Preface

We, doctoral graduates of Dundar F Kocaoglu, compiled this Festschrift[4] to honor him and his work in Engineering Management and especially in Hierarchical Decision Modeling (HDM). He is known to us all as "Dr. K".

Dr. K is a legend in the field of Engineering Management. His contributions to Engineering Management began with his creation of the "Engineering Management Program" at the University of Pittsburgh in the late 1970s. In the 1980s, he moved to Portland State University to start his second engineering management program. Dr. K graduated 26 PhD from 1981 to 2014. Their topics and current position of employment are listed below.

At University of Pittsburgh:

1. **John Shepherd**, 1981; Optimal Project Portfolio Under Multiple Criteria; Management Consultant, Pennsylvania
2. **Amir Sadrian**, 1986; Portfolio Selection and Resource Allocation for R&D Projects Using 0-1 Goal Programming, Bell Labs (retired), New Jersey
3. **Margaret Shipley**, 1986; HDM for Strategic Planning and Resource Allocation in Academic Institutions, University of Houston, Texas
4. **Hugo Gomez-Guzman**, 1986; Production Scheduling in a Manufacturing Cell, Management Consultant, Mexico
5. **Jang Ra**, 1988; Analysis of Expert Judgments in HDM, University of Alaska (retired), Alaska

At Portland State University:

1. **Guven Iyigun**, 1994; Strategic R&D Portfolio Selection; Unilever, Europe
2. **Sida Zhou**, 1995; Aggregation of Group Decisions; Intel Corp., Oregon

[4] In academic world, a Festschrift is defined as a volume written to honor an academic during his or her life. Generally the volume is composed of articles by the doctoral students of the academic person—Wikipedia.

3. **Karen Beekman Eden**, 1997; Information Technology in the Health Care Industry; OHSU, Oregon
4. **Tugrul Daim**, 1998; Technology Eval'n. and Acquisition Strategies in the U.S. Electronics Mfg. Industry; PSU, Portland
5. **Tom Long**, 1998; Culture and Strategy in the Electronics Industry; CEO, Oregon
6. **Erwin L**. "**Al**" **Herman**, 1998; Strategies in the U.S. Electronics Industry; CEO, Ohio
7. **Razif Abd. Razak**, 1999; Site Selection for Petroleum Explorations; Universite Technologia, Malaysia
8. **Robert Martin**, 2002; A Unified Model for the Software Development Process; Management Consultant, Oregon
9. **Toryos Pandejpong**, 2002; Technology Selection in the Petrochemical Industry; King Mongkut University, Thailand
10. **Stacey E. Ewton** (**Schultz**), 2003; Impacts of E-Commerce Technologies on Business Processes; CEO, Oregon
11. **Nathasit Gerdsri**, 2004; Technology Roadmapping for Emerging Technologies; Mahidol University, Thailand
12. **Jonathan Ho**, 2004; Strategic Technology Choices for Semiconductor Manufacturing Industry , Yuan Ze University, Taiwan
13. **Audrey Alvear**, 2005; Technology Strategies in a Developing Economy; Consultant, California
14. **Hongyi Chen**, 2007; Sensitivity Analysis in Decision Making; Univ. of Minnesota, Minnesota
15. **Iwan Sudrajat**, 2007; Supply Chain Management in U.S. Electronics Manufacturing Industry; Research Manager, Indonesia
16. **Pisek Gerdsri**, 2009; Nat'l Technology Policies for Emerging Nano-Tech. Applications; SCG, Thailand
17. **Kenny Phan**, 2013; Innovation Measurement; PSU, Portland
18. **Pattharaporn Suntharasaj**, 2013; International Collaboration in Science & Technology; NSTDA, Thailand
19. **Nasir Sheikh**, 2013; Solar Photovoltaic Technology Assessment; SUNY-Stony Brook, South Korea
20. **Thien Tran**, 2013; University Knowledge and Technology Transfer; Consultant, Texas
21. **Ilknur Tekin**, 2014; Green Innovativeness and Financial Performance; Nike, Portland

Dr. K's contributions to our field have been in multiple dimensions. He was the second Editor-in-Chief for the IEEE Transactions on Engineering Management. Under his tenure, the journal became one of the top journals. Dr. K started PICMET (Portland International Center for Management of Engineering and Technology) in 1991. Since then, the annual PICMET conference has become the premier conference in our field. It now alternates between Portland and an international location.

The recent out-of-Portland conferences have been held in Korea, Turkey, South Africa, Thailand, Canada, and Japan.

This book has 15 chapters written by PSU doctoral graduates. The theme of the book is concentrated on Hierarchical Decision Modeling.

The first four chapters (1, 2, 3, 4) present HDM applications for Technology Assessment. The following four chapters (5, 6, 7, 8) present HDM applications for Strategic Planning. Next three chapters (9, 10, 11) present National Technology Planning applications. Final four chapters (12, 13, 14, 15) present Decision-Making Tools developed either by development of new HDM applications or for use with existing HDM applications

We would like to thank Dr. K for his contributions to the field. The following section describes the introductory fundamentals of HDM in his own words:

> Implicit in the development of decision models is a complex process through which relative values are assigned to the various decision elements. The coefficients in the objective function of an optimization model are the weighted contributions of the decision variables to the objective. The scores used in project selection methods are the relative importance measures of the various criteria and attributes. Probability distributions reflect the relative likelihood of the occurrence of various events.
>
> In some cases, these relative values can be obtained by a straightforward measurement of a quantitative or quantifiable characteristic of the system. Cost, distance, time, and probabilities of repetitive events are examples of such measurable values. In most cases, however, the values are not in a readily measurable form. It is seldom that the decision maker deals with repetitive events. A vast majority of decisions involves uncertainty of the occurrence of a one-time event and the risk of its outcome. For example, in many cases, probabilities cannot be determined from previous observations because of the non-repetitive nature of the events. Relative impact of emerging technologies on a company's objectives cannot be measured because the technologies have not even been developed yet.
>
> However, the decision makers can typically make educated guesses about the likelihood of the outcomes. Their judgment based on years of experience on similar conditions in the past reflects the relative strength of their belief in the occurrence of an outcome in comparison with another outcome. Similarly, the weights assigned to criteria, attributes and other parameters in decision models represent the final impacts of interrelated actions on the outcome of those models.
>
> Subjective probabilities, importance weights, and the relative contributions of decision variables have two characteristics in common: First, the measurements are in ratio scale. Second, although they cannot be measured by direct objective methods, they are implicit in the value judgments of the decision makers.
>
> In HDM, the subjective judgments expressed in pairwise comparisons are converted to relative weights in ratio scale. This is done by a series of mathematical operations on three matrices. The methodology can be used for quantifying the judgment of a single decision maker, or multiple decision makers. When multiple decision makers are involved, the HDM approach is an effective way to form consensus among decision makers where the members of the group have different goals. HDM links the decision elements at multiple levels of organizational entities, in which decisions at the operational level are made in support of higher level goals and objectives, and when the objectives are met, the final results of the operational decisions are transformed into benefits for the organization. This is a systematic process, but it is difficult to quantify the direct relationships between the benefits at the top of decision hierarchy and the operational decisions at the bottom without dividing the space between the top and bottom of decision hierarchy into intermediate levels. That is what the HDM does.

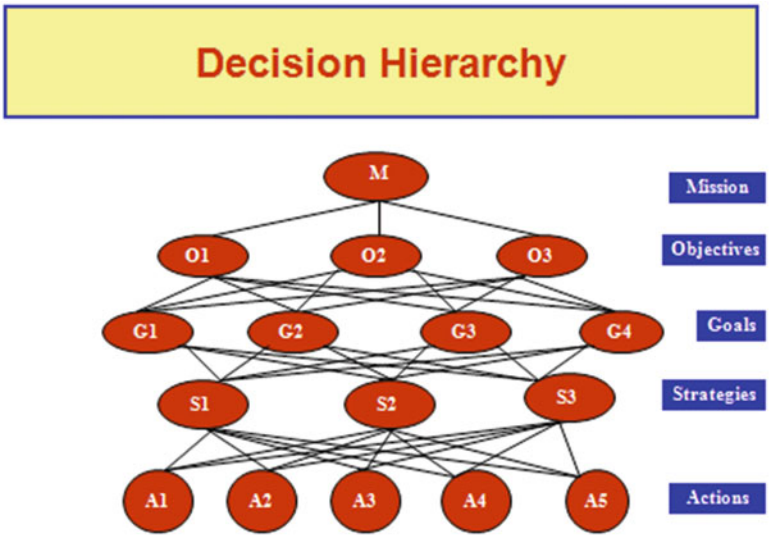

Fig. 1 A typical hierarchical decision model (HDM)

The number of levels in HDM depends upon the logical sequence of the decisions involved. If too many levels are identified, the number of measurements becomes exceedingly large; if too few levels are used, measurements become difficult because of excessive aggregations.

The typical starting point to trigger a decision process is the establishment of the mission and objectives. These are broad statements specifying the overall benefits expected from an organized activity. Because of the abstract nature of objectives and the difficulty of developing a precise measure of effectiveness for the benefits, the objectives need to be disaggregated into specific goals with recognizable targets. Once the goals are defined, the approach to achieve those goals has to be developed. This is done by establishing strategies and identifying specific actions as the components of the strategies.

Each level of such a decision hierarchy consists of multidimensional, often conflicting decision elements. At the top, multicriteria objectives contribute to the fulfillment of the mission. At the bottom, each action becomes a part of one or more of the strategies with varying degrees of contribution to each strategy. Strategies impact multiple goals. The achievement of each goal results in meeting one or more of the objectives. These impact relationships are depicted in a typical HDM Hierarchy in Fig. 1.

When the arcs connecting the nods in Fig. 1 are measured by quantifying expert judgments, a vector at the "Objectives" level and a series of matrices below the Objectives are obtained. Relative value of each decision element at each level of the hierarchy is then determined by performing matrix multiplications among the levels. The final result is a normalized set of values representing the relative contribution of each action to the mission of the organization.

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