

# Chapter 13

## Application of Fuzzy Topsis and Taguchi Methods for Optimization Problems With Disruptive Risk: A Systematic Review

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### **ABSTRACT**

*Ranking and choosing research projects and analyzing experiments are usually difficult and complex responsibilities for professional research councils at universities and research centers. Its complexity stems from having more than one variable in each project, and the participation of many decision-makers in the ranking process and selection of research projects based on many variables. The fuzzy set theory provides the required flexibility to show the uncertainty about the lack of knowledge, and also it can manage the uncertainty in the real world that the values of criteria are not defined properly. For this purpose, in the environment where the criteria of research projects are vaguely defined, the ranking methods such as Taguchi, which can reduce the number of experiments and making process more efficient, can be used for quality design in designing and processing product. In this work, first of all, the authors review fuzzy TOPSIS technique and the Taguchi method as well; then they approach research efficiency and optimization of the level of effective parameters in an experiment.*

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## **INTRODUCTION**

Modern organizations work in a dynamic and competitive environment in which critical factors for their survival and expansion, often result in their effort for efficiency and effectiveness. Despite the concepts of performance, being in harmony, well-organized organizations might consider the importance of their competitors and compare their situation with them. Dynamic job environment has caused the importance of considering the competitors, changes over time (Sergey & Kweku, 2013). One of the most important indexes for comparison is the efficiency rate that has a broad meaning in product literature.

The flexibility of the concept of efficiency and its ability to being common in people's daily life has allowed them to define this concept by their knowledge and attitude, which is different from other common definitions in other countries and majors (Chen & Richard, 2014). By using Taguchi and fuzzy TOPSIS models, efficiency in the organization and research can be evaluated and analyzed. In these methods, a set of goals and criteria are used to judge options, and by using a method of ranking, options are ranked according to the satisfaction of goals and criteria (Hajkowicz and et al., 2000). As a result, the option that can be ideal in every situation is more or less impossible, but choosing the most relevant result is relatively possible.

## **Fuzzy Mathematics**

Fuzzy methodologies are efficient techniques for considering vagueness in the human decision. One of the branches of contemporary mathematics is fuzzy logic that determines complicated problems, and changes in the management environment can be more simply controlled by using this method.

Based on scientific principles, it has been proved that all things include an eternal principle which by this principle it is true or not. It may be possible to doubt 'trueness' or 'falseness' of something, but they do not have doubt about one thing, that each occurrence is either 'true' or 'false.' There are many examples like atoms vibrate or not, and grass is green and is not red or many other examples. In other words, the desired solution like the grass being green or red defines the trueness or falseness of a solution, should not be expanded to everything. The problem with science is expanding this matter to all occurrences. In logic and mathematics this principle was the norm, anything is either true or false, so in this way, relevant topics or mathematical expressions are either entirely right or completely false, black or white, one or zero, many examples can be presented (Wang & Elhag, 2006).

The problem with science has this kind of definition among all logical and mathematical matters. We will see that it should not be interpreted this way, but everything should be measured relatively and should be graded. Everything is 'relatively' right or wrong. In other words, real phenomena are not black or white but somehow 'gray.' Science shows gray realities with black and white tools and this was why we thought that reality is also black or white. Considering a person with age of more than 18 years as a mature one is not a true fact. The fact has some other particular concept. Between 15 to 16 years old, adults barely can be found and also amongst 23 or 24 years old there can be, though rare, that is not mature yet.

In the mathematics environment, there are many concepts, logics, and relations. Many of these relations and concepts are based on a two-value system meaning of true or false. For example, it is said: this system is stable (or unstable) because of some principle or relation or mathematical theory. Here only two values are considered, i.e. stable and unstable for a controllable system (it is covered in linear control course). In another example, software engineers say that particular software service is safe or unsafe and considering only two values: safe or unsafe, and value a system as safe or unsafe. Actually

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