

A Framework for Analyzing Metropolitan Capacities to Achieve Knowledge-based Development; Case Study: Tehran Metropolis

Sahar Nedae Tousi^{a*}- Borhan Amjadinia^b

^a Assistant Professor of Urban and Regional Planning and Design, Faculty of Architecture and Urban Planning, Shahid Beheshti University, Tehran, Iran (Corresponding Author).

^b M.A. of Regional Planning, Faculty of Architecture and Urban Planning, Shahid Beheshti University, Tehran, Iran.

Received 13 July 2018; Revised 23 December 2018; Accepted 29 December 2018; Available Online 18 March 2020

ABSTRACT

In the late twentieth century, the world entered the structural transition process due to scientific advances and the advent of new ICT-based paradigms. The emergence of the network society and the “knowledge-based economics” phenomenon, which relates to the economic importance of knowledge production, commercialization, and utilization, has raised a new perspective called “knowledge-based urban development” in urban planning and development. This transition is greatly characterized by shifting the role of competing cities and metropolises to play a knowledge role in the global economy. This new trend, along with the recent developments in Iran’s macro policies, has also made the metropolises of Iran, especially Tehran, to inevitably move towards the knowledge economy. Therefore, since the recognition of the status quo and capacity assessment of metropolitan areas are the first and foremost step in the planning process, the present study aims to identify and analyze the capacity of Tehran metropolis for knowledge-based development and finally to develop a knowledge-based development model to help the metropolis to improve its competitiveness. In order to assess the capacity of Tehran metropolis for knowledge-based development, first, its capacity is investigated compared to the other 14 metropolises in Iran in terms of the input and output of knowledge-based urban development, using a comparative analysis. The outcome of this analysis reveals a significant difference between the Tehran metropolis and other Iranian metropolises in capacity for knowledge-based development. Then, the capacity of Tehran metropolis for achieving knowledge-based development is measured by comparing the existing proposals presented in the strategic-structural plan of Tehran with the strategies used in the world. Finally, a path analysis model was used to explain the reason for the knowledge-based development of Iranian metropolises. Testing the theoretical model proposed in the present study, which eventually leads to the development of an empirical knowledge-based development model for Iranian metropolises, confirms the impact of three main inputs on the knowledge-based development of Iranian metropolises: science-research capital, support capital, and general capital of knowledge city.

Keywords: Knowledge-based Urban Development, Capacity Assessment, Science-Research Capital, Public Capital Of Knowledge City, Tehran Metropolis.

* E_mail: s.n.tousi@gmail.com

1. INTRODUCTION AND PROBLEM STATEMENT; A KNOWLEDGE-BASED URBAN DEVELOPMENT IS ESSENTIAL FOR GLOBALIZATION ERA

Over the past two centuries, the ideas of neoclassical economics, which knew land, labor, and capital as the three main factors of production, have played a dominant role in understanding and shaping social production. These ideas regarded knowledge, education, and intellectual capital as secondary parameters of production (Yigitcanlar & Velibeyoglu, 2008). In the last few decades of the twentieth century, and especially since the 1970s, the world has entered the structural transition process, due to scientific advances and the advent of new ICT-based technological paradigms. The current society is often known as the information society or knowledge society (Castells & Cardoso, 2005, pp. 3-4), and its most remarkable characteristic is the ever-increasing role of information and knowledge in all spheres of life and the introduction of concepts such as “network society” and “knowledge-based economy” in the areas of socio-economic development (Mahdizadeh, 2010). On the other hand, in the globalization process of economy, the economic geography of metropolises has shifted to advanced services and products. Compensation for high costs and the maximum use of economic benefits available in metropolises have made indispensable to organize and direct economy towards high value-added products, known as knowledge economy (Sarvar & Poortaher, 2016). The ever-increasing importance of knowledge and information has also revived one of the city’s most historic roles, i.e. the centrality of knowledge. Although this role has been diminished in the 19th and 20th centuries due to the pressures cities were undergoing to accommodate increasing productive activity, it is now revived with the decline of industrial activity in most metropolitan areas. (Knight, 1995). Hence, the emergence of the network society and the “knowledge-based economics” phenomenon, which relates to the significant economic importance of knowledge production, commercialization and utilization, has raised a new perspective called “knowledge-based urban development” in urban planning and development. Nowadays, the term “knowledge city or capital” is used as a brand for cities with knowledge-based development (Yigitcanlar, 2014; Knight, 1995). Chatzkel (2006, p. 135) defines the knowledge city as a region that relies on its capacity to create and direct its knowledge capabilities in wealth creation. In such cities, capacity-building and knowledge-sharing are considered as a basis for global competitive advantage and quality of domestic life (Javier Carrillo, 2006). From Kunzmann’s perspective (Kunzmann, 2008, p. 300), knowledge-based urban development is a key planning approach

to attracting and retaining knowledge workforce and knowledge-based activities, as well as enhancing competitive cities. In addition, the knowledge-based urban development provides a framework for the collaborative development of all groups (public, private, academic, and social) in developing future urban and regional strategic and knowledge-based policies.

After the proposal of the initial knowledge-based urban development scheme- with the aim of achieving sustainability and improving the quality of life, enhancing the skills and knowledge of citizens and human resources as a means for human intellectual development (López-Ruiz, Alfaro-Navarro, & Nevado-Peña, 2014)- its use has become more widespread over time (Knight, 1995). The knowledge-based urban development strategy, which has been on the agenda of global knowledge cities, such as Austin, Barcelona, Helsinki, Manchester, Melbourne, Singapore, etc., has been considered in emerging knowledge cities such as Beijing, Brisbane, Dubai, Istanbul, Kuala Lumpur, Monterrey and Shenzhen in the last decade in order to achieve competitiveness and sustainability (Yigitcanlar, 2014; Yigitcanlar & Kamruzzaman, 2018).

Metropolises, along with the many benefits including job creation, provision of effective and intelligent infrastructure, service delivery and poverty reduction (Azimi, Sarrafi, & Ahmadi, 2007), have all the negative features of urbanization. Their scale and complexity make them unmanageable or fragile economically, socially, environmentally and politically (Yeganegi Dastjerdi, 2010). So, it is clearly found that conventional industrial models of capitalism in metropolises are unstable and the ultimate prospect of this trend will be the inevitable environmental, social and economic collapse of cities (Ergazakis, Psarras, & Metaxiotis, 2006). Such problems in metropolises, especially in metropolises of the Third World, as well as the benefits that knowledge-based production brings in the globalization era, make it necessary to change the approach and pay attention to the knowledge-based development of these urban centers (Baum, Yigitcanlar, Horton, Velibeyoglu, & Gleeson, 2007, p. 18; Winden, Berg, & Pol, 2007).

Given the changed direction of urban and regional spatial development policies in Iran in recent years, the spatial development planning and policy-making system of Iran has also attempted to take steps towards knowledge-based planning and management to meet the new needs of society. Along this way, joining major international IT institutions, emphasizing the debates on knowledge-based economics, and expansion of information and communication technology in Iran’s macro documents on countrywide development, such as 20-year national vision and the five-year development plans and finally, consideration of the goal of knowledge-based urban development as one of the major development goals in Tehran’s 20-year

long-term development vision, Tehran's strategic-structural plan and Tehran conurbation development plan are evidence of these efforts. In addition to the abovementioned plan, the rapid growth of the requirements and needs of the information society and the knowledge-based economy at national level are among the necessary operational measures in this regard. The results of the report on the provinces of Iran in terms of the ICT Development Index (IDI) by the end of 2016 indicate the accelerated movement of most provinces towards the information society (Nasri, 2017). The study of the seven-year trend of this index, which measures the level of access to Internet and communication tools, the extent of use, and the skill and literacy of using the tools, shows its growth for all provinces of Iran, as its average value has increased from 3.10 in 2010 to 5.61 by the end of 2016. In this index, Tehran province still ranks first among the other provinces over the last seven years, followed by Semnan, Qom and Mazandaran provinces. Also, compared to other countries, especially in terms of skills of using, Iran has a relatively good infrastructure status (Ahmadi, 2017).

2. BACKGROUND AND THEORETICAL FOUNDATIONS

Knowledge economy and knowledge-based development; in the last few decades of the twentieth century, due to scientific and technological advancements, in particular with the advent of new ICT-based technological paradigm, human society is in the process of a structural transition. The current society is often known as the information society or knowledge society (Castells & Cardoso, 2005, pp. 3-4), and its most remarkable characteristic is the increasing role of "information and knowledge" in all spheres of life and introduction of concepts such as "network society" and "knowledge-based economy" in the areas of socio-economic development (Mahdizadeh, 2010). Attention to the role of knowledge in the socio-economic development of societies is not new, and in the past, science and technology have always been important topics in theories of growth and development, but since the introduction of the theoretical perspective of human capital in the post-World War II period, the importance of knowledge and education has been more emphasized (Nazeman & Eslamifar, 2010). At present, the term "Knowledge-Based Economy" (KBE) or "Knowledge Economy" (KE), which has been particularly emphasized in nations development strategy by the Organization for Economic Cooperation and Development (OECD), emphasizes the role of science and technology in the economic development process (Nazeman & Eslamifar, 2010). Although a clear and single definition of knowledge-based economy or knowledge economy has not yet been provided (Windén, Berg, & Pol, 2007), researchers, scientific centers, and economic

organizations have each in turn attempted to define this concept. According to the OECD, the knowledge economy is "an economy that is directly based on the production, distribution and utilization of knowledge and information (Ergazakis, Psarras, & Metaxiotis, 2006, p. 68)". Powell & Snellman (2004, p. 199) refer to the knowledge economy as products and services that are based on knowledge-driven activities and help accelerate technological and scientific advancements.

Two major approaches can be identified in applying the knowledge economy concept. In the first approach, the knowledge economy is regarded as a separate part of the economy in which new technological knowledge is produced through universities and research centers. In the context of this approach, as the role of science knowledge increased in economic development, the importance of academic and research centers increased and they were given the third role of commercialization in addition to teaching and knowledge production. Accordingly, numerous studies such as that by Baycan & Stough (2013) have been carried out in the field of knowledge commercialization as a driver of regional economic growth. Based on the results of these studies, as the innovative role of universities increases in economic value-adding and space competitiveness, new forms of cooperation and networking of academic centers at local, regional, national and even international and global levels are to be expected. In the second approach, knowledge economy or knowledge-based economy is considered with a more holistic look and in which organizations and people effectively encourage themselves to acquire, produce, distribute and use knowledge (tacit and documented) for wider socioeconomic development. In his definition based on the second approach, Windén (Windén, Berg, & Pol, 2007, pp. 527-528) considered the knowledge economy with four main pillars: (1) an economic and institutional regime that provides the required motivation for effective use of existing knowledge, production of new knowledge and entrepreneurship, (2) an educated and skilled population for knowledge production and use, (3) dynamic information infrastructures for facilitating effective communication and information distribution and processing, and finally (4) a system of research centers, universities, think-tanks, consultants, corporations and other organizations that can import global knowledge, attract and adapt it to local needs and produce new local knowledge.

The knowledge-based urban development and achievement of the knowledge city; urbanization has been recognized as indisputable phenomena in the new millennium. Thus, the twentieth century can be known as the century of cities. On the other hand, the present century is also known as the century of knowledge and learning. After World War II, in many industrialized countries, more than half of GDP has shifted from material to knowledge-based. So, it can be said that the twenty-first century society is a post-industrial society, and the knowledge city, stemming from the

convergence of two ideas of increasing urbanization and knowledge-based economy, is its horizon (Javier Carrillo, 2006). As societies become more knowledge-based, the nature of urban development changes and the reason for this is that the importance of knowledge activities increases, and these activities require situations and environments that are different from those needed by the commodity-based activities (Knight, 1995).

The need for a new notion in urban development and the effort to move industrial cities to those with a knowledge-based economy first emerged in the industrial cities of the United States since the 1970s (Zhao, 2010). But this notion has been scrutinized in Europe and expanded to include all kinds of knowledge

resources and sustainable development requirements. In the early applications of this notion, the industrial composition of the workforce was considered, then the role of science, technology, and innovation in the introduction of knowledge into industrial development was emphasized, and more recently the “knowledge” concept has been expanded to encompass all its types, including cultural values and the local environment (Knight, 1995). All these events have resulted in the emergence of a new concept called “knowledge city” (Ergazakis, Psarras, & Metaxiotis, 2006). The following figure summarizes the evolution of this concept from Ergazakis’s perspective over the past decades (Fig. 1).

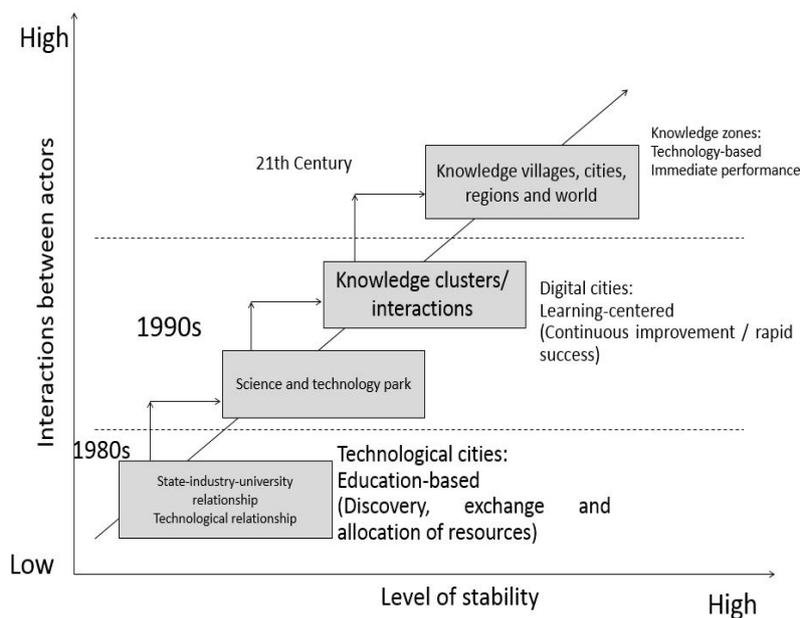


Fig. 1. Evolution of the “Knowledge City” Concept
(Ergazakis, Metaxiotis, Psarras, & Askounis, 2006, p. 76)

Today, the term “knowledge city” is used as a brand of cities with knowledge-based development (Yigitcanlar, 2014). Many definitions have been presented for “knowledge city” or “knowledge-based city”; Dvir and Pashar (2004) define it as a city purposefully designed to foster knowledge. Yigitcanlar (2014) describes the knowledge city as a region that its economy is driven by the export based on research, technology, and mental power, and much of its GDP significantly relies on the investigation in education, teaching and research. Martinez (2006) defines the knowledge city as a city with the task of transferring the current state of cities from a physical product-based economy to the requirements of a knowledge-based economy. The knowledge city seeks to achieve knowledge-based development through the continuous encouragement of knowledge management processes (including production, sharing, evaluation, renovation and updating of knowledge). This development can

be achieved through the constant interaction between knowledge factors (the knowledge city itself) with each other and at the same time, between them and the knowledge factors of other cities. Citizens’ knowledge-sharing culture, proper city design, and ICT networks and infrastructures support these interactions. The term “knowledge factor” also refers to any entity (human, organization, company, university, technology park, etc.) that can manage knowledge (Ergazakis, Metaxiotis, & Psarras, 2004; Ergazakis, Psarras, & Metaxiotis, 2006).

Shortly, in the knowledge economy era, where cities are considered a major factor of development, stable economic growth and prosperity largely relate to knowledge-based activities. The new forces and developments of this age lead cities to orient their competitive strategies towards rebuilding and improving their knowledge bases. Knowledge-based production is generally clustered in areas with rich

scientific and cultural knowledge bases related to particular industries, and this spatial requirement creates the tendency to polarize this high-growth activity in a limited number of cities around the world, which are the context of rich clusters of knowledge workforce and activity and different lifestyles (Ergazakis, Metaxiotis, Psarras, & Askounis, 2006; Yigitcanlar & Velibeyoglu, 2008; López-Ruiz, Alfaro-Navarro, & Nevado-Peña, 2014; Yigitcanlar, O'Connor, & Westerman, 2008; Ergazakis, Psarras, & Metaxiotis, 2006; Knight, 1995). The efforts of these cities to achieve the knowledge-based urban development bring many benefits compared to the commodity-based development.

3. METHOD AND CONCEPTUAL FRAMEWORK

Within the framework of the main objective of the present study, entitled "Proposal of a suitable framework for capacity assessment of metropolises and development of appropriate planning strategies", the following sub-goals are also considered at the case study level: Proposal of a comparative framework for assessment of Tehran metropolis's capacity

for knowledge-based development, compared to other Iranian metropolises (external capacity assessment); Proposal of a framework for assessment of Tehran metropolis's capacity for knowledge-based development in planning documents (internal capacity assessment) and identification and development of a knowledge-based development model for Iranian metropolises and its application in Tehran metropolis. The selected methodology is based on the methodological approach of Ergazakis et al. (2006), known as KnowCis, proposed in a study of a group of knowledge cities. This approach consists of five basic steps: "recognition of the state quo of the city as a knowledge city", "definition of a strategy", "production of a detailed action plan", "implementing" and "calculation/evaluation". The relationship between the research objectives and the KnowCis process can be illustrated in Fig.2. Accordingly, the methodological framework is divided into two general sections. The first section attempts to identify the criteria, processes, tools, and models needed to recognize the status quo of Tehran metropolis in terms of its capacity for knowledge-based development. The second section also presents Tehran metropolis knowledge-based development planning process.

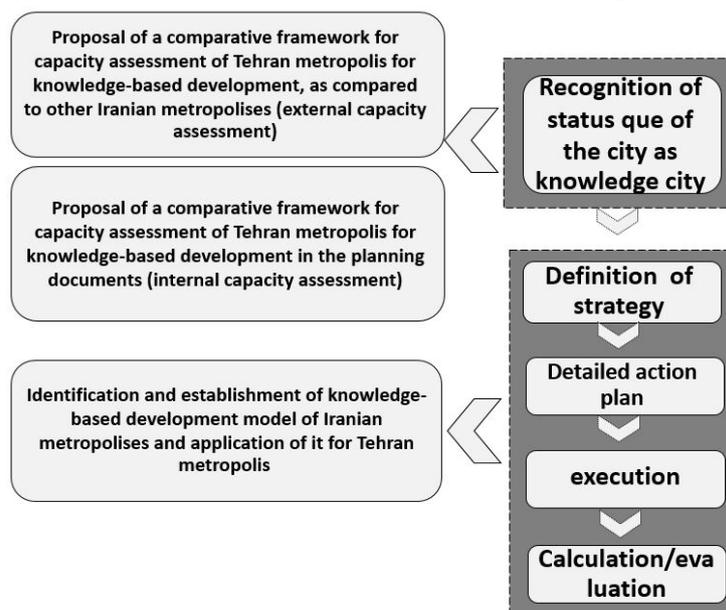


Fig. 2. Explanation of the Relationship between the Knowcis Process and the Objectives Associated with the Case Study

(Ergazakis, Metaxiotis, Psarras, & Askounis, 2006, p. 76)

The study of knowledge cities around the world requires a comparative element. Because being knowledge-based is not an absolute condition but a relative feature attributed to cities. Therefore, in order to analyze the capacity of Tehran metropolis, it should be studied through a comparative model. To this end, different scenarios can be pursued such as the comparative analysis of Tehran metropolis versus global knowledge cities, the comparative analysis of

Tehran metropolis versus regional knowledge cities, the comparative analysis of Tehran metropolis versus domestic cities and the comparative analysis of Tehran metropolis in a series of time versus its past. In order to complete the above methods, one can also refer to the analysis of the situation of Tehran metropolis in terms of current management and planning capacities to achieve the goals of knowledge city. Despite of the advantages of comparative analysis of Tehran

metropolis versus global and regional knowledge cities as well as comparative analysis of Tehran metropolis in a series of time, due to lack of information in these cases, the third method should be chosen. Because through this method, it is possible to compare cities by collecting data on cities from the same agencies responsible for provision of data and information. For this purpose and for comparative analysis of the capacity of Tehran metropolis for knowledge-based development, other Iranian metropolises are used as

comparative examples. But since Tehran metropolis may have significant advantages over many other metropolises in many aspects of knowledge-based development and this makes it difficult to identify its strengths and weaknesses, so in addition to comparative analysis, some kind of internal analysis is carried out to complete the matrix of Tehran metropolis's strengths and weaknesses in terms of knowledge-based development capacity using these two methods (Fig. 3).

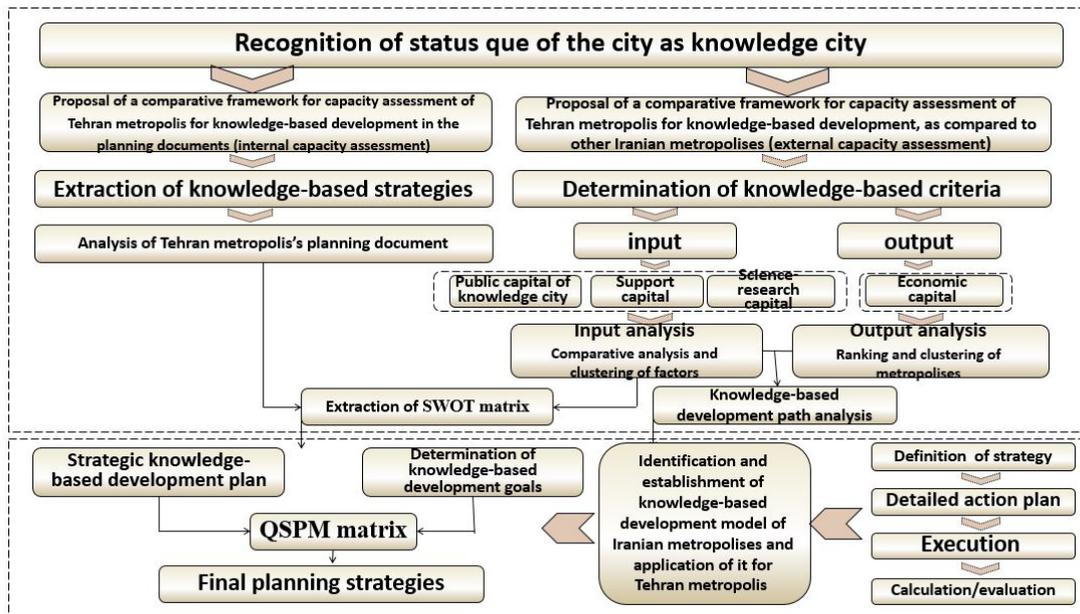


Fig. 3. Comprehensive Process of Achieving Research Goals Based on the Knowcis Model

In order to analyze the external capacity of Tehran metropolis for knowledge-based development, it was compared with 14 other Iranian metropolises. To this end, it is necessary to first determine the criteria for comparing the cities in terms of their capacities for knowledge-based development. Thus, first all the criteria extracted from theoretical and empirical foundations are presented and then the methods and tools used for comparing cities are explained (Table 1). After determining the criteria, according to the available information and statistics, it is attempted to calculate and prepare each one with one or more indices. Now, it is time to implement capacity assessment processes and models. There are several ways to do this:

Step 1: Inspired by the method used by Van Weiden et al. (Windén, Berg, & Pol, 2007) in their study entitled "European Cities in the Knowledge Economy: Towards a Typology", all criteria set in two general parts. The first part contains criteria that indicate the structural characteristics of metropolises for the effective acquisition, production, distribution and use of tacit knowledge in order for knowledge-based development. The criteria in the first part are the prerequisites and infrastructures necessary for achieving knowledge-based development, hereinafter

referred to as knowledge-based development input. The second part also contains criteria that reflect the level of knowledge-based development of metropolises and can be used to compare the economy structures of metropolises in terms of being knowledge-based. The data in this part are called knowledge-based urban development output. An important part of the output of knowledge-based urban development, as identified by Van Weiden and his colleagues, relates to the capital of knowledge-based economy, but according to other studies in the theoretical review, it is found that features such as having wealth and prosperity, as well as specialized economic structure and focusing cities on finite areas are among the requirements of knowledge-based economies.

Step 2: Then, in the second step, inspired by the method presented by Yigitcanlar (2014) in his study entitled "Benchmarking the Performance of Global and Emerging Knowledge Cities", the metropolises are ranked in terms of the degree of being knowledge-based. Output criteria allow for this ranking after appropriate weighting.

Step 3: In the next step, the output criteria of knowledge-based urban development are analyzed and interpreted

by comparison and using analytical and visual tools and methods. The purpose of this step is to determine Tehran's position as compared to other metropolises in terms of different output criteria of knowledge-based urban development.

Step 4: In the fourth stage, it is attempted to discover the process, stages and the role of different factors in achieving the knowledge-based development of Tehran metropolis and other Iranian metropolises. For this purpose, the path analysis technique is used on the output criteria. The path analysis requires a basic theoretical model. To this end, first, in this section, according to the theoretical foundations, a theoretical model is drawn between the input and the output of the knowledge-based urban development and finally it is tested using empirical data collected.

Step 5: Finally, to complete the SWOT table developed for Tehran metropolis in order to achieve knowledge-based development, the strategies used for knowledge-based development around the worlds and the strategies proposed in Tehran structural-strategical plan are compared to measure the comprehensiveness of these proposals to achieve knowledge-based development.

In the aforementioned methodological framework, in order to collect the data required for 178 selected indices, the statistics provided by various centers such as the Iranian Statistical Center, the Secretariat of the Metropolitan Mayors' Periodic Meeting, the Assessment and Qualification Working Group of the Knowledge-Based Companies and Institutes, Islamic World Science Citation Center (ISCs), Ministry of Science, Research and Technology Website, Intellectual Property Office, Iranian Library

& Information Science Association, Ministry of Information and Communications Technology of Iran, Iran Civil Aviation Organization, Islamic Republic of Iran Railways, Information of Iranian Cinema Halls Owners, the Iranian Department of Environment as well as the data presented in numerous research projects, books and scientific research have been used. According to the purpose of the analysis, several methods have been used in each step of the present study. First, all the data collected were interpolated, aligned and standardized using scientific methods and Excel and SPSS software. Then, the importance of each data collected for achieving knowledge-based development was determined and weighted according to experts' opinions using the AHP model and Expert Choice software. Then, using cluster analysis, the Iranian metropolises were clustered according to their knowledge-based output and input. Then, the effect of different components on the achievement of knowledge-based development was identified using a path analysis in SPSS software. After the recognition of status que of the situation and in order to present final suggestions, first, the internal and external factor matrix was extracted from the external and internal analysis of Tehran metropolis's knowledge-based urban development. Then, using the path analysis process and obtaining the path of knowledge-based development of metropolises, the goals of knowledge-based urban development were set. Then, based on the goals set and the strengths, weaknesses, opportunities and threats extracted, some strategies were developed for knowledge-based development of Tehran metropolis. The above strategies were scored in the QSPM model and led to the suggestion of final strategies. A list of selected criteria is presented in Table 1.

Table 1. Criteria Derived from Theoretical and Empirical Foundations for Analyzing the External Capacity of Tehran Metropolis for Knowledge-based Development

Decision-making areas	Categories	Criteria	Sources				
			(Sharifzadegan & Tousi, 2015)	(Montreal Knowledge City Advisory Committee, 2003)	(Carrillo, 2006)	(Martinez, 2006)	(Benneworth & Hospers, 2007)
Economic capital	Macroeconomic capital	Gross Domestic Production (GDP)(wealth)	*				
		Employment and income	*				
		Specialized economic structure	*	*			
		Foreign direct investment	*	*			*
		Major international companies	*	*			*
		Urban competitiveness	*	*			*

Economic capital	economic capital	Knowledge-based	Knowledge-based employment	*	*	*	*	*	*	*	*	*		
			Knowledge-based industries and companies							*	*	*		
			Economic innovation			*							*	
			Creative industries and companies					*	*				*	
			Support of intellectual capital							*				
Science and research capital	research capital	Development and	Research and development workshops			*			*	*				
			Research and development projects			*			*	*				
			Employment in research and development area			*			*	*				
			Investment in research and development			*			*	*				
	canla	Hardware	Valid higher education centers	*			*		*	*				
			Reputation of higher education centers			*	*			*				
			Faculty members and instructors										*	
	capital	Software	Students	*			*					*		
			International students	*									*	
			Science and technology parks and growth centers	*	*									
Suppose capital	based economy capital	Driver of knowledge-	patents			*		*	*	*	*	*		
			Human capital			*	*	*	*	*	*	*	*	
	Human capital		Basic professional skills of employees			*	*	*	*	*	*	*		
			Basic professional skills of community			*	*	*	*	*	*	*	*	
			Professional skills of immigrants								*			
			Enjoyment of creative society										*	
learning capital	Education and		Education cost and value-added			*						*		
			Public library			*		*					*	
			Training workshop											
ICT capital			ICT knowledge and literacy		*									
			Enjoyment of computer					*						
			Wideband internet	*	*		*	*			*			
			Access to internet		*									
			General ICT status					*						
			ICT services and products providers					*						
			Electronic governance			*								
Unit metropolitan website				*										

Public capital of knowledge city								
Identity capital	Reputation and image		*					
	Scale	*	*					
Communicational capital	Tourism			*				*
	Museum			*				
	Land accessibility and travel							*
	Air accessibility and travel		*	*				
Service capital	Rail accessibility and travel		*					
	Public residences			*				
	Cultural service (cinema, theatre)			*				*
	Recreational and leisure services		*					*
	Commercial services							*
	Sport services							*
	Healthcare services		*	*				*
Qualitative capital	Bank and insurance							*
	Security	*						
	Cost of living	*	*					
Relational capital	Affordable housing	*						
	Quality of life	*	*	*	*	*		
	Cultural variety	*	*	*	*			*
	Social tolerance	*	*		*			*
Environmental capital	Social justice and cohesion	*	*		*			
	Social capital					*		
	Eco city characteristic	*	*					
	Environmental impact	*						
	Air pollution				*			
	Garbage recycling				*			
	Wastewater treatment				*			
Spatial capital	Public transportation	*		*				
	Urban greenness			*				
	Planned areas for knowledge-based activities				*			
Institutional capital	Effective leadership	*						
	Strategic participation and networking	*						
	Government effectiveness	*						
	Strategic planning	*						
	Social and political participation	*	*	*	*			
	Urban branding	*						
	NGO							*

In order to determine the theoretical model of the path analysis process, all the variables and their relationships between them were specified according to the theoretical foundations (Figure 4). Therefore, in order to keep the validity and reliability of the model,

the input and output criteria of knowledge-based urban development were summarized in four macro decision-making areas and the relationships between them were identified by previous studies. The first decision-making area relates to economic capital, which

represents the outputs or outcomes of knowledge-based urban development, which itself encompasses both macroeconomic capital and knowledge-based economic capital. But the other three decision-making areas represent the inputs or prerequisites for the knowledge-based urban development. The first of these is the science-research capital, which is represented in the form of three categories of research and development capital, hardware capital of higher education, and software capital of higher education. The second is the support capital, which is studied in

the categories of motivational capital of knowledge-based economy, human capital, teaching and learning capital, and ICT capital. The third input required to achieve the knowledge-based development is also the public capital of the knowledge city, though not directly related to the knowledge-based development, contains the general qualities that each city has to improve the living conditions of its citizens and thus, they are required to attract specialist workers and knowledge workers in the field of urban competitiveness.

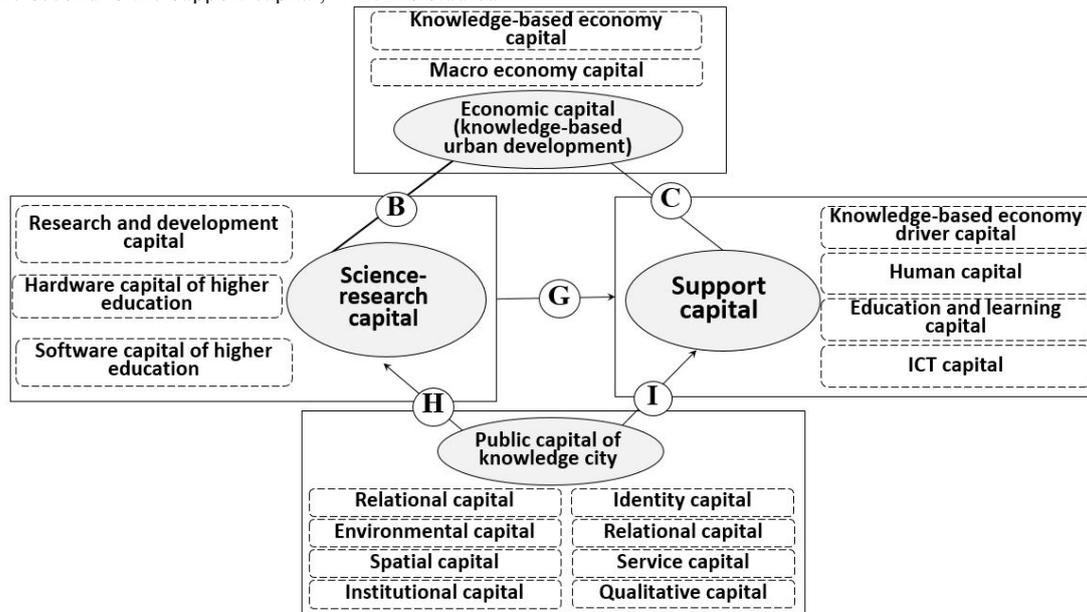


Fig. 4. Theoretical Model of Path Analysis of Knowledge-based Metropolitan Development

The important theoretical propositions supporting and justifying the paths established in the above model, which were extracted from theoretical reviews, are as follows:

- "One of the most important capital of the knowledge city is the capital of renovation and development, including investment in research and development, patents, trademarks, and start-ups (Martínez, 2006)": Paths H, I, C and B.

- "In a knowledge-based economy, there is a system of research centers, universities, think-tanks, consultants, companies and other organizations that can attract global knowledge and adapt it to local needs and produce new local knowledge (Windén, Berg, & Pol, 2007)", in this regard, universities and especially regional universities play a key role in the knowledge-based development (Yigitcanlar, Edvardsson, Johannesson, Kamruzzaman, Ioppolo, & Pancholi, 2017): Path B.

- "Seven categories of capital, including human capital, organized civil society, heritage and culture, natural assets, environmental assets, quality of urban infrastructure, and intellectual and creative assets, as real wealth of regions, provide the basis for increasing

their competitiveness in the knowledge economy era (Yigitcanlar & Velibeyoglu, 2008)": Paths B, C, and G.

- "Cities need knowledge infrastructures, technological infrastructures and especially electronics, a focus on educated people, and the ability to attract knowledge workers in order to be competitive in the knowledge age (Yigitcanlar & Velibeyoglu, 2008)": Path C.

- "In knowledge cities, it is essential to establish institutions to promote the development of knowledge-based regions. The institutions may be technological institutes, research centers, technology parks, universities, etc. (Ergazakis, Metaxiotis, & Psarras, 2006)": Paths C, and B.

- "The economy of a knowledge city produces high value-added products using research, technology and mental power, so it plays a significant role in providing well-being in cities (López-Ruiz, Alfaro- Navarro, & Nevado-Peña, 2014)": Path B.

- "Science and Technology Parks are designed and built to integrate public and private research and information capabilities of universities in a right place, and help industrial development and dynamics of technology by collaborating with professors, experts, and researchers,

using the information and experiences of other countries and creating and innovating top technologies (Davoodi, Shabanali, & Kalantari, 2014)": Paths G and C.

- "In knowledge cities, educational institutions influence the production of talented people. In these cities, universities are knowledge engines that produce talented people and connect citizens in knowledge spaces (Yigitcanlar, O'Connor, & Westerman, 2008)": Paths G and C.

- "Access to the knowledge manpower and distinctive human capital is one of the most important incentives for companies to cluster in a given place. Gathering people in a specific place is also a prerequisite for generating productivity in production through knowledge overflow. However, it should be remembered that the qualities of life and place in knowledge cities are important determinants of a city's ability to employ new talented people (Yigitcanlar, O'Connor, & Westerman, 2008)": Paths C and I.

- "In a knowledge-based economy, an economic and institutional regime provides a required incentive to produce new knowledge and effectively use existing knowledge. (Winden, Berg, & Pol, 2007)": Paths C and I.

- "There is a well-educated and skilled population in the knowledge-based economy that can produce and use knowledge (Winden, Berg, & Pol, 2007)": Path B.

- "Today's metropolises of the world are intensively competing to give people a more pleasant living environment and opportunities, preceding their competitors in attracting capital, knowledge, technology and scientific elite (Yeganegi Dastjerdi, 2010)": Paths C and I.

- "Strengthening the city's knowledge foundations needs to strengthen its cultural foundations in all dimensions (Knight, 1995)", "because the knowledge force is attracted to those places that are vital and culturally diverse (Yigitcanlar, O'Connor, & Westerman, 2008)": Paths C and I.

- "In a knowledge-based economy, an economic and institutional regime provides a required incentive to produce new knowledge and effectively use existing knowledge. (Winden, Berg, & Pol, 2007)": Paths H, G, and C.

- "In order to achieve the knowledge-based urban development, after identifying the assets, it is necessary to use support systems (such as knowledge-based strategic planning) to maintain and strengthen them (Winden, Berg, & Pol, 2007)": Path I, H, C, and B.

- "Transforming scientific discoveries into marketable technologies is a matter that requires an organizational mechanism to manage this cycle (Ekhtiarzadeh, 2013)": Paths I, H, B, and C.

- "According to Van Weiden and his colleagues, some issues such as being knowledge-based (universities and other knowledge infrastructure), industrial structure, urban facilities and quality of life, accessibility, urban diversity, scale and social justice in cities lead to human capital development and the development of new knowledge industries (Winden, Berg, & Pol, 2007)": Paths C, B, and I.

4. APPLICATION OF THE SELECTED METHODOLOGY FOR CASE STUDY OF TEHRAN METROPOLIS AND PRESENTATION OF FINDINGS

In this first section, entitled "external capacity assessment of Tehran Metropolis for knowledge-based development" is performed using the combined data obtained from the criteria, categories, and decision-making areas set as the knowledge-based urban development output. To this end, the Iranian metropolises are classified in terms of the level of being knowledge-based. In the second section, entitled "analysis and categorization of the factors of knowledge-based metropolitan development", utilizing decision-making areas, output categories and criteria of knowledge-based metropolitan development, factors effecting the knowledge-based development of metropolises are analyzed with an emphasis on Tehran metropolis and the Iranian metropolises are classified in terms of similarities in knowledge-based development outputs. In the third section, it is also attempted to outline a way to interpret how knowledge-based metropolitan development takes place. The starting point of this section is to use the developed theoretical model illustrating the theoretical relationships between the outputs and the inputs of knowledge-based urban development. Finally, in the section entitled "internal capacity assessment of Tehran Metropolis for knowledge-based development", it is attempted to provide an internal analysis of the planning proposals presented for Tehran Metropolis against the strategies developed in the section of theoretical foundations.

4.1. External Capacity Assessment of Tehran Metropolis for Knowledge-based Development

The knowledge-based economic structure of a city depends on many factors. As Weiden et al. (2007) stated, although many factors contribute to the knowledge-based urban development, these factors can be divided into two main categories: input and output. Some factors as the requirements, facilities, and infrastructures required for being knowledge-based, lead to the reinforcement of other factors, which are knowledge-based outputs or outcomes. For this purpose, in the present study, first, the knowledge-based metropolitan development outputs were used to rank metropolises in terms of being knowledge-

based. These data are derived from the combination of weighted measures of wealth, employment and income, specialization of the economic structure, knowledge-based employment, knowledge-based industries and companies, and economic innovation, that first are categorized as macroeconomic capital and microeconomic capital, and finally, expressed in the context of economic capital decision making area. According to the results presented in Figure 5, Tehran and Zahedan metropolises are ranked first and last in terms of Knowledge-based development, respectively. Accordingly, Isfahan is the second knowledge-based metropolis in Iran, with a score of nearly one quarter of Tehran. Tehran metropolis has a significant distance from Isfahan metropolis. Although there is a significant different between Isfahan metropolis and Arak metropolis, as the third knowledge-based metropolis in Iran, it is decreases slightly among the other metropolises. Studying the level of knowledge-based development of metropolises in terms of individual categories and criteria better reveals the knowledge-

based development level of metropolitan areas. In terms of macroeconomic capital, Tehran metropolis is relatively superior to other metropolises, followed by Isfahan metropolis, with a short distance from its next metropolis, but after the third rank, metropolises are very close together. According to the graph of criteria, the reason behind the superiority of Tehran and Isfahan metropolises over other ones can be attributed to their specialized economic structure. In this category, Tehran has scored 4.45 times the second metropolis (Isfahan), 7.30 times the third metropolis (Mashhad) and 13.61 times the last metropolis (Zahedan). By examining all criteria, it is clear that Tehran has absolute superiority over all other metropolises in all the criteria. In the category of industries and companies, Isfahan has the second rank after Tehran, with a significant distance from it. Moreover, the distance from Isfahan and the next metropolis is significant. While, in terms of knowledge-based employment and knowledge-based industries, there is no significant difference between metropolises after Tehran.

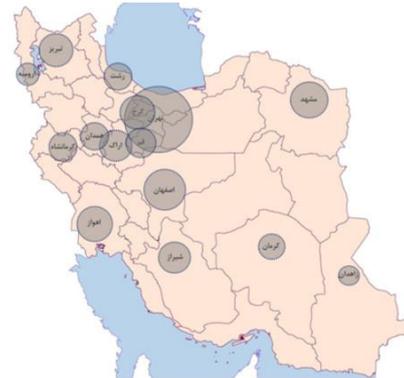
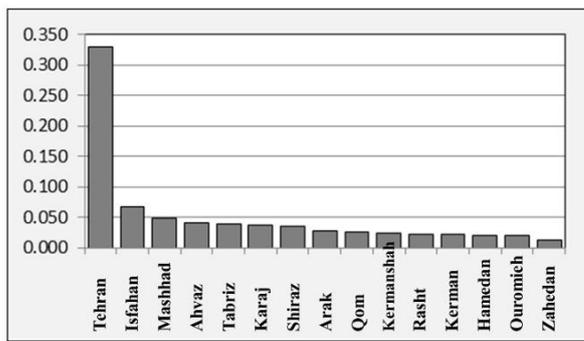


Fig. 5. Ranking of Iranian Metropolises in Terms of Knowledge-based Development Output Indices

Analysis and categorization of the factors of knowledge-based metropolitan development: After investigating the Iranian metropolises in terms of knowledge-based development to rank them, it is necessary to analyze and explain the factors resulting in this type of development. To this end, considering the knowledge-based urban development inputs and outputs and the study of outputs in the previous section, it is necessary to determine the relative status and position of

metropolises in terms of knowledge-based inputs to obtain an image of strengths, weaknesses, opportunities, and threats Tehran metropolis faces to achieve the knowledge-based urban development. To this end, each of the three decision-making areas identified in the preceding sections are analyzed (Figures 6 to 8), and after clarifying the status of metropolises, it is attempted to categorized metropolises according to the consistency of their inputs, using cluster analysis.

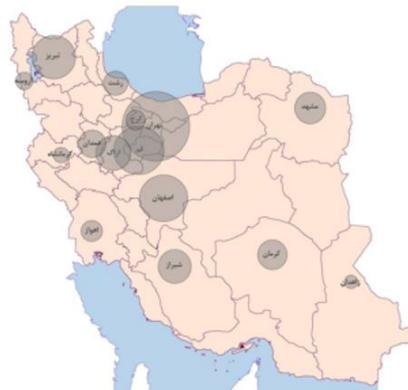
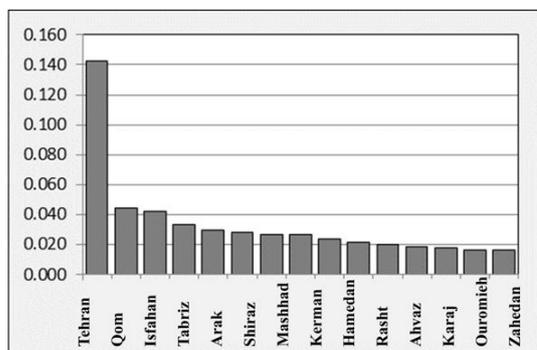


Fig. 6. Ranking of the Knowledge Status Iranian Metropolises in Terms of Science-research Capital (Consisting of Macroeconomic Capital and Knowledge-based Economy)

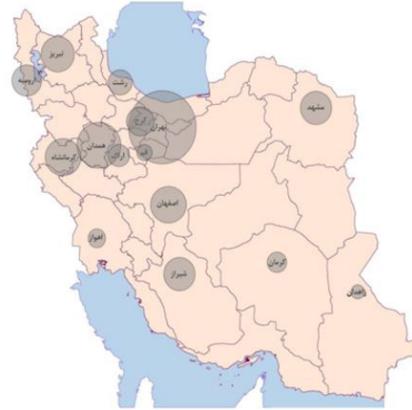
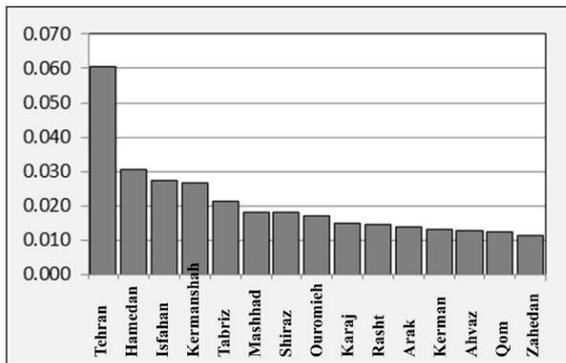


Fig. 7. Ranking of the Knowledge Status of Iranian Metropolises in Terms of Support Capital (Consisting of Motivational Capital for Knowledge-based Economy, Human, Education and Learning and Information and Communication Technology Capital)

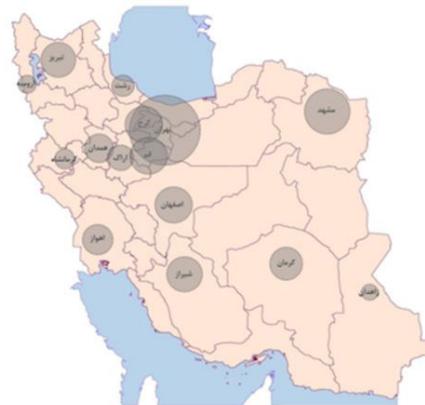
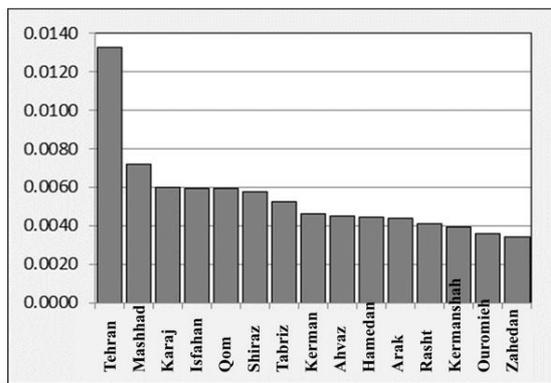


Fig. 8. Ranking of the Knowledge Status of Iranian Metropolises in Terms of the Public Capital of Knowledge City (Consisting of Identity, Communication, Service, Qualitative, Relational, Environmental, Spatial, and Institutional Capital)

Overall, Tehran metropolis can be considered as a pioneer in all three decision-making areas of science-research capital, support capital and public capital of knowledge city, but its superiority decreases from science-research capital to support capital and ultimately the public capital. The strengths of Tehran metropolis in the field of the input capitals of knowledge-based urban development are very high compared to other

Iranian metropolises and its weaknesses are limited to criteria such as specialized economic structure, lack of R&D workshops, international students, science and technology parks, public libraries, tourism, sport, health and etc. services, cultural diversity, social cohesion and justice, and above all, institutional capital and its subsystems (Table 2).

Table 2. Knowledge Status of Iranian Metropolises in Terms of Three Input Decision-making Areas

Metropolis	Science-research Capital	Support Capital	Public Capital	Metropolis	Science-research Capital	Support Capital	Public Capital
Arak	0.873	0.672	0.7967	Shiraz	0.825	0.870	1.0508
Ouromieh	0.527	0.819	0.6556	Qom	1.318	0.598	1.0824
Isfahan	1.254	1.314	1.0846	Karaj	0.538	0.718	1.0895
Ahvaz	0.598	0.605	0.8239	Kerman	0.787	0.637	0.8448
Tabriz	0.976	1.015	0.9525	Kermanshah	0.485	1.270	0.7167
Tehran	4.204	2.889	2.4159	Mashhad	0.796	0.875	1.3073
Rasht	0.642	0.698	0.7515	Hamedan	0.693	1.467	0.8067
Zahedan	0.483	0.553	0.6212		-	-	-

4.2. Explanation and Identification of Drivers of Knowledge-based Metropolitan Development in Iran Using path Analysis

The drivers of the knowledge-based metropolitan development in Iran have been explained and identified with an emphasis on the status quo of Tehran metropolis using the path analysis. To do this, first, according to the theoretical foundations, the theoretical path graph, that illustrates the direct and indirect effects of each component on the other components, is drawn in the section of conceptual framework. To determine the path coefficients and to calculate the direct and indirect effects of the variables using the regression technique, the paths were separated in the drawn graph such that the origins of the arrows refers to the independent variables and their ends refer dependent variables. Then, information on the output and input decision-making areas of 15 metropolises was entered into SPSS software and linear regression analysis was performed for each of the components with respect to its dependent variables. In this process, in each

step, one of the variables as dependent variable and the variables associated with the origin of the arrows ending in the above variable as independent variables were used in the regression analysis to obtain beta coefficients that represent direct effects of independent variables on the dependent variable. In this process, only those beta coefficients with the Sig. value lower than 0.05, are reliable. Overall, the path analysis seeks to test the theoretical model obtained in the theoretical framework and finally to present the empirical model of the case study. The information of the theoretical model was entered into SPSS software and linear regression was performed separately for each of the components by considering that component as dependent variable as well as its related independent variables specified in the theoretical model (except for public capital of knowledge city which has no independent variable). In the regression of the support capital, as the Sig. value of path I was greater than 0.05, this path was excluded from the model and finally the empirical model of the knowledge-based urban development path was obtained, as shown in Figure 9.

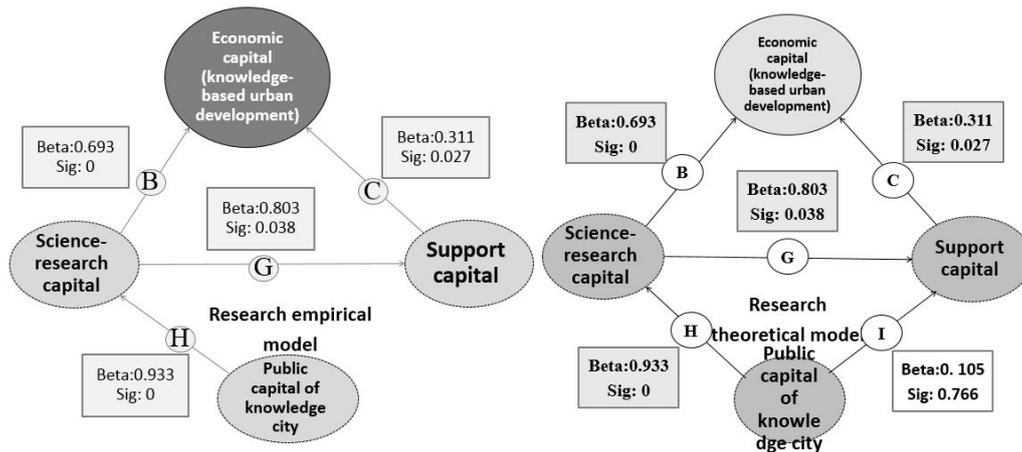


Fig. 9. Theoretical Model (Right) and Fitted Empirical Model (Left). Analysis of the Knowledge-based Development Path of the Iranian Metropolitan

According to Table 3, the output components lead to the knowledge-based development through five different ways, two of which are direct and the other three indirect. Among the output components,

science-research capital, public capital of knowledge city and support capital had the greatest impact on the knowledge-based development of Iranian metropolises knowledge, respectively.

Table 3. The Level of the Dependency of Iranian Knowledge-based Metropolitan Development on Each of the Output Components

Independent Variable	Path Name	Impact Type		
		Direct	Indirect	Total
Public Capital	HB	-	0.646	0.879
	HGC	-	0.233	
Science-research Capital	B	0.693	-	0.942
	GC	-	0.249	
Support Capital	C	0.311	-	0.311

4.3. Internal Capacity Assessment of Tehran Metropolis for Knowledge-based Development

In completing the external analysis of Tehran metropolitan knowledge development capacity, compared to other metropolises, it is necessary to undertake a further analysis of the inner capabilities of Tehran metropolis for knowledge development. To this end, considering the importance of the proposed theoretical strategies in the literature for the development of different knowledge cities in the world, the proposals of the Tehran Strategic-Structural Plan are evaluated in line with the internal analysis of the capacity development of Tehran metropolitan knowledge base. As can be seen in Table 4, the Structural Strategic Plan of Tehran has adopted some of the strategies for urban knowledge development, implicitly covered many and excluded some. One of the most important strategies that the Structural Plan of Tehran has not mentioned in spite of having a knowledge development perspective can be the creation of specialization strategies and focusing on a few specific economic sectors with ambitious goals in mind. The widespread social and political demand for a knowledge city, the training and implementation of knowledge management processes in the public sector, the institutional setting to expand the visibility of the knowledge city perception among people, officials, business groups, etc., and website design. Comprehensive, integrated metropolitan area to provide e-government services and meet information needs They process and access to different communities (Boomsazegan Consulting Engineering, 2006) noted. The following are the guidelines for summarizing the coding table:

1. Turning Tehran into a knowledge-based city and Iran's gateway to the information age by transforming its industrial and service structure to increase the share of knowledge-based economy and competitiveness in the global economy.
2. Effectively organizing tourism, cultural, artistic, sports and other activities to showcase the potential of Tehran's national and global competitions.
3. Providing space for science and technology parks and utilizing advantageous zones to form specialized

clusters of science and research firms, as well as the gradual replacement of medium and small high-tech industries with large polluting industries.

4. Adjust travel demand by organizing and providing public services in urban centers, terminals and railway stations and equipping metro stations as soon as possible as a valuable opportunity for city organizing and ICT development to make the city electronic.
5. Establishing mechanisms to support increased productivity in economic sectors, in particular international marketing and technology transfer for small and medium-sized industries.
6. Establishment of world-class business-centric service-centers in order to create the space necessary for the presence of transnational global productive services companies and space allocation marketing to attract internationally active firms in the Islamic and Middle East Asian countries.
7. Converting Tehran into a global and strategic metropolis
8. Positive engagement of the country with the world economy by providing the infrastructure, communications and space needed for the presence of global firms and activating the city globally, along with promoting livelihoods and residential comfort.
9. Transforming Tehran into a smart city and a premier space for national development management and transnational relations with centers, activities, and conferences on political, civil, scientific and engineering, art and tourism based on national partnerships and civilizations dialogue playing a national role in leading and flourishing scientific activities, Cultural, artistic and social drawer
10. Top city in scientific innovation, absorption and transfer of advanced technology of commercial exchange in urban network of Iran
11. Tehran's industrial and service restructuring by creating and developing high-tech industries, developing scientific and research centers and settlements, and superior services.

Action Plan: Abbas Abadabad has been designated as the International Socio-Cultural Center and the Bassat-Shaft axis as the center of Tehran's world economy in the physical construction of Tehran's north of Enghelab Street.

Table 4. Internal Analysis of Tehran Structural Strategic Plan Based on Knowledge-based Urban Development Approaches

Area	Criteria	Tehran Structural-strategic Plan											Action plan		
		20-year vision	Strategic Plan												
			1	2	3	4	5	6	7	8	9	10		11	
Economic development	Specializing and focusing on a few specific economic sectors with ambitious goals	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Attracting national and international financial support through marketing, tax plans, etc. for knowledge-based actions	•√	•√	•	•	•	√	√	√	•√	•	•	•	•	•

Economic development	Financial support and encouragement of newly established single companies and knowledge-based services	•	•√	•	√	•	•	•	•	•	•√	√	√	•		
	Incentive policies for attracting private sector support and investment in research and development	•	•√	•	√	•	•	•	•	•	•√	√	√	•		
	Incentive policies for attracting creative entrepreneurial company to the city	•	•√	•√	√	•	•√	•	•√	•	•√	√	√	•		
	Encouraging ICT-based activities and commercial networks	•	•√	•	•	•	•	•	•	•	•	•	•√	•		
Social development	Providing general and supportive training to enhance ICT literacy and skills	•	•√	•	•	•	•	•	•	•	•	•	•	•		
	Provide educational opportunities through ICT	•	•√	•	•	•	•	•	•	•	•	•	•	•		
	Preparing residents and providing opportunities for them to turn information into useful and usable knowledge	•	•	•	•	•	•	•	•	•	•	•√	•	•		
	Developing high- quality educational centers to train knowledge staff and improve their skills	•	•	•	•	•	•	•	•	•	•	•√	•√	•√	•	
Spatial development	Providing citizens with opportunities to create value, such as: creating small creative groups, creating spaces for ongoing social dialogue, and building comprehensive, high quality websites and networks.	•	•	•	•	•	•	•	•	•	•	•	•√	•	•	
	Encouraging people to participate in cultural activities	•	•	•√	•	•	•	•	•	•√	•√	•√	•	•	•	
	Strengthening the network of public libraries	•	•	•	•	•	•	•	•	•√	•	•	•	•	•	
	Developing a clear vision and goals, activities and actions for the realization of knowledge city	•√	•√	•	•	•	•	•	•	•	•√	•	•	•	•	
	Attention to the cultural and social needs of different cultures in planning and designing the knowledge city	•	•	•	•	•	•	•	•	√	•√	•	•	•	•	
	Creating attractive environments to attract and retain knowledge workers	•	•√	√	•	•	•	•	•	•√	•	•	•	•√	•√	•
	Development of spatial knowledge-based for spatial proximity of knowledge institutions in the city	•√	√	•	√	•	•	•	•√	•	•	•	•	•	•	√
	Creating and maintaining informal recreational parks and centers and public spaces	•	•√	√	•	•	•	•	•	•√	•	•	•	•	•	•
	Encouraging investors to build buildings for knowledge-based business growth centers	•	•	•	√	•	•	•	•	•	•	•	•	•	√	•√
	Formulating the goals and strategies of the ICT field according to the broader context of development	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Hosting leisure, sports and entertainment events in the city	•	•	√	•	•	•	•	•	•√	√	•√	•	•	•	•	
Policy-making for maintaining low-income jobs (nurses, teachers, police, etc.)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	

Technological development	Launching common information and knowledge systems for the public to provide public services such as routing, weather information, online shopping, information	•	•√	•	•	•√	•	•	•	•	•	•	•	•	•	•	•	•
	Designing a comprehensive and integrated metropolitan website to provide electronic services and to assess the information needs of citizens and their access to different communities	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Launching knowledge and information security systems to protect sensitive knowledge and information	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sign		√ Consistent			•√ Relatively Consistent			• Not Related										

5. CONCLUSION AND RELEVANT STRATEGIES

As mentioned earlier, the process of achieving research goals has been coordinated with a process known as KnowCis, in order to analyze the capacity of Tehran metropolitan knowledge development and to provide planning solutions. As a summary it is attempted to draw a picture of the process of planning the development of the Tehran metropolitan knowledge base on the basis of the steps taken. In the first phase of the process, the current status of the city as a knowledge city must be recognized. The output of this stage provides the tools needed for the second stage, called Strategic Plan Presentation. Two major outputs are needed at this stage. First, extract the goals of metropolitan knowledge development through an empirical path analysis model. In the following, a summary of its current status should be provided using the results of external and internal analyzes carried out on the capacity of Tehran metropolitan knowledge development. To this end, the output of this section is presented as a SWOT matrix consisting of the strengths, weaknesses, opportunities and threats of Tehran metropolis in order to realize the city of knowledge. Following on from the developed goals and using SWOT analytical matrix, metropolitan knowledge development strategies of Tehran are presented which will be determined after leaving QSPM matrix.

As it was clear from the empirical model of the path analysis of the metropolitan knowledge base of the country, in total, there are five paths between the input and output components that can be described in the following strategic statements:

- 1) Scientific and research capital leads to the development of urban knowledge.
- 2) Scientific and research capital contributes to the

development of urban knowledge through impact on supporting capital.

3) The public capital of the city of knowledge leads to the development of knowledge based on its influence on scientific and research capital.

4) The public capital of the city of knowledge through its influence on scientific and research capital, and the scientific and research capital through its influence on the supporting capital, leads to the development of knowledge-based ones.

5) Backup capital leads to the development of knowledge base.

Among the three components mentioned in the above propositions, as obtained from the results of linear regression analysis, the component of scientific and research capital has the most influence on the development of urban knowledge. This component also acts as the output of the knowledge capital component of the knowledge city and the output component of the supporting capital. Therefore, it is attempted to place the focus of this component and its importance on the goals of the Tehran Metropolitan Knowledge Development Program.

Summary Two parts of internal analysis and external analysis of the development capacity of Tehran metropolitan knowledge base led to the presentation of SWOT matrix. In the first matrix, all the possible strategies for developing metropolitan knowledge base in Tehran were presented in three goals, and then these strategies were prioritized using QSPM method. Final strategies are most closely related to the goals formulated in this section. The strategies formulated using the QSMP method are prioritized to ultimately extract the top 15 strategies that will best deliver the planning system to the goals as a result of combining strengths, weaknesses, opportunities, and threats.

Table 5. Final Strategies Extracted By QSPM Method

Goal	Strategy	Score
Strengthening Science-research-Capital	Introducing the concept of knowledge city in universities and research centers widely to take the most of its advantages ($S_{1,3} T_2$)	6.5
	Cooperation of the Knowledge City Committee in providing space and incentive policies to universities to establish a Special Research and Development Unit ($W_2 O_{11}$)	7.3
	Introducing incentive policies (tax, etc.) to increase the number of research and development workshops (W_3, O_3)	7.1
	Support for universities to establish specialized development centers ($W_3 T_1$)	6.9
	Suggesting concrete solutions to universities to strengthen need-based research ($S_1 O_3$)	6.3
	Guiding universities and R&D centers to focus their research activities on urban and regional specialties ($S_{1,2} T_1$)	6.1
Strengthening Support Capital	Providing incentive policies to increase the number of science and technology parks and growth centers ($W_3 O_{3,4}$)	6.4
	Creating coordination between the university, the private sector and the public sector (triple helix) to strengthen the knowledge-based industries ($S_6 O_3$)	7.6
	Providing appropriate context for introducing scientific inventions to domestic and foreign investors ($S_4 T_3$)	6.4
	Accelerating the creation process of free service portals and databases ($W_8 O_9$)	6.8
	Extensively providing ICT training for individuals, companies, businesses, etc. ($W_{1,8} T_5$)	5.9
Strengthening the Public Capital of Knowledge City	Mobilizing all the forces and capabilities of urban management to guide the city towards knowledge-based development ($W_{9,10,11,15,16} T_6$)	6.2
	Determining knowledge-based zone spaces to increase spatial proximity of knowledge-based Products and its overflow formation ($O_2 S_6$)	7.1
	Considering the cultural and social needs of different cultures in urban planning and design ($W_{17} O_1$)	6.8
	Special support for new knowledge-based companies ($S_6 O_4$)	6.5
	Establishment of a single information center, portal and database with a dedicated officer to meet the needs of the knowledge city ($W_{3,13} O_{11}$)	6.9

6. SUMMARY

Over the past few decades, significant advances in knowledge and technology have transformed the image of societies. The radical changes that have made metropolises, and especially the leading metropolises, have made changes in their economic structure by moving from material-based products to the provision of knowledge-based services and products. This, in addition to increasing GDP and improving the economic status of these metropolises, has also led to a marked improvement in their biological quality and sustainability. Many studies have focused on the process of making these changes and comparing the success of different cities in this field. The present study, with a detailed review of previous studies based on the KnowCis Knowledge Development Planning process, developed a proposed process for the development of Tehran metropolitan scholars. Secondly, while giving a comprehensive overview of the theoretical and empirical foundations available in this field, firstly, using the method used by Weiden et

al. The scholars were divided and then inspired by the Yigitcanner method and utilizing extravagant data to rank the country's metropolises in terms of degree of knowledge.

In addition to previous studies inspired by previous studies, the present study has attempted an innovative approach to the study of urban knowledge development by measuring the relationship between cities' knowledge outcomes and achievements with their knowledge development requirements and requirements. To present and explore the role and impact of various causes and factors in achieving the scientific goal, in addition to determining the status of cities in this regard. In contrast to conventional approaches reviewed in international research, it has been attempted to use a framework consisting of appropriate national criteria rather than using European cities' ranking and capacity assessment frameworks in analyzing the metropolitan status of Iran (such as the Winden et al. Framework). to be used. Also in contrast to the ranking models of researchers such as Yigitakanler, based on the

combination of weighted indices and the weighted combination of different indices without considering the linearity between the variables and the possible causal relationships between them, a dynamic model is based on the proposed causal relationships between the types of effective capital. For this purpose, by applying theoretical path analysis model - based on extensive studies of the subject literature - and performing statistical calculations based on accurate and valid statistics and statistics, the empirical model of development of Iranian metropolitan scholars was obtained. In addition, using the results of the path analysis model and the SWOT matrix from the studies, the final development strategies of Tehran metropolitan scholars in the form of three ultimate goals of enhancing scientific and research capital, supporting capital and It was suggested strengthening the public capital of the city of knowledge. However,

the planning system of the country in general and the metropolitan planning system of Tehran in particular to achieve the development of knowledge and the benefits of this type of development should, by adopting a holistic approach, provide the infrastructure. And the conditions for the production and exploitation of knowledge, which are set out in the first two objectives, by expanding the infrastructure and public services available under the third objective, provide a suitable and attractive platform for enhancing the competitiveness and attraction of specialist and knowledge-based forces as Provide a leading, creative and entrepreneurial class. The ultimate perspective of such an approach is the existence of a high quality environmental and bio-urban that focuses its development on highly productive and value-added economic areas.

REFERENCES

- Ahmadi, M. (2017). Communication and Informational Technology in Iran in Terms of International Index in 2016, Islamic Republic of Iran, Ministry of I.C.T, Deputy of Strategic Supervision on ICT, Economic Studies Office.
- Azimi, N., Sarrafi, M., & Ahmadi, M. (2007). How to Use the Capacity of Metropolises to Strengthen the Transnational Role and Promote the International Position of the Country, Higher Education and Research Institute of Urban Management, Plan and Budget Organization.
- Baum, S., Yigitcanlar, T., Horton, S., Velibeyoglu, K., & Gleeson, B. (2007). The Role of Community and Lifestyle in the Making of a Knowledge City. Brisbane: Griffith University.
- Baycan, T., & Stough, R. (2013). Bridging Knowledge to Commercialization: The Good, the Bad, and the Challenging. *The Annals of Regional Science*, 50 (2), 367-405. https://www.researchgate.net/publication/257335758_Bridging_knowledge_to_commercialization_The_good_the_bad_and_the_challenging
- Benneworth, P., & Hospers, G.J. (2007). Urban Competitiveness in the Knowledge Economy: Universities as New Planning. *Progress in Planning*, 67, 105-197. https://www.researchgate.net/publication/248512645_Urban_Competitiveness_in_the_Knowledge_Economy_Universities_as_New_Planning_Animateurs
- Boomsazegan Consulting Engineering. (2006). Strategic-structural Urban Development Plan of Tehran, Tehran Urban Development Plans Management and Planning Authority.
- Brown, J., Lutz, J., Gibney, J., & Murie, A. (2010). Making Creative-knowledge Cities: A Guide for Policy Makers. Amsterdam: Amsterdam Institute for Social Science Research (AISSR), University of Amsterdam. <https://dare.uva.nl/search?identifier=bd6a5ae4-1007-46e4-bcfe-b7aa4fca2b6e>
- Carrillo, F.J. (2004). Capital Cities: A Taxonomy of Capital Accounts for Knowledge Cities. *Knowledge Management*, 8 (5) 28-46. https://www.researchgate.net/profile/Francisco_Carrillo/publication/220363100_Capital_cities_A_taxonomy_of_capital_accounts_for_knowledge_cities/links/5716b9fa08ae497c1a570596/Capital-cities-A-taxonomy-of-capital-accounts-for-knowledge-cities.pdf
- Carrillo, F.J. (2006). A Taxonomy of Urban Capital. In F. Javier Carrillo, Knowledge Cities :Approaches, Experiences and Perspectives, 43-58. Oxford: Elsevier.
- Castells, M., & Cardoso, G. (2005). From Knowledge to Polic.y. Washington, DC: Johns Hopkins Center for Transatlantic Relations.
- Chatzkel, J. (2006). Greater Phoenix as a Knowledge Capital. In J. F. Carrillo, Knowledge Cities :Approaches, Experiences and Perspectives, 135-144. Oxford: Elsevier.
- Davoodi, H., Shabnali Gh., & Kalantari, Kh. (2014). Strategies to Improve the Functions of Science and Technology Parks in Agricultural Technology Development. *Iranian Journal of Agricultural Economic and Development Research*, 45 (2), 351-361. https://ijaedr.ut.ac.ir/article_52171_eb21739ceaa555b519255bf3a8e005a4.pdf
- Dvir, R., & Pashar, E. (2004). Innovative Engines for Knowledge Cities: An Innovation Ecology Perspective. *Journal of Knowledge Management*, 8 (5), 5-15. https://www.researchgate.net/publication/220363169_Innovation_engines_for_knowledge_cities_An_innovation_ecology_perspective
- Ekhtiarzadeh, A. (2013). University Spin Offs' Growth Model, *Iranian Journal Of Management Sciences IAMS*, 31, 61-86. http://journal.iams.ir/article_167.html
- Ergazakis, K., Psarras, J., & Metaxiotis, K. (2006). Knowledge Cities: The Answer to the Needs of Knowledge-based Development. *VINE, The Journal of Information and Knowledge Management Systems*, 36 (1), 67-84. https://www.researchgate.net/publication/235293486_Knowledge_cities_The_answer_to_the_needs_of_knowledgebased_development
- Ergazakis, K., Metaxiotis, K., & Psarras, J. (2004) Towards Knowledge Cities: Conceptual Analysis and Success Stories. *Knowledge Management*, 8 (5), 5-15. https://www.researchgate.net/publication/220363394_Towards_Knowledge_Cities_Conceptual_Analysis_and_Success_Stories
- Ergazakis, K., Metaxiotis, K., & Psarras, J. (2006). An Emerging Pattern of Successful Knowledge Cities' Main Features. In F. Javier Carrillo, Knowledge Cities :Approaches, Experiences and Perspectives, 3-15. Oxford: Elsevier.
- Ergazakis, K., Metaxiotis, K., Psarras, J., & Askounis, D. (2006). A Unified Methodological Approach for the Development of Knowledge Cities. *Knowledge Management*, 10 (5), 65-78. https://www.researchgate.net/publication/220363568_A_unified_methodological_approach_for_the_development_of_knowledge_cities
- Florida, R., Mellander, C., & Gulden, T. (2009). Global Metropolis: The Role of Cities and Metropolitan Areas in the Global Economy. Toronto: Rotman School of management, University of Toronto.
- Holden, M., & Connelly, S. (2006). The Learning City . Vancouver: The World Urban Forum.
- Investopedia. (2016). Investopedia. www.investopedia.com/
- Javier Carrillo, F. (2006). The Century of Knowledge Cities. In F. Javier Carrillo, Knowledge Cities :Approaches, Experiences and Perspectives. Oxford: Elsevier.

