my odd days.

Preface

Supplier selection is not a mere clerical process. It is a product-specific multi-criteria-based optimization problem. Judicious selection of suppliers could minimize procurement cost, enhance quality and reliability of supply, and thereby enhance profit margin of the company by minimizing upstream supply chain risk. Today, supply chain surplus of a company depends considerably on proper selection of its suppliers. Success of Apple Industry is a good indication of that. A decision maker has to trade off tangible and intangible criteria to select the best supplier or suppliers for the focal company. Several methods are available for selecting the best ones. Among these methods, the analytic hierarchy process (AHP) and the analytic network process (ANP) are the most used for their computational simplicity and consistency. This book encompasses several criteria and methods for supplier selection in a systematic way based on extensive literature review from 1998 to 2012 and includes illustrative case studies and examples for interested researchers.

The purpose of this book is to present a comprehensive review of the latest research and development trends at the international level for modeling and optimization of the supplier selection process for different industrial sectors. It is targeted to serve two audiences: the MBA and Ph.D. student interested in procurement and the practitioner who wishes to gain a deeper understanding of procurement analysis with multi-criteria-based decision tools to avoid upstream risks to get better supply chain visibility. This book is expected to serve as a ready reference for supplier selection criteria and various supplier evaluation methods for forward, reverse, and mass-customized supply chain. This book also encompasses strategic sourcing in detail for forward, reverse, and sustainable mass-customized supply chain.

Chapter 1 introduces the basic concept of multi-criteria decision-making process. It also introduces fundamental idea and steps of decision-making process. In brief, Chap. 1 gives fundamental idea of AHP, type of scale, prioritization methods, problem of rank reversal, validation of AHP, fuzzy hierarchical TOPSIS, VIKOR, uncertainty analysis with multi-criteria decision analysis tools, cascaded fuzzy inference system, and intuitionistic fuzzy set. Chapter 2 reviews supplier selection

methods for traditional, reverse, and mass-customized supply chain. Chapter 3 mentions steps to develop mathematical model for supplier selection, evaluation, and order allocation problem. Chapter 4 discusses in detail about strategic sourcing. It includes several mathematical models with illustrative case studies. Chapter 5 discusses mainly on the limitations of fuzzy analytic hierarchy process and consistency of decision to aware researchers about certain limitations of fuzzy analytic hierarchy process. All mathematical models are solved with either MATLAB or R or LINGO. In the appendix, some computer code written in MATLAB, R, and VB.NET is also included for the interested reader.

I would like to give sincere thanks to Prof. T.L. Saaty, the originator of AHP and ANP method, and distinguished University Professor of Business Analytics and Operations Department of Joseph M. Katz Graduate School of Business, University of Pittsburgh, USA, for sharing his notes, published and unpublished research work on AHP and ANP. Without his continuous support and inspiration, it was difficult for me to know AHP and ANP in detail. My special thanks are due to Prof. Rozann Whitaker Saaty of the Creative Decisions Foundation of Pittsburgh, USA, for sharing her research work on AHP and ANP. I wish to thank Professor Timothy J. Ross of Civil Engineering Department of University of New Mexico; Professor Ahti A. Salo of Mathematics and Systems Analysis Department of Aalto University School of Science, Finland; and Dr. Matteo Brunelli, postdoctoral researcher of Systems Analysis Laboratory of Aalto University, Finland, for their wholehearted support and great encouragement in producing this book. I wish to thank various researchers and my students for their support to complete my work. I am also indebted to editorial team at Springer, for their support, assistance, and guidance on this book.

While every attempt has been made to ensure that no errors (printing or otherwise) may be present, the possibility of their existence is expected. As the saying goes, to err is human. I would be grateful to the readers if these errors are pointed out to me. Suggestions for further improvement of the book would be thankfully acknowledged. If any fact, data, figure, concept, etc, resemble with any published and/or unpublished work, then it is unintentional and I would remain grateful to readers if they kindly acknowledge it.

Jaipur

Krishnendu Mukherjee

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About the Author

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Notations

AHP	Analytic hierarchy process
ANP	Analytic network process
ATO	Assembly to order
CA	Cluster analysis
CBR	Case-based reasoning
CI	Consistency index
CODP	Customer order decoupling point
DEA	Data envelopment analysis
EM	Eigenvalue method
EPAs	Environmental Protection Agencies
ETO	Engineer to order
FAHP	Fuzzy analytic hierarchy process
FANP	Fuzzy analytic network process
FNIS	Fuzzy negative ideal solution
FPIS	Fuzzy positive ideal solution
GA	Genetic algorithm
GDM	Group decision-making method
GHGs	Greenhouse gases
GP	Goal programming
GPD	Green product design
IFS	Intuitionistic fuzzy set
LLSM	Logarithmic least square method
MADM	Multi-attribute decision making
MAUT	Multi-attribute utility theory
MCDA	Multi-criteria decision analysis
MCDM	Multi-criteria decision making
MEFAHP	Modified extent fuzzy AHP
MEFAHP-GA	Modified extent fuzzy AHP and GA
MIP	Mixed-integer programming
MODM	Multi-objective decision making

MOGA	Multi-objective genetic algorithm
MTO	Make to order
MTS	Make to stock
NIS	Negative ideal solution
PFA	Product family architecture
PIS	Positive ideal solution
SCV	Supply chain visibility
TFN	Triangular fuzzy number
TOPSIS	Technique for order preference by similarity to ideal solution
TVP	Total value of purchase
TVRP	Total value of reliable purchase
VIKOR	VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian

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