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A survey of optimum strategies to urban planning and management by using TOPSIS method (Case study: Cities of Mazandaran Province, Iran)

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Abstract

One of the most important factors in quality improvement of transportation, communication, accommodation, utilities is urban infrastructures development. Certainly, with the intention of achieving the goal, approaches to urban infrastructures management must be ranked by scientific and logical evaluation and calculation. This paper presents evaluation of governmental, private, and public–private partnership (PPP) approaches based on efficient performance of Mazandaran's cities as a Multiple Attribute Decision (MADM) problem by the TOPSIS for prioritization of effective indicators to rank the approaches, so it increases urban management system efficiency in Mazandaran's cities.

Keywords: Urban Management, Technique for Order Performance by Similarity to Ideal Solution (TOPSIS), Multiple Attribute Decision Method (MADM), Optimum Strategies. Mazandaran Province

Introduction

Throughout the world, enormous growth in demand for urban services in developing countries is considerable. State and local government is attempting to provide larger utilities and better infrastructures in cities. In addition, varied decision making institutes, different views, and many other factors are related to urban management make complex circumstances. Consequently, it is necessary that countries pay attention to urban management. One of the most important factors in quality improvement of transportation, communication, accommodation, utilities is urban infrastructures development. Infrastructure means fundamental installations that supply citizens' needs and demands of providing energy. In large cities, developing infrastructures is difficult and expensive because of massive growth of cities and population (Shieh, 2006). Providing available, flexible, reliable and safe services is essential point in urban management and planning (Razavian, 2002). This article focuses on existing common approaches to infrastructures, planning of important indicators of infrastructures such as cost, performance, quality, useful life, and reconstruction. Furthermore, the indicators have been assessed by experts and qualified persons' opinions based on providing questionnaire and opinion poll forms (Mahalingam, 2010). At the end of the article the most optimal solution than other alternatives was selected by Multiple Attribute Decision Method (MADM) and (TOPSIS) technique.

Urban management

Planning, investment, and city management have been surprisingly become so complex due to massive growth of cities. Urban management as organized regulation of city development includes policies, programs, plans, and operations that adapt increase of population to infrastructures availability. Urban management has a close relationship with constant policies, social cooperation, economic prosperity, etc. (Loosemore et.al, 2007).

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Approaches related to management and construction of urban infrastructures

Governmental approach

In this case, government designs, builds, finances and operates (DBFO) infrastructures, so ministries and governmental organizations have to accept much pressures. Government should considers current circumstance, existing facilities, and scientific predictions to plan, monitor, and construct projects (Liao, 2000).

Private approach

In this case, the project and its process are completely done by private companies. Therefore, it raises allocation of resources, optimal use of private company's financial resources, creating safe competitive environment for long term investments, obtaining new techniques of management and consequently, production and distribution of wealth in country (Pakdaman, 1995).

Public–private partnership (PPP) based on the private finance initiative (PFI) approach

The PFI is a form of public-private partnership (PPP). Under the most common from PFI, the private sector designs, builds, finances and operates (DBFO) facilities based on 'output' specifications decided by public sector managers and their departments. PFI differs privatization in that public sector retains a substantial role in PFI projects as the main purchaser of services, an essential enabler, and a supervisory body of the projects. Moreover, government can use valuable experiences of private sector to make decisions in many fields (Hasanpoor, 1999).

Multiple Attribute Decision Method (MADM)

Multiple Attribute Decision Method (MADM) is applied approach in this study that criterion of decision is indicators. Goals clearly are stated that the aims and indicators of urban management are assigned through filling some different forms and questionnaire by experts. In MADM, a choice of options is considered. MADM approach to process information is divided to varied parts caused by inputs from operator that one of them is remedial model (Marques et.al, 2011).

Compensatory approach

In this approach we have some exchanges through indicators it means that change in an indicator is covered by converse change in other or others indicators. Remedial model uses some approaches such as: TOPSIS, ELECTR, the linear allocation, AHP (Asgharpoor, 2009).

TOPSIS method and project modeling

In this article collected information after census and necessary correction has been put in information bank .The data consist of some effective indicators in urban management. The importance and role of these indicators in three approaches of urban management:

- Governmental approach
- Private approach
- Public – private partnerships (PPP) based on private finance initiative (PFI) approach are recognized and evaluated to choose suitable urban management system for studied Sections and evaluating efficient criterion of each policy. In the next step, indicators and policies are ranked based on the different forms and questionnaire have been filled by experts and managers. The priority and weight of different indicators are recognized by MADM & TOPSIS. This technique assumes each indicator is absolutely increasing or decreasing that it means indicators are positive or negative. The positive is the indicator of profit and loss index is an indicator that has a negative aspect. Thus maximum existing value represents positive ideal and minimum existing value indicates negative ideal for the approaches. Table 1 show the result:

Table 1. Recognizing negative and positive indicators importance

Indicator importance	Indicator
-	Cost
+	Dimensions
+	Quality
+	Useful Life
+	Performance
+	Renovation & Reconstruction

Results

TOPSIS Technique

Step 1: Making Decision Matrix & Normalized Decision Matrix: In this step, importance of each indicator is assigned based on experts' opinions. After analyzing, normalized results are calculated by equation (1) (Moghassem, 2010), that are available in table 3. Where represents normal-

ized index and represents the level of importance each index has:

$$rij = \frac{Xij}{\sqrt{\sum_{i=1}^{m} Xij^2}} \quad (1)$$

Table shows total importance coefficient of indicators are one that means indicators importance is proportional.

