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## EXTENDED ABSTRACT BOOK

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# Comparative Analysis of Supplier Selection using Analytic Hierarchy Process and Potential Method

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## ABSTRACT

Comparing alternatives is the standard approach used to address problems through Multi-Criteria Decision Making (MCDM) methods. It involves evaluating multiple factors and calculating weighted outcomes for each alternative. Some of the well-known MCDM methods are the Analytic Hierarchy Process (AHP) and the Potential Method (PM). PM utilizes a directed graph based on pairwise comparisons to assign a value for each alternative. In this study, PM is applied to the supplier selection problem that has already been analyzed using AHP. The purpose is to demonstrate the application of PM in decision making. Furthermore, both methods rank the alternatives in a similar way, demonstrating that PM is equally competent as AHP in solving real-world complex problems with multiple criteria.

**Keywords:** Multi-Criteria Decision Making, Analytic Hierarchy Process, Potential Method, Supplier Selection

## 1. INTRODUCTION

In decision-making, it's important to find and select options based on the decision-maker preferences. Decision making process always require examining various options and choosing the one that best meets goals and values (Štirbanović et al., 2019). Multi-Criteria Decision Making (MCDM) is a method to help decision-makers handle complex situations involving multiple criteria. This study focuses on two main methods in MCDM which are The Analytic Hierarchy Process (AHP) and the Potential Method (PM). The AHP is widely used method for MCDM that was developed by Thomas L.Saaty during the 1970s. It helps decision makers compare factors in pairs and their relative importance to help enforce consistency in judgements (Huang, 2021; Schiavon et al, 2023). In contrast, the PM applies network analysis in analysing the relationship and relative preference between different alternatives to support decision making (Čaklović & Kurdija, 2017).

This study focuses on improving the analysis of AHP matrices by utilizing the PM in a supplier selection case study taken from Hruška et al. (2014). The aim is to evaluate the decision results of both techniques, especially regarding the resultant weights and rankings.

## 2. METHODOLOGY

The Potential Method is a decision-making approach that employs a graph called as a "preference graph to represent pairwise comparisons between alternatives (Čaklović and Kurdija, 2017). Definition 1 formally describe the preference graph while Figure 1 provides some examples of its various forms.

**Definition 1** (Čaklović & Kurdija, 2017)

A preference graph is a triple $G=(V,A,F)$ where $V$ is a set of $n\in$ vertices, $A\subseteq V\times V$ is a set of directed edges, and $F:A\to$ is a preference flow which maps each edge $(u,v)$ to the corresponding intensity $F_{(u,v)}$.

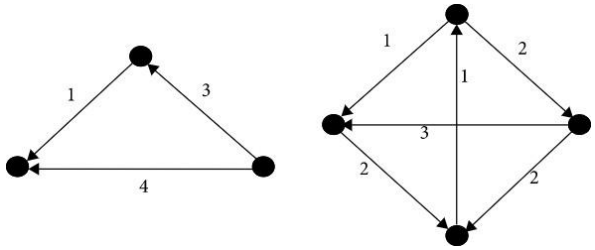



**Figure 1.** Some examples of preference graph

## 3. IMPLEMENTATION, RESULTS & DISCUSSION

Hruška et al. (2014) are needed to find the best supplier for a Czech manufacturing company. The company is seeking a new supplier for a particular item. There are 10 criteria to be evaluated to find the best suppliers. The company has three potential suppliers and is using a structured, multi-criteria decision-making approach to evaluate them.

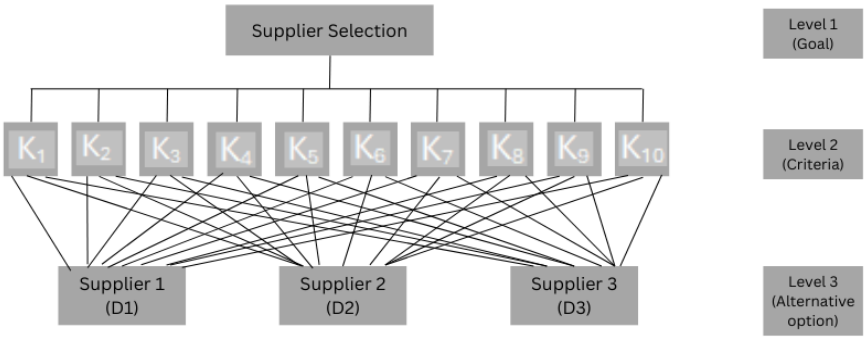



**Figure 2.** The hierarchy of problem (Hruška et al., 2014)

### 3.1 Weight Determination

The initial step in analyzing hierarchical decision problems is finding the weights of criteria. The preference graph with respect to criteria from supplier problem is illustrated in Figure 3.

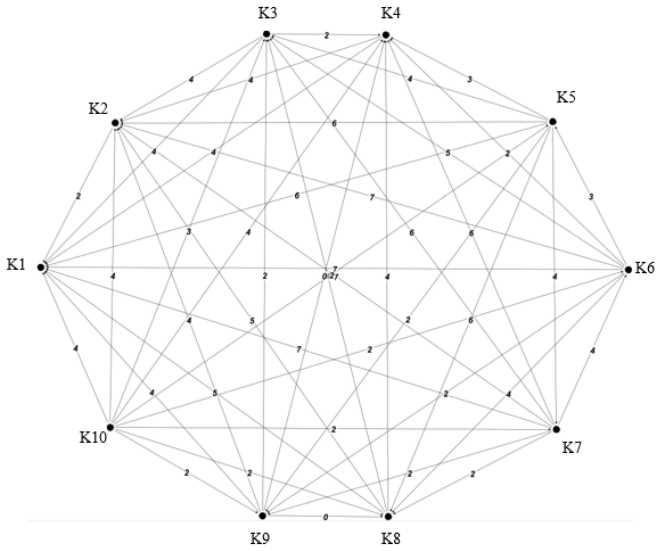



**Figure 3.** Preference graph for the criteria

Table 1 presents the global weights assigned to each criterion as determined by the PM, along with their rankings.

**Table 1.** Global weightage of suppliers

| Suppliers / Criteria | D1 | D2 | D3 |
|---|---|---|---|
| K1 | 0.0379 | 0.1517 | 0.0095 |
| K2 | 0.1256 | 0.1256 | 0.0010 |
| K3 | 0.0995 | 0.0078 | 0.0006 |
| K4 | 0.0559 | 0.0559 | 0.0035 |
| K5 | 0.0712 | 0.0035 | 0.0004 |
| K6 | 0.0418 | 0.0041 | 0.0002 |
| K7 | 0.0285 | 0.0002 | 0.0036 |
| K8 | 0.0504 | 0.0100 | 0.0002 |
| K9 | 0.0510 | 0.0032 | 0.0004 |
| K10 | 0.0135 | 0.0430 | 0.0003 |
| Global weight | 0.5753 | 0.4050 | 0.0197 |
| Final Ranking | 1 | 2 | 3 |

Table 2 shows the final results for the PM and AHP. In the PM analysis, supplier D1 has the highest weight of 0.5753. The supplier D2 follows with 0.4050 and D3 has 0.0197. The AHP shows similar results where D1 has a weight of 0.4785, D2 has 0.4397 and D3 has 0.0816. Both methods rank the suppliers in the same order as D1 > D2 > D3.

**Table 2.** Comparison of weight and ranking for suppliers

| Suppliers | AHP | Rank | PM | Rank |
|---|---|---|---|---|
| D1 | 0.4785 | 1 | 0.5753 | 1 |
| D2 | 0.4397 | 2 | 0.4050 | 2 |
| D3 | 0.0816 | 3 | 0.0197 | 3 |

## 4. CONCLUSION

The results of the Potential Method are similar to those of the AHP. This shows that PM is consistent and reliable for decision-making. Such consistency suggests that PM is not just good for choosing suppliers, it can also be useful in other multi-criteria decision-making situations. The PM is an organized framework that allows decision-makers to evaluate options effectively. This makes PM a valuable tool for tackling complex issues in different areas.

## ACKNOWLEDGEMENT

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