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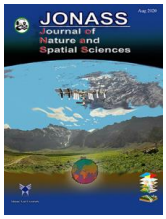

Investigate and comparison of urban smart-making indicators in Yazd

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ARTICLE INFO

Article history:
Receive Date: 26 September 2021
Revise Date: 09 March 2022
Accept Date: 22 March 2022

Keywords:
Smart City, Indicator, Regions, Yazd

ABSTRACT

Background and objective: The rapid growth of the world's population is a factor in focusing on smart cities; the smart city's ultimate goal is to achieve a clean, healthy, safe, and sustainable city. The biggest challenge of smart city policies is to consider the low importance of smart urban growth indicators. Given that several plans are currently being implemented to make Yazd smart, it is necessary to develop smart urban growth indicators to achieve this goal. The Yazd can be known as a city with the opportunity and potential for smart growth by considering its unique architecture and the people's lives model from the past until now; the history of this goes back to the distant past The purpose of the present study was to evaluate the indicators of smart cities in regions of Yazd. This research is practical in terms of purpose

Materials and methods: The method of data collection is through a questionnaire. The statistical population was Yazd citizens, and according to Cochran's formula, it was 384 people. Data are analyzed using AHP techniques. The research results show that the regions of Yazd are in a different situation in terms of smart city indicators.

Results and conclusion: The important principles are the difference of smart-making indicators in the five regions of Yazd, so that region 3 with a numerical 0.415 is in the first rank and region 2 with a numerical 0.148 in the fifth rank and in the most unfavorable conditions of urban smart growth indicators Hooshmand that needs to study the regions to remove obstacles and limitations and use the opportunities according to the level of indicators in the regions.

1.Introduction

The smart city is distinguished by the concepts of talent, creativity, e-city, etc.; however, it is placed next to these concepts, in order to achieve a smart city as a new paradigm to respond to problems and

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Peer review under responsibility of Maybod Branch, Islamic Azad University

DOI: https://dx.doi.org/10.30495/jonass.2022.1941366.1018

create a city based on ICT, participation-oriented and sustainable (Nastaran & Pirani, 2019). The horizontal expansion of the city is a phenomenon that has occurred in the last half-century, not only in developed countries but also in developing countries. This phenomenon is the uncontrolled expansion of the city to the suburbs and outer areas and in the form of scattered and isolated development, the consequences of which can be the destruction of local communities, separation of social options, increasing the cost of urban service infrastructure, increasing the length and distance of trips. These problems are obstacles to achieving sustainability and a smart city, but the smart growth approach can lead the city to sustainable development (Abdollahi & Fatahi, 2018).

Urbanization is an endless phenomenon. Today, 54% of the world's population lives in cities, which is expected to reach 66% by 2050. Overall, urbanization will add another 2.5 billion to cities over the next three decades with population growth. Population growth has caused so many problems that it overshadows urban planning policies and sustainable development issues. In order to improve these consequences, many efforts have been made, one of the most important of which is to pay attention to smart city indicators (Ketabchi et al., 2019). A smart city is a region, region, and town that provides high quality of life and economic development by investing in human, social, and ICT resources and by wisely managing natural resources through participatory governance, providing a high quality of life and economic development (Santis et al., 2014).

New communication technologies have led to profound effects and changes in the economic, social, cultural, and political fields and urban management. Benefiting from the advantages of new technologies, IT should be considered a driver of improving the quality of urban life (Khodadadi et al., 2018). Today, meeting the daily needs of people using IT has become one of the most important concerns of city officials .In general, the main currents that lead cities to smart approaches are as follows: Issue 1: Accelerated urbanization: The world is at an unprecedented level of urbanization, and this trend is growing rapidly. Thus, the early urbanization of the world is an inevitable reality that faces many problems (Ebrahimi et al., 2020).

Therefore, rapid urbanization and efforts to reduce the problems caused by urban population growth are among the main factors in the emergence and emergence of smart cities (Poor Ahmad et al., 2019). But the second issue: the effects of cities on the environment, moving towards smart given the population growth in cities and their main role in the economic and social dimensions around the world to the effects of cities on the environment can be mentioned. Smart cities face a combination of multiple political/governance, economic, social, and a range of concepts related to human-centered cities to improve the quality of life of their citizens (Hassanabadi et al., 2021). The urbanization and urban planning process from the distant past to the present have faced many ups and downs .The urbanization process can not be studied anywhere independently of social, economic, and political issues. Looking at the trend of urbanization and urban planning in Iran, it can be seen that Iranian cities with evolved features have undergone a great change over the decades, which should be considered in smartening of the cities (Moghani & Khodaman, 2017).

