Dimensional Analysis under Intuitionistic Fuzzy Environment for Supplier Selection

L. A. Pérez-Domínguez, A. Alvarado-Iniesta, and J. L. García-Alcaraz
Department of Industrial and Manufacturing Engineering
Autonomous University of Ciudad Juarez
Ave. Del Charro 450 Norte
Ciudad Juarez, Chihuahua, 32315, Mexico

Corresponding author's Email: luis.dominguez@uacj.mx

Author Note: I am Doctoral Student of the DOCI program at Autonomous University of Ciudad Juarez and I am really motivated to write this paper because it enables us to express the findings of our research on intuitionistic fuzzy set and decision making field. I also want to thanks to team members that collaborated in order to achieve our objective on this project. Especially, thanks to my supervisor Dr. Alejandro because his direction has been well focused on my preparation.

Abstract: Nowadays, supplier selection is an important activity in the performance of any company. Supplier selection is considered as a complex multi-criteria and group decision making problem that involves information that sometimes is vague or incomplete. This study presents a hybrid of Dimensional Analysis techniques with Intuitionistic Fuzzy Sets for supplier selection. The study considers a group of experts and a set of criteria to be evaluated by them for selecting the best alternative. The method uses intuitionistic fuzzy sets for representing qualitative information. A numerical example is presented to demonstrate the effectiveness of the proposed method.

Keywords: Intuitionistic Fuzzy Set, Dimensional Analysis, Supplier Selection, Multi-Criteria

1. Introduction

In recent years, many advances in the manufacturing field have been developed due to global competitiveness among companies. Firms have been investing in advanced manufacturing technologies (AMT) like robots, because they provide opportunities for improvement in their manufacturing performance in terms of cost, quality, and flexibility (Tahriri et al., 2011). In this sense, robot supplier selection receives high interest by experts as an important topic of research involving multicriteria decision making (Rao et al., 2011; Tansel İç et al., 2013; Shabtay et al., 2014; Rashid et al., 2014).

Koulouriotis & Ketipi (2014) report that there actually exists several decision making methods focused on the robot supplier selection problem; for example, AHP, TOPSIS, Utility Theory, Fuzzy, DEA, Revised Weighted Sum, Linear Programming, also hybrid methods, as: AHP-QFD, Fuzzy-AHP, QFD-FMEA, Fuzzy-TOPSIS, Fuzzy-AHP-TOPSIS, VIKOR-ELETRE. However, robot supplier selection is still an issue that needs to be solved, whether there are different aspects involved, such as imprecise data, multiple criteria and several alternatives, etc. (Saen, 2006; Rashid et al., 2014).

In 1986, Atanassov introduced the intuitionistic fuzzy set (IFS) as a suitable manner to deal with uncertain environments, as an extension of fuzzy theory. The literature about IFS in decision making problems has been increasing (Wang et al., 2013; Chen, 2014; Liu & Wang, 2014; Aloini et al., 2014; Zhang et al., 2014). Intuitionistic fuzzy sets are more capable than traditional fuzzy sets at handling vague and uncertain information in practice (Chen, 2014); as a result, many of the techniques that present a hybrid with fuzzy theory have been developed with the intuitionistic fuzzy version. Therefore, the objective of this work is to present the intuitionistic fuzzy set version of the technique Dimensional Analysis (DA) that was reported by Blaglia & Gabbrinielli (2000) in the selection of robots and applied recently by Garcia et al. (2013) in the process of supplier selection. As it was mentioned above, techniques for choosing or the best techniques for choosing is an issue that can be argued for a long time, and very unlikely agreed upon.

The rest of this work is organized as follows: In section 2, a detailed description of the intuitionistic fuzzy dimensional analysis method is given. Section 3 presents a numerical example. Conclusions are presented in the last section of this paper.