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Determining Appropriate Zones for Knowledge Intensive Firms Site Selection Using GIS:
Case Study of Tehran Metropolitan Area

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ABSTRACT

In this study, the integration of fuzzy analytic hierarchy processes (FAHPs) and fuzzy overlays in GIS was used to determine appropriate geographic zones for the establishment of knowledge intensive firms in 22 districts of the Tehran metropolis. According to the theoretical background, a number of criteria were selected for the identification of appropriate geographic zones. The results show that among the selected criteria, proximity to existing knowledge intensity firms, and companies providing information and communication technology (ICT) services, higher education and research centers, being close to convenient transportation network and land use have more important role in the location of firms. According to the findings, among 22 regions, regions 3, 7, 6, 1, 2, 10, 4, 11, and 12 are the most desirable ones for the deployment of firms. Ultimately, regions 6, 7, 3, and 1 have received "very high" priority for the deployment of knowledge intensive firms.

KEYWORDS

Appropriate Zones, FAHP, GIS, Knowledge Intensive Firms, Tehran

INTRODUCTION

Knowledge intensive services include a wide range of services such as legal services, marketing, consulting, engineering, technical, information and communications, electronics, biotechnology, nanotechnology, optics and photonics, chemical products, electronics, information and communications and computer technologies, medical and pharmaceutical engineering, aerospace, energy and other innovative services (Mas-Verdu' et al., 2011; CECKCI, 2016).

From the 1960s onwards, the advent of the information revolution was accompanied by the formation of Post-fordist economy. The economy is known as informational or knowledge economy, which has even made the cities that are not founded based on capitalism encounter with structural changes (Rocco, 2006; Sarrafi, 2001). In addition, economic globalization has led to the development and concentration of advanced and knowledge intensive services in cities (Lim, 2003), including metropolises in advanced and growing economies. Tehran, as the largest center of production and consumption in Iran (Madanipour, 1998, & 1999) is also influenced by the economic globalization and

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has been faced with drastic functional-structural changes over the years 2000 to 2010 (Mohammadi, Sarrafi, & Tavakolinia, 2012).

Tehran, with the transition from an industrial to a service-based economy era, in addition to the concentration of financial resources and knowledge (Madanipour, 1999), has quickly entered advanced services economy and informational economy. So that in 2010 the service sector formed 78% of its economy (Tehran Municipality, 2014). As a result, between 2000 and 2012, the Advanced Producer Services was formed in Tehran and developed (Mohammadi et al., 2012). Since 2010, with the approval of and support for knowledge intensive firms (KIFs) by the Islamic Consultative Assembly of Iran, a new wave of knowledge intensive firms has started to work in Tehran during 2011-2016. So that until the first half of 2016, about 1, 000 of the total 1, 500 knowledge intensive companies founded in Iran had been established in Tehran metropolis (CECKCI, 2016).

However, the problem is that the companies have often begun to select a location without any programs in advance and out of spatial planning principles. It is estimated that by 2025, more than 20 new companies will be established in cities of Iran (CECKCI, 2016). This issue and the lifting of international sanctions have increased the tendency to establish knowledge intensive firms in Tehran metropolis. Before the imposition of international sanctions against Iran, foreign firms were not in Tehran metropolitan geography and local companies often worked at home (Mohammadi, 2012). Since the beginning of 2016 the sanctions have been moderated and it seems that due to the increase of political and economic international relations, foreign firms will be stimulated to work in Tehran. Therefore, appropriate location of new companies will be necessary.

Thus, the main purpose of this study is to identify and introduce appropriate regions and areas for the location of knowledge intensive firms in Tehran. In this study, we seek to answer the key question that which regions of Tehran have the highest potential and suitability for the location of KIFs? The answer to this question requires the use of proper Multi Criteria Decision Making (MCDM) techniques in Geographic Information Systems (GIS).

Multi-criteria decision analyses in GIS make it possible to combine multiple criteria. (Feizizadeh & Blaschke, 2013), make good judgments (Gbanie et al., 2008; Sumathi, Natesan, & Sarkar, 2013; Chen et al. 2011), analyze the complex relationships between various factors (Malczewski, 2006) and finally take the right decisions. MCDM methods are divided into two categories: Multi-Attribute Decision Making (MADM) and Multi-Objective Decision Making (MODM) (Malczewski, 1999). In this study MADM method in emphasized for the location. MADM evaluation methods in combination with methods of spatial analysis in GIS provide favorable conditions for space allocation. Moreover, the fuzzy analytic hierarchy process (FAHP) is a method of multi-criteria decision analysis (MCDA) which has a high potential for integrating with GIS analyses, spatial data and human decision-making, in matters relating to the location. It can also be combined with fuzzy logic techniques (Feizizadeh, Shadman, Jankowski, & Blaschke, 2014; Kahraman, Cebeci & Ruan, 2004).

Fuzzy methods can standardize the maps through determining the membership or lack of membership of each criterion (Gorsevski & Jankowski, 2010; Jiang & Eastman, 2000). In this study, the FAHP and fuzzy overlay in GIS are used for determining the best zones. This article is prepared for the first time in relation to determining the location of KIFs in Tehran and it is innovative in this regard and could be of interest to the readers. The article is made up of five main sections, including introduction, theoretical principles, methods, results and discussion, and conclusion.

BACKGROUND

In recent years, despite the use of MCDM and FAHP methods to analyze the spatial location and locate firms in cities (Kubler et al., 2016; Wang, Luo & Hua, 2008), their use was limited for "knowledge-based companies". For example, He et al. (2017) used fuzzy AHP technique to determine the appropriate areas for the establishment of knowledge-based companies. The results of their study

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