Cognitive Ergonomics in 2016

Ronald John Lofaro
Embry-Riddle Aeronautical University, USA

INTRODUCTION

Cognitive Ergonomics deals with, amongst other areas, decision-making, skilled performance(s) and training. This chapter will briefly explicate what began, 30 years ago as a cognitive task analysis (CTA) for identifying critical skills needed for skilled performance, with decision-making involved in every step. Over the years, it evolved into a Delphi paradigm that extended far beyond a CTA. With the advances in technology, especially communication technologies, some of this paradigm has re-emerged in what are termed Estimate-Talk-Estimate (ETE) Delphi efforts. This Chapter will show how to integrate the elements of the paradigm cited above with elements of Pareto Analysis and ETE. The resultant model uses today's technology to achieve extremely accurate results across many venues. Thus, this Chapter is a natural progression/extension of the author's Chapter entitled "Knowledge Engineering: A Methodology and Examples" (Lofaro, R.J., 2013) in the 3rd edition of The Encyclopedia of Information Science and Technology (2014). In that Chapter the author presented both the Small Group Delphi (Lofaro, 1992) as developed and expanded over the years and the newer Estimate-talk-Estimate variant of the Delphi process. At that point, elements of both Delphi processes were blended to produce an initial look, with some methodological avenues, for use in a paradigm in tune with the tremendous speed, instantaneity and scope of today's technological advances in communication. This Chapter will take that rough template and integrate it with elements of Pareto techniques, to initially identify and sharpen criticality of possible problems/solutions of issues. The selection and the rationale for the selection of the elements of both the Pareto analysis and for the elements of the SGDP will be explicated. At that point, the new Pareto/SGDP/ETE process could be implemented to achieve guidelines for achievable resolution of a variery of problems requiring accurate decision-making. The decision-making will be of a distributed nature, enabled by computers and the Internet. Further, this Chapter will examine three current, problematic areas and outline how this now tri-partite paradigm can be used on these areas to show how decisions can be made on standards, policy and training needs

BACKGROUND

Knowledge engineering (KE) has been defined as follows: "... an engineering discipline that involves integrating knowledge into computer systems in order to solve complex problems normally requiring a high level of human expertise." (Feigenbaum and McCorduck, 1983). For a succinct overview of KE, see Studer, Benjamins and Fensel (1998). Knowledge engineering is also linked to cognitive science and socio-cognitive engineering where the knowledge is produced by socio-cognitive aggregates (mainly humans); this was one rationale for the SGDP. 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. Therefore, CE has mainly replaced KE as the term used in such efforts. 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.

Delphi Processes

A subset of CE is the Delphi technique/process. Traditional Delphi techniques include anonymity of response, multiple iterations, convergence of the distribution of answers and, a statistical group response (Judd, 1972). A seminal paper on the Delphi process was written by a then-Rand Corporation employee (Brown, 1968) and may be available from Rand or from American Society of Tool and Manufacturing Engineers (ASTME), *now known as Society of Manufacturing Engineers.* It would seem clear that Cognitive Ergonomics can avail itself of Delphi processes

The Small Group Delphi Paradigm

A modification to Delphi processes is the small group Delphi paradigm (SGDP). The SGDP took the Delphi process in another direction by modifying it via merger with elements of group dynamics in order to have interactive (face-to-face) Delphi workshops. The development of this modified Delphi, the SGDP, involved the merger of a specific knowledge engineering technique (Delphi), with Fleischmann's theories of underlying abilities (Fleishmann and Quaintance, 1984; revised 2000) and some principles of group dynamics. This modification resulted in a paradigm for using small groups of subject matter experts (SMEs) for any project that requires that a set of SMEs be used to identify, evaluate, and criticality rank tasks (an extended and enhanced task analysis), identify core needs/skills, recommend modifications to equipment, procedures and training. Finally, the SGDP can be used to sharpen, modify and revise existing methodologies. Thus, traditional Delphi processes were modified into a new paradigm (Lofaro, 1992). This effort and the subsequent use (Lofaro, Gibb and Garland, 1994; Gibb and Lofaro, 1994; Lofaro, 1998, 1999) of the resultant

paradigm, SGDP, in other, varied venues have produced both new modifications to the SGDP and highly accurate data that were operationally implemented. The extensions of the paradigm indicated that it had an applicability over many domains. These many SGDP efforts also resulted in sharpening, modifying and revising the original methodology. That the core SGDP has been used in many environments demonstrated a robust flexibility and generalizability of the paradigm. As Meister (1985) had noted, "The (Delphi) methodology is by no means fixed…[it] is still evolving and being researched." This is as true now as it was when Meister stated it. In point of fact, with the leaps in communication methods and related technology, even more so.

CURRENT ADVANCES IS DELPHI PROCESSES AND A NEXT STEP

The use of face-to-face Delphi techniques has been re-discovered. It is important to state that, circa 2005, the use of face-to-face groups in a Delphi has now become accepted. New technologies have resulted in what are generically referred to as mini-Delphi or Estimate-Talk-Estimate (ETE) with many variations. Other innovations come from the use of computer-based (and later web-based) Delphi conferences. One example of a difference in a type of ETE (a computer-based Delphi) versus either a traditional or SGDP Delphi is the iteration structure used in the traditional or SGDP Delphis, those iterations which are is divided into three or more discrete rounds, can be replaced by a process of continuous (roundless) interaction, enabling SMEs to change their evaluations at any time. As Bolognini (2001) has said, the involvement of a large number of participants, the use of two or more panels representing different groups (such as policy-makers, experts, citizens), which the administrator can give tasks reflecting their diverse roles and expertise, and have them interact within ad hoc communication structures: these are strengths of computer and web-based ETEs. The

Related Content

Modeling of Uncertain Nonlinear System With Z-Numbers

Raheleh Jafari, Sina Razvarz, Alexander Gegovand Satyam Paul (2021). *Encyclopedia of Information Science and Technology, Fifth Edition (pp. 290-314).*

www.irma-international.org/chapter/modeling-of-uncertain-nonlinear-system-with-z-numbers/260193

Interoperability Frameworks for Distributed Systems

José Carlos Martins Delgado (2018). *Encyclopedia of Information Science and Technology, Fourth Edition (pp. 6566-6578).*

www.irma-international.org/chapter/interoperability-frameworks-for-distributed-systems/184352

Accident Causation Factor Analysis of Traffic Accidents using Rough Relational Analysis

Caner Erdenand Numan Çelebi (2016). *International Journal of Rough Sets and Data Analysis (pp. 60-71).*

www.irma-international.org/article/accident-causation-factor-analysis-of-traffic-accidents-using-rough-relational-analysis/156479

Estimating Overhead Performance of Supervised Machine Learning Algorithms for Intrusion Detection

Charity Yaa Mansa Baidoo, Winfred Yaokumahand Ebenezer Owusu (2023). *International Journal of Information Technologies and Systems Approach (pp. 1-19).*

www.irma-international.org/article/estimating-overhead-performance-of-supervised-machine-learning-algorithms-for-intrusion-detection/316889

Behavioral Based Technologies for Enhancement of Login/Password Systems

Sérgio Tenreiro de Magalhãesand Vítor J. Sá (2015). *Encyclopedia of Information Science and Technology, Third Edition (pp. 4258-4266).*

www.irma-international.org/chapter/behavioral-based-technologies-for-enhancement-of-loginpassword-systems/112868