According to the spokesman of Yazd City Council, due to the annexation of the central part to Yazd city with the consent of Yazd City Council, this city has become a metropolis. The city of Yazd in recent years has had a lot of growth and expansion and, in terms of smart due to its special architecture, has great potential.

Achieving the principles of the city in the direction of smart requires attention to having smart citizens. The existence of a smart city is one of the most important and undeniable pillars of a smart city. The scientific gap seen in some research related to smartening is to ignore it. In this regard, the research has tried to use the opinions and views of citizens in the form of a questionnaire because it causes more knowledge in the heart of society, public opinion, and subsequently their cooperation to demand the smart making of cities related education.

This research aims to evaluate and compare smart city indicators in the five regions of Yazd. Considering that the research hypothesis is based on the assumption that the smartening indicators of the city in the five regions are not on the same level and are in a different situation, it will be checked.

1.1. Theoretical Foundations and Research Background

The term smart city and its roots must be derived from the smart growth movement that emerged in the late 1980s and early 1990s and supported new urban planning policies (Harrison & Donnelly, 2011.p.2-7). Based on the smart growth approach, development decisions affect everything from personal life to communities and nations .In order to overcome the side effects of development, smart growth indicators can help maintain and develop healthy, safe, comfortable, and attractive urban environments (Karadag, 2013). Smart cities appear as a tool to visualize the urban texture. They evolved slowly after the 1990s but rapidly from the early 2000s onwards (Angelidou, 2015).

The term was again given serious attention in the first years of the mid-2000s by some technology companies such as IBM (2009), Cisco, and Siemens (2004) to integrate information systems and urban services and infrastructure. In fact, from these years on, indicators such as transportation, electricity, water and sewage infrastructure, security, health, and treatment were given importance (Horrison & Donnelly, 2011).

Theoretically, the city formed an information city by adopting and integrating technology into its texture. The information city focused on how the Internet, cyberspace, and real space could affect urban development. Over time, the technological view of the information city gave way to the technological-social view, which led to the emergence of the digital city. This development showed that technology could solve economic and social problems, especially in the field of increasing participation and reducing social constraints. Since the 1990s, the digital-oriented approach has been combined with the entrepreneurial approach, resulting in the emergence of the smart city in which digital technologies could accelerate competitiveness and economic growth(Fig.1).

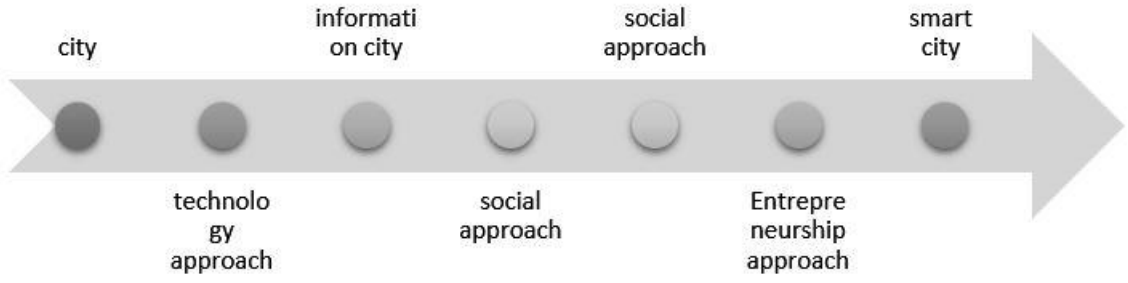

Fig. 1- The evolution of the smart city (Hatami et al., 2021: 321)

1.1.1. Domestic Research

Hatami et al. (2021), in an article entitled "Sustainable Smart City: Concepts, Dimensions, and Indicators," paid attention to social, economic, and environmental indicators in the context of cities and finally concluded that you have to think a kind of localization according to the social, economic and political conditions of each society and paid attention to the slogan "think globally and act locally".

Ebrahim Bozani et al. (2021) have classified the areas of Kashan in terms of the extent of having smart city indicators. The results show a clear difference in this regard between the regions of Kashan, and regions two and four have more favorable conditions, and region five has more unfavorable conditions that need special attention.

Abedini et al. (2019) evaluate and measure the indicators of smart urban growth in metropolitan areas of Tabriz. The research method is descriptive-analytical and quantitative planning models, entropy, and multi-criteria TOPSIS decision-making methods have been used for ranking. The study results show that region 1 in socio-economic indicators, 3 in access and physical indicators, and 2 in environmental indicators are prioritized.

Abdollahi and Fatahi (2018), in an article entitled "Assessment of smart urban growth indicators using Elektra in Kerman," has concluded that by criteria of social, environmental, physical indicators, access to region 2 of Kerman for smartening has more potential and region 4 has the least opportunities and potential that should be considered in this regard.

1.1.2. Foreign Research

In an article entitled "Developing sustainable and integrated indicators for better management of smart cities," Rayashi and Dincer (2021) introduce eight indicators, including the economy, the environment, smart people, governance, energy, infrastructure, and transportation and resilience. In his opinion, the three indicators of the economy, society, and smart people, and energy are the most vital indicators for a smart city.

Mitchell Panaska and Velas (2019), in an article entitled "Tracking urban indicators in smart cities," introduces indicators such as the use of digital technologies, information, transportation infrastructure, urban management, security, culture, and health care. According to him, with these indicators, cities can collect data related to the smart city and process it in different ways, change it, and finally use it in practice.

Dustder et al. (2017), in his article entitled "Smart city strategies," has stated strategies for the development and advancement of cities' goals in the field of smart city development. These strategies include strengthening urban infrastructure, service innovation, engagement of city managers, product development, cost reduction, effective decision making, and increased investment in this area.

In an article entitled "Assessing the smart of cities using indicators for small and medium-sized cities and communities, case study: Northern Italy," Bruni et al. (2017) considered the importance of the environmental indicator and introduced the increase of smart of the cities of the world, especially the medium-sized cities. According to the research background, the studied indicators in a smart city were collected in the following table.

1.1.3. Study Area

The Yazd, the capital of Yazd province, is located on the edge of the central deserts and the northern edge of the Shirkuh mountain range. With an area of 2397 km^2, Yazd is the first raw clay city in the world and the second historical city in the world. Yazd is located in the center of the county in terms of geographical location and has a level of 1215 meters above sea level. (Fig. 2). With a population of 529673, Yazd is the twelfth largest city in Iran and, with an area of 100 km^2, is the seventh-largest city in Iran. (Statistics Center of Iran, (2016))

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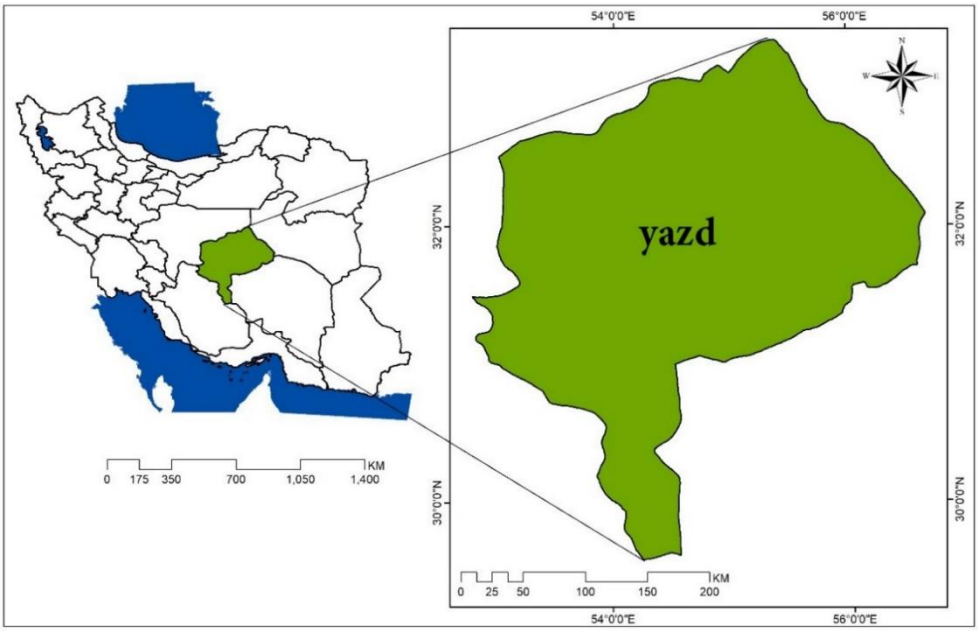

Fig. 2 - Geographical location of Yazd Province

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2.Materials and methods

This research is applied in terms of purpose. Both library and field methods have been used to collect the required information. In the library section, data was collected from research articles and backgrounds, and in the field section, data was collected through sampling and a questionnaire in March 2020. Random sampling has been used, and the sample size of 384 people from the population of 529673 in Yazd was estimated using the Cochran sampling method.

Cronbach's alpha method was used to test the reliability of the questionnaires. Cronbach's alpha reliability was 0.811, which indicates the high reliability of the questionnaire. Based on the collection of studies, seven research indicators were identified, then compared and evaluated using the AHP method in the five regions of Yazd

The AHP method is one of the most widely used methods for ranking and determining the importance of factors that prioritize each criteria using pairwise comparisons of options, which has been used in this research. The AHP process simplifies complex problems by analyzing them. Evaluation of the relative importance of decision-making criteria and comparison of decision-making options according to each criterion were performed with pairwise comparisons, which includes the following three stages:

Create a comparison matrix at each hierarchy level, starting with the second level and going down. (Table 2& Table 3).

