A MADM Method for Office-Job Assignment Problem

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Abstract: There are different kinds of jobs in any organization; some of them have more traffic to one another, in the other words there are communicative rates between these office jobs. In this paper we want to develop an approach of analytical hierarchy process (ANP) so that enable us in assigning jobs to suitable office rooms. We suppose that we know distances between places and could predict the amount of flow movements between theses jobs and would like to minimize the Flow × Distance.

Keywords: ANP Algorithm, Interoffice movements, Quadratic assignment Problem

1. INTRODUCTION

Although there are some discrepancies between movements on the floor of shop and on the floor of an offices, but the concept of flow stands up in the same manner for both of them. According to [1] material handling has two common interrelated objectives that are minimization of intercellular flows and distances between these cells. In the office job structure, we are interested in minimizing the unnecessary interactions similar to movements between different departments of an organization as possible as. We could define the mathematical model as incoming formulas:

\[
\min \frac{1}{2} \sum_{i} \sum_{j} \sum_{m} \sum_{j} x_{ij} m D_{ij} F_{im} \\
\text{s.t.} \\
\sum_{i} x_{ij} = 1 \quad \forall i \\
\sum_{i} x_{ij} = 1 \quad \forall i \\
x_{ij} \in \{0,1\} \quad \forall i,j \\
\]

Where \(i, j\) are indexes for office jobs. \(l, m\) are considered as indexes for office positions. \(F_{im}\) is the flow movement between \(l_m\) and \(D_{ij}\) presents the distance between \(i, j\). (1) minimize the Flow × Distance as travel distance. Number (2) and (3) respectively show the unique job for each office and inversely.

This problem is well known as Quadratic assignment problem (QAP). In the computational complexity theory, this problem is NP-hard; so in the large cases, classical algorithms do not guarantee an optimum solution. Because of interdependent relation concept among each office as a place for all jobs as alternatives for each place (or inversely), we use ANP approach as general version of analytic hierarchy process (AHP) method which expands linear top down structure to relations in all directions. This new and practical decision making method is introduced in [9]. This method is applicable in various areas, we reviewed the relative literatures; reference [2] and [3] used ANP method for decide about the priority of choices and used them in a zero-one goal programming in order to satisfying constraints. There is a scheduling problem on faculty–course assignment in [4]; they used both AHP and ANP to weigh conflicting objectives and employed it in scalarization. In [5] a multiple attribute decision making (MADM) concept is supposed in two stages method that leads to determine cell formation, intracellular machine layout and cell layout as three basic steps in the design of cellular manufacturing system (CMS). They called part-machine incidence matrix (PMIM) and defined the arrays in the PMIM, based on the operational sequences of machines for producing each part. The initial PMIM is solved by the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and then improved by Simple Additive Weighting (SAW) or TOPSIS again. Then the structure of the cells, machines layout in each cell are obtained. It might consume that the final result of this approach could be assigned as an input movement matrix for our algorithm.

We believe the concept of QAP is rooted in decision making, so we deal with the office-job assignment problem in supposed material handling system and chose best alternative by a MADM concept. The result leads to minimum travel distance cost regard to distances between
rooms in each assigned personnel and flows between them too.

2. ANP MODEL AND METHOD

First of all we should clarify the structure of our ANP model, and then we could proceed along the comparisons. Reference [6] expressed that the objective of decision model would decompose into clusters, sub-clusters, and so on until a manageable level is reached, which is often the alternatives or options and correlations can be stipulated in any part of the decision model. Hence there are some different ANP models according to problem definitions and assumptions so we draw ANP structure to exploit our idea in different manner as Fig1 shows.

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![Diagram of ANP structure for four job offices and job movements (there are interactions between locations of offices and jobs).](Image)

Figure1. The ANP structure for four job offices and job movements (there are interactions between locations of offices and jobs).

Our comparisons are based on the multiplying matrix that we call it “main matrix” hereafter. We would explain how we form it as following sections.

A. Expanded Distance Matrix:

There is a distance matrix which each block of this matrix contains all of jobs so the distance between each pair of offices is constant for all of pair cells that are in mentioned block except the comparison among same cells or main diagonal of distance matrix, these arrays would be zero.

B. Expanded Interoffice Movement Matrix

The second matrix is flow matrix; all of pairs of main blocks are same as each other and same as the flow matrix between cells except main diagonal that is zero. We refer to this intercellular movement matrix.

The way of filling two matrices is a reason for two side comparing cells and blocks in this kind of assignment problem. After multiplying of each array to array of two mentioned matrices, we have a main matrix to traverse following steps:

I. We could assign one job with most flows to office which has minimum sum of distance to other office places as we know the distances between places.

II. After removing one job and one office, comparing would been done for remaining jobs in each place rather than other jobs in other office places. Remember the structure of four offices in Fig.1, after removing one cell and its related location, there are 3 offices and 3 jobs or a $9 \times 9$ matrix for comparing. So there are nine $5 \times 5$ matrices because when we compare one job to other jobs, this job is removed from other places and there are only two other jobs in other places. The array of each comparison matrix will obtain from the difference of that job in determined office to fixed job in fixed place by using the main matrix.

III. Normalize each comparing matrix and then calculate its eigenvector.

IV. Now collect the weight vectors in the super-matrix, locate each weight in appropriate place, there is some empty places in this matrix that are related to specified cell in specific block that did not participate in each job comparison, we fill these empty points with zeroes. The final eigenvector from this super-matrix is scale for decision, the order of offices is important in selecting best job for mentioned place, the cause of importance is the same value of same jobs for different offices, hence we select the minimum weight of priorities and follow it, if after selecting one job another office select that job again, ignore this selection and select second rank for this office and so go on to accomplish the assignment.

It is denoted in [7] that the unit of measurement is not unique; we can use different number to represent the weights in scale. There is a 9-point fundamental scale measurement that is represented in [9]. But we could use another measurement scale numbers which could represent the comparing process too.

3. REFERENCES

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Books:
