Chapter 5

# Knowledge Engineering, Cognitive Ergonomics, and Knowledge Management in 2017:
## A New Delphi Paradigm With Applications

**Ronald John Lofaro**
*Embry-Riddle Aeronautical University, USA*

## ABSTRACT

*Today there is a new emphasis on a discipline related to knowledge engineering (KE): knowledge management (KM). The chapter shows that a Delphi methodology, developed and used with real success from 1986 through 2003, can be revised and up-dated to take a place in the spectrum of KE/KM. This new model combines elements of a Pareto technique at the front end of an small group Delphi paradigm/ estimate-talk-estimate (SGDP/ETE) process to initially identify and sharpen the criticality of problems and their solutions. The final stage of the model uses real time Delphi (RTD) techniques. As a result, the final paradigm uses today's technology to achieve extremely accurate decision making and indicate what can be successful courses of action across many venues. Examples will be given of how this new model could be applied to current, real-life problems in three very different arenas.*

## INTRODUCTION

KE was defined in 1983 by Edward Feigenbaum and Pamela McCorduck as follows: "KE is an engineering discipline that involves integrating knowledge into computer systems in order to solve complex problems normally requiring a high level of human expertise." In 2017 one finds that an expansion in the field called knowledge engineering (KE) has occurred and is still in progress. It seems that KE now stands alone and has some five to seven Journals dealing with KE research, models and applications. In fact, KE is now such an enormous field and endeavor; there are even two Journals with the same title:

International Journal of Knowledge Engineering; one from IGI Global and the other put out by Bioinfo Publications. Knowledge engineering is also linked to cognitive science and socio-cognitive engineering where the knowledge is produced by socio-cognitive aggregates (mainly humans); A newer term, cognitive engineering (CE), includes mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design. There is not only great overlap with KE, but almost an isomorphism.

Cognitive Ergonomics deals with decision-making and focuses on the fit between human cognitive abilities and limitations and the task. As such, it can be viewed as a portion of a Venn diagram Universe that includes Cognitive Engineering, again with definite overlapping.

Today, there is a new emphasis on a discipline related to KE: knowledge management (KM). Knowledge management (KM) has been defined as "...the practice of selectively applying knowledge from previous experiences of decision making activities with the express purpose of improving the organization's effectiveness." (Jannex, 2014). The main difference between KM and KE seems to be that the (knowledge) manager establishes the direction the process should take, where the (knowledge) engineer develops the means to accomplish that direction. Therefore, accurate decision-making plays large in both the knowledge manager's and the knowlede engineer's road to success/failure. Aside: The author has many articles (e.g., Lofaro & Smith 1999; 2000; 2001a; 2001b; 2003; 2009) and a book chapter, (Lofaro & Smith, 2010) in print on decision-making in the unforgiving aeronautical environment.

Currently, the KM aspect of KE has become a multidisciplinary field, bringing in concepts and methods from several computer science domains such as artificial intelligence (AI), databases, expert systems, decision support systems and geographic information systems.

There is also a somewhat new emphasis in the KE/KM fields on ontology, a term that comes from philosophy. In philosophy, it is the study of the nature of being, becoming, existence, or reality, as well as the basic categories of being and their relations; it often deals with how entities may be grouped, related within a hierarchy, and subdivided according to similarities and differences. In KE/KM, an ontology is a formal naming and definition of the types, properties, and interrelationships of the entities that really or fundamentally exist for a particular domain of discourse. It is thus a practical application of philosophical ontology, with a taxonomy (see later in Chapter). A KE/KM ontology compartmentalizes the variables needed for some set of computations and establishes the relationships between them; thus, an ontology is used to limit complexity and to organize and structure information. It has now found practical applications in AI, information science and technology; in short: in much of KM and KE.

For a more complete overview and discussion on KE, differing views and uses, the reader is referred to Studer, Benjamins and Fensel (1998). For works on KM, Amazon's web site has 50 or more, including the ubiquitous *The Complete Idiot's Guide to Knowledge Management* (Rumizen, 2001). At this point, the author believes that readers of this Chapter, as they are and have been in these fields for years, need no further citations.

## HISTORY AND RATIONALE

As to why this Chapter came to be written: It really began in 1986 with a modified Delphi as will be shown; this modification was termed a small-group Delphi paradigm (SGDP) (Lofaro, 1992a) using intact, face-to-face groups of subject matter experts (SME's) to work on specified tasks. Circa 2010, the author realized that this 1986 SGDP could nowadays be seen as a KE effort. Additionally, the author

## Related Content

The role of Financial Market Infrastructures in Financial Stability: An Overview
Serafin Martinez-Jaramillo, Jose Luis Molina-Borboaand Bernardo Bravo-Benitez (2018). *Risk and Contingency Management: Breakthroughs in Research and Practice (pp. 256-276).*
www.irma-international.org/chapter/the-role-of-financial-market-infrastructures-in-financial-stability/192380

Offshore Wind as a Base for a New Sustainable Business
Almudena Filgueira-Vizoso, Joaquín Enríquez-Díaz, Isabel Lamas-Galdo, Félix Puime Guillén, David Cordal-Iglesias, Begoña Álvarez Garcíaand Laura Castro-Santos (2021). *Financial Management and Risk Analysis Strategies for Business Sustainability (pp. 254-270).*
www.irma-international.org/chapter/offshore-wind-as-a-base-for-a-new-sustainable-business/274730

Evolution and Future of the Marketing and Sustainability Linkage: Towards a Civil Marketing Approach
Sandra Lizzeth Hernández-Zelaya, Fernando Reyes-Reinaand María Elena Rodríguez Benito (2021). *Financial Management and Risk Analysis Strategies for Business Sustainability (pp. 105-123).*
www.irma-international.org/chapter/evolution-and-future-of-the-marketing-and-sustainability-linkage/274724

Agent-Based Approach for Monitoring Risks in Software Development Projects
Jirapun Daengdej (2021). *Transdisciplinary Perspectives on Risk Management and Cyber Intelligence (pp. 91-104).*
www.irma-international.org/chapter/agent-based-approach-for-monitoring-risks-in-software-development-projects/260606

An Investigation for CA-Based PageRank Validation in View of Power-Law Distribution of Web Data to Enhance Trustworthiness and Safety for Green Cloud
Arnab Mitra (2021). *Advanced Models and Tools for Effective Decision Making Under Uncertainty and Risk Contexts (pp. 368-378).*
www.irma-international.org/chapter/an-investigation-for-ca-based-pagerank-validation-in-view-of-power-law-distribution-of-web-data-to-enhance-trustworthiness-and-safety-for-green-cloud/261325