Step 2: Weighting Normalized Decision Matrix: In this step, each attribute is assigned a weight based on experts' opinions and its importance in comparison with other attributes. The normalized and weighted decision matrix V is obtained by multiplying column (j) of matrix R at the relevant weight (wj). Tables 4, 5 shows the results.

Step 3: Determining Positive Ideal Solution and Negative Ideal Solution:

2 virtual options (positive ideal, negative ideal) are defined as follows: is the best option (positive ideal) and is the least effective option (negative ideal) (Byun, 2003). (Table 5) shows the results.

$$A^{+} = (\{(\max Vij / j \in J) Or (\min Vij / j \in J')\} / i = 1, 2, \ldots, m) \quad (2)$$

$$A^{+} = (\{(\min Vij / j \in J) Or (\max Vij / j \in J')\} / i = 1, 2, \ldots, m) \quad (3)$$

Table 3. Normalized Decision Matrix

Indicator / Approaches	D Cost	E Dimensions	F Quality	G Useful Life	H Performance	I Renovation & Reconstruction
A Governmental	0.651446	0.140242	0.080688	0.055493	0.072838	0.126899
B Private	0.232339	0.140242	0.080688	0.055493	0.072838	0.126899
C Public-Private Partnerships	0.116215	0.449774	0.245342	0.841525	0.764112	0.511294

Table 4. Indicators weights based on results of questionnaire forms

Indicator	D Cost	E Dimensions	F Quality	G Useful Life	H Performance	I Renovation & Reconstruction
Weights	0.95	0.7	0.9	0.9	0.75	0.85

Table 5. Optimized Weigh Matrix

Indicator / Approaches	D Cost	E Dimensions	F Quality	G Useful Life	H Performance	I Renovation & Reconstruction
A	0.6189	0.0982	0.0726	0.0499	0.0546	0.1079
B	0.2207	0.2870	0.6066	0.0927	0.1223	0.3075
C	0.1104	0.3148	0.2208	0.7574	0.5731	0.4346

Table 6. The Distance from the positive ideal and negative ideal solutions

Indexes / Ideal	D Cost	E Dimensions	F Quality	G Useful Life	H Performance	I Renovation & Reconstruction
A^{+}	0.1104	0.3148	0.6066	0.7574	0.5731	0.4346
A^{-}	0.6189	0.0982	0.0726	0.0499	0.0546	0.1079

Step 4: Measuring the Distance Amount: The distance between every N-dimensional option can be measured by Euclid's Method. The distance between option (i) and the positive ideal can be obtained from (Eq. 4):

$$S_{i+} = \sqrt{\sum_{j=1}^{n}(Vij - Vj^{+})} \quad (4)$$

In the same way, the distance between option (i) and the negative ideal can be obtained from (Eq. 5) (Wang et.al, 2010):

$$S_{i-} = \sqrt{\sum_{j=1}^{n}(Vij - Vj^{-})} \quad (5)$$

The equation amounts earned in this step are shown in (table 7).

Table 7. The Distance from the positive ideal and negative ideal

Indexes / Ideal	Si^+	Si^-
A	1.2110	0.0132
B	0.8210	0.7250
C	0.3858	1.0970

Step 5: Calculating the relative distance between A_j and A^+:

Equation 6 is used to calculate the distance and the results are shown in (table 8).

$$C_{i*} = \frac{S_{i-}}{S_{i+} + S_{i-}} \quad (6)$$

Table 8. Calculation of Relative Distance for option

Options	Relative Distance
A	0.0107
B	0.4689
C	0.7398

Step 6: Ranking groups: The available options can be ranked on the basis of decreasing order of Ci_*. As (table 9) shows, strategic approach is ranked first, project-centered approach is ranked second and the traditional approach is ranked third.

Table 9. Ranking available options on the basis of decreasing order

Rank in Decreasing Delay	Options	Final Score
First	C	0.7398
Second	B	0.4689
Third	A	0.0107

Conclusions

According to the results of this research, public–private partnerships (PPP) based on the private finance initiative (PFI) under supervision of government sector approach has first grade due to the least distance from the ideal criterion. This approach improves projects quality because of better performance so returning period of infrastructures renovation and reconstruction will be longer, and costs will decrease. Furthermore, government facilities, powers, and abilities can be aligned with private sector capital and resources to have best performance (Fraud, 2001). The approach is useful, especially for developing country such as Iran. Also, private sector approach decrease costs and increase quality, usefulness and performance of infrastructures. Because private sector resources and capacities are limited in comparison with other sectors, private sector must carefully design, build, finance, operate, and monitor the projects. The most essential problem of this approach is lack of some powerful supervisory bodies in developing country. Consequently, individual and independent decisions has been made by private sector and wasting of capital. This approach is suitable for developed countries that have scientific regulation. In government approach, government expends enormous costs for urban infrastructures and many big governmental investor companies have been active in utilities. Nevertheless, this approach causes complex problems because process of design, operation, supervision, and management are done by government. Therefore, government can't appropriately distribute resources, facilities and services.

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