- Knight, R.V. (1995). Knowledge-based Development: Policy and Planning Implications for Cities. *Urban Studies*, 32 (2), 225-260. <https://journals.sagepub.com/doi/10.1080/00420989550013068>
- Kunzmann, K.R. (2008). Spatial Dimensions of Knowledge Production. In T. Yigitcanlar, K. Velibeyoglu, & S. Baum, Knowledge-based Urban Development: Planning and Applications in the Information Era, 296-300. New York: Information Science Reference.
- Lever, W.F. (2002). Correlating the Knowledge-base of Cities with Economic Growth. *Urban Studies*, 39 (5-6), 859-870. https://www.researchgate.net/publication/238398339_Correlating_the_Knowledge-Base_of_Cities_with_Economic_Growth
- López-Ruiz, V.R., Alfaro-Navarro, J.L., & Nevado-Peña, D. (2014). Knowledge-city Index Construction: An Intellectual Capital. *Expert Systems with Applications*, 41 (12), 5560-5572. https://www.researchgate.net/publication/261288505_Knowledge-city_index_construction_An_intellectual_capital_perspective
- Mahdizadeh, J. (2010). Basics and Concepts of Knowledge-based Urban Development. *Urbanism Issues*, 30, 72-81. <https://www.noormags.ir/view/fa/articlepage/962544/>
- Martínez, S.D. (2006). A Comparative Framework for Knowledge Cities. In F. Javier Carrillo, Knowledge Cities :Approaches, Experiences and Perspectives, 17-30. Oxford: Elsevier.
- Montreal Knowledge City Advisory Committee. (2003). Montreal, Knowledge City. Montreal: Report Prepared by the Montreal Knowledge City Advisory Committee, available at: www.ville.montreal.qc.ca/pls/portal/docs/page/prt_vdm_fr/media/documents/mtl-knowledge.pdf
- Nasri, M. (2017). The Status of the Provinces of Iran from the Perspective of IDI Index Till the End of the Year 2016, Islamic Republic of Iran, Ministry of I.C.T, Deputy of Strategic Supervision on ICT, Economic Studies Office.
- Nazeman, H., & Eslamifar, E. (2010). Knowledge Based Economy and Sustainable Development. *Knowledge and Development Journal*, 33, 184-214.66. <https://danesh24.um.ac.ir/index.php/development/article/view/27316>
- Powell, W.W., & Snellman, K. (2004). The Knowledge Economy. *Annual Review of Sociology*, 30, 199-220. <https://www.annualreviews.org/doi/abs/10.1146/annurev.soc.29.010202.100037>
- Prudhomme, R. (1996). Urban Transport and Economic Development. New Delhi: 7th conference on the Development and Planning of Urban Transport in Developing Countries.
- Sarvar, H., & Poortaheri, M. (2016). Economic Globalization and Localization Land Uses of Advanced Services in Metropolitans (Case Study of Tehran Metropolis). *The Journal of Spatial Planning*, 20 (3), 155-178. <https://hsm.spmodares.ac.ir/article-21-10560-en.pdf>
- Sarrafi, M., & Azimi, N. (2010), Qualifications of Transnational Role for Iranian Metropolis. *Journal of Population Association of Iran*, 5 (10), 148-187. <http://anthropology.ir/article/18251.html>
- Sarrafi, M., & Mohammadi, A. (2016). Analysis of Spatial Distribution Pattern of Knowledge-intensive Firms Case Study: Tehran Metropolis. *The Journal of Spatial Planning*, 20 (3), 181-209. <http://ensani.ir/fa/article/download/368116>
- Schricke, E., Zenker, A., & Stahlecker, T. (2012). Knowledge-intensive (Business) Services in Europe. Belgium: European Commission.
- Sharifzadegan, M., & Nedae Tousi, S. (2015). Iran's Regional Competitiveness Spatial Development Framework Case Study: 30 Provinces of Iran. *HONAR-HA-YE-ZIBA MEMARI-VA-SHAHRSAZI*, 20 (3), 5-20. https://jfaup.ut.ac.ir/article_56874_1265ca957c2694fdc2776cbb820778c5.pdf
- Winden, W.V., Berg, L.V., & Pol, P. (2007). European Cities in the Knowledge Economy: Towards a Typology. *Urban Studies*, 44 (3), 525-549. https://www.researchgate.net/publication/248974058_European_Cities_in_the_Knowledge_Economy_Towards_a_Typology
- Yigitcanlar, T., & Kamruzzaman, Md. (2018). Does Smart City Policy Lead to Sustainability of Cities? *Land Use Policy*, 73, 49-58. <https://www.sciencedirect.com/science/article/abs/pii/S0264837717314667>
- Yigitcanlar, T., Edvardsson, I., Johannesson, H., Kamruzzaman, M., Ioppolo, G., & Pancholi, S. (2017). Knowledge-based development Dynamics in Less Favoured Regions: Insights from Australian and Icelandic University Towns. *European Planning Studies*, 25 (12), 2272-2292. https://www.researchgate.net/publication/318794952_Knowledge-based_development_dynamics_in_less_favoured_regions_insights_from_Australian_and_Icelandic_university_towns
- Yigitcanlar, T. (2014). Position Paper: Benchmarking the Performance of Global and Emerging Knowledge Cities. *Expert Systems with Applications*, 3-11. https://www.researchgate.net/publication/260481930_Position_paper_Benchmarking_the_performance_of_global_and_emerging_knowledge_cities
- Yigitcanlar, T., & Lönnqvist, A. (2013). Benchmarking Knowledge-based Urban Development Performance: Results from the International Comparison of Helsinki. *Cities*, 31, 357-369. https://www.researchgate.net/publication/257097198_Benchmarking_knowledge-based_urban_development_performance_Results_from_the_international_comparison_of_Helsinki

- Yigitcanlar, T., & Velibeyoglu, K. (2008). Knowledge-based Strategic Planning: Harnessing (in)Tangible Assets of City-regions. Italy, Matera: International Forum on Knowledge Asset Dynamics.
- Yigitcanlar, T., & Velibeyoglu, K. (2008). Knowledge-based Urban Development: The Local Economic Development Path of Brisbane, Australia. *Local Economy*, 23 (3), 195–207. https://www.researchgate.net/publication/24085548_Knowledge-Based_Urban_Development_The_Local_Economic_Development_Path_of_Brisbane_Australia
- Yigitcanlar, T., O'Connor, K., & Westerman, C. (2008). The Making of Knowledge Cities: Melbourne's Knowledge-based Urban Development Experience. *Cities*, 25 (2), 63-72. https://www.researchgate.net/publication/222407335_The_Making_of_Knowledge_Cities_Melbourne's_Knowledge-based_Urban_Development_Experience
- Yeganegi Dastjerdi, V. (2010). Dialectic of Metropolitan Area and National. *Urban Economy*, 7 (2), 26-33. <http://ensani.ir/fa/article/244064/>
- Zhao, P. (2010, April). Building Knowledge City in Transformation Era: Knowledge-based Urban Development in Beijing in the Context of Globalisation and Decentralisation. *Asia Pacific Viewpoint*, 51 (1), 73-90. https://www.researchgate.net/publication/227818822_Building_knowledge_city_in_transformation_era_Knowledge-based_urban_development_in_Beijing_in_the_context_of_globalisation_and_decentralisation_velopment

HOW TO CITE THIS ARTICLE

Nedae Tousi, S., & Amjadinia, B. (2020). A Framework for Analyzing Metropolitan Capacities to Achieve Knowledge-based Development; Case Study: Tehran Metropolis. *Armanshahr Architecture & Urban Development Journal*. 12(29), 251-273.

DOI: 10.22034/AAUD.2020.103364

URL: http://www.armanshahrjournal.com/article_103364.html



