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ELECTRE III model for value engineering applications

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ABSTRACT

Value engineering (VE) programs are implemented to enhance the value received over the life-cycle of constructed assets. It is defined as the process of relating the functions, quality, and costs of the project in the determination of optimum solutions for the project. Value engineering is carried out to optimize the performance and costs of products (e.g., project, service, item, etc.) by identification and removal of unnecessary costs. Such costs include either total life-cycle costs or direct costs of production (e.g., construction, implementation, installation, etc.). This paper considers the application of the ELECTRE III model in the context of value engineering. The steps of the ELECTRE III model include; estimation of concordance indices, estimation of discordance indices, estimation of credibility scores, performing distillation procedure, and performing complete ranking. The proposed methodology is intended to support the decision making on alternatives with an increase in the efficiency of the resolution process. A numerical example is presented to demonstrate the use of the proposed methodology.

1. Introduction

Value engineering (VE), which has been introduced and expanded in certain industrial establishments, has been attracting major attention as a new method of achieving reduction in costs, which in turn increases the profitability for the company. VE is defined as [1]: *a systematic approach to analyzing functional requirements of products or services for the purpose of achieving the essential functions at the lowest total cost.* Value engineering methodology evolved in the forties when the transition was made from search for alternative to search for means of fulfilling functions of an alternative. It was observed that function oriented alterations in working methods, often result in improving quality along with eliminating unnecessary cost [2]. Value engineering provides excellent results as a method of cost reduction. Further, it has been reported to be effective at the research and development as well as design stages [1]. It has been applied not only to hardware but also to processes, office routines, and methods of organization.

In VE, the measurement and analysis are carried out in three main steps [1]: 1) definition of function, 2) evaluation of function, and 3) development of alternatives. Table 1 lists these main steps, their implications, and associated questions. This sequence of steps in VE activity is called an implementation plan or a job plan. Usually, a job plan consists of the following six steps [1]:

1. selection of the product to be analyzed
2. gathering of information
3. functional analysis (definition and evaluation of function)
4. development of improvement proposals (creativity, evaluation and refinement)
5. testing and validation
6. submission of change proposal and implementation.

Value engineering in the construction industry is mainly an organized effort to challenge design and construction plans of projects to provide the required facility at the lowest overall costs, consistent with requirements for performance, reliability and maintainability [3]. A lot of effort has been made to apply value engineering in the construction industry [2,4,5]. This paper presents a tool that is considered a direct application of value engineering, utilizing ELECTRE III as an outranking method to facilitate evaluation of alternatives. A numerical example is worked out to illustrate the main features of the developed tool.

2. Description of ELECTRE III

ELECTRE (in its various forms) was conceived in response to deficiencies of existing decision making solution methods [6–8]. Different versions of ELECTRE have been developed including ELECTRE I, II, III, IV and TRI. All methods are based on the same fundamental concepts but differ both operationally and according to the type of the decision problem. Specifically, ELECTRE I is designed for selection problems, ELECTRE TRI for assignment problems and ELECTRE II, III and IV for ranking problems. ELECTRE III has been used in different applications [9–15]. ELECTRE III outperforms other multi-criteria decision making methods for its ability to deal with inaccurate, imprecise, uncertain data. For criterion j being considered, three associated thresholds are defined which are indifference (q),

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