Calculate the relative weights for each element of the hierarchy (Table 4 and Fig. 5) and

Estimate the compatibility rate to check the compatibility of arbitration.

2.1. Data collection through field studies (questionnaire):

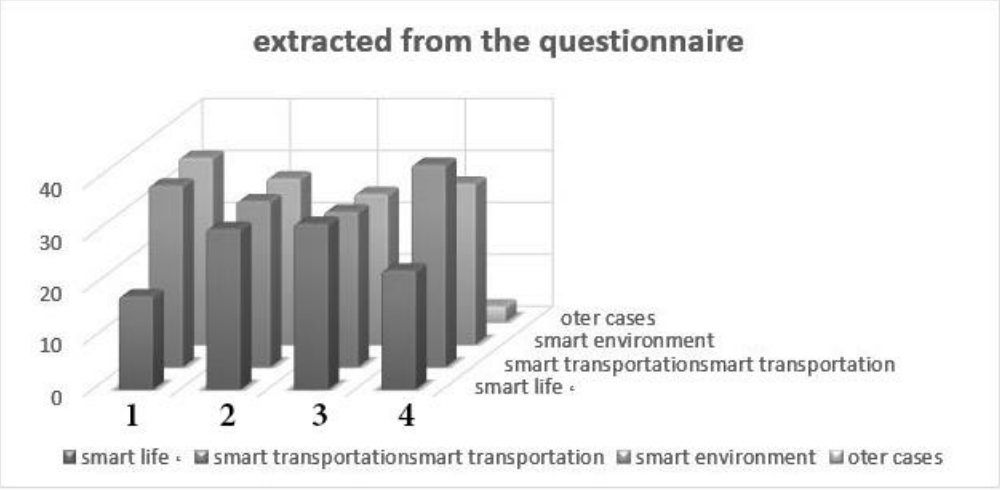


Fig. 3 - Items extracted from the questionnaire

The research questions were evaluated in three groups of 20-30(1), 30-40(2), 40-50(3), and more than 50 years(4). The questions were designed so that they were easy to express so that people would fully understand the purpose of the questionnaire. Finally, the items obtained in the questionnaire as a criterion included living environment, smart transportation, and smart life. It is noteworthy that some people mentioned some other cases. However, due to the small number of them, it was not considered an effective result of the questionnaire, which is shown in the figure as in other cases. (Fig. 3) The point that can be obtained from the mentioned questionnaire is the existence of a citizen aware of the cases of smartening cities, which can be an effective step in accelerating the relevant goals.

Smart City Indicators and Variables

According to previous studies and theoretical foundations, in addition to collecting data through a questionnaire, seven relevant indicators and variables were collected to review the site. (Table 1 and Fig. 4)

Smart government (management)

Smart economy (competitiveness)

Smart citizens (human and social capital)

Smart transportation (smart mobility)

Smart governance (participation)

Smart environment (natural resource)

Smart life (quality of life)

Table 1- Indicators and variables of smart city, Rahnama and Hamidi (2021: 605), Rahnama and Kamandari, (2017: 219)

No.	Indicators	Variables
1	Smart government (management)	(The importance of political issues for citizens, the level of willingness to engage in political activities, the level of satisfaction with the quality of schools, the level of satisfaction with the fight against corruption and crime, the level of satisfaction with the performance of the city council, the level of satisfaction with the municipality, the number and share of kindergartens to the children population), number of cultural centers
2	Smart economy (competitiveness)	Increase employment rates, define new business models to attract companies for the growth of the sustainable economy
3	Smart citizens (human and social capital)	Education level, fluency in foreign languages, number of study hours, willingness to participate in training courses, knowledge of urban management laws, number and share of the literate population, willingness to participate in city council elections, participation in voluntary affairs
4	Smart transportation (smart mobility)	Reduce traffic congestion, empower smart transportation system
5	Smart governance (participation)	Provide transparent and efficient e-government services, participate in decision making
6	Smart environment (natural resource)	The level of individual efforts to protect the environment, the type of thinking about nature protection, the level of satisfaction with access to green space, the level of attention to optimal water consumption, the level of attention to optimal electricity consumption, group attention, and cooperation in environmental protection in the living environment
7	Smart life (quality of life)	Satisfaction with the quality of the health system, satisfaction with the education system, satisfaction with recreational spaces and leisure in the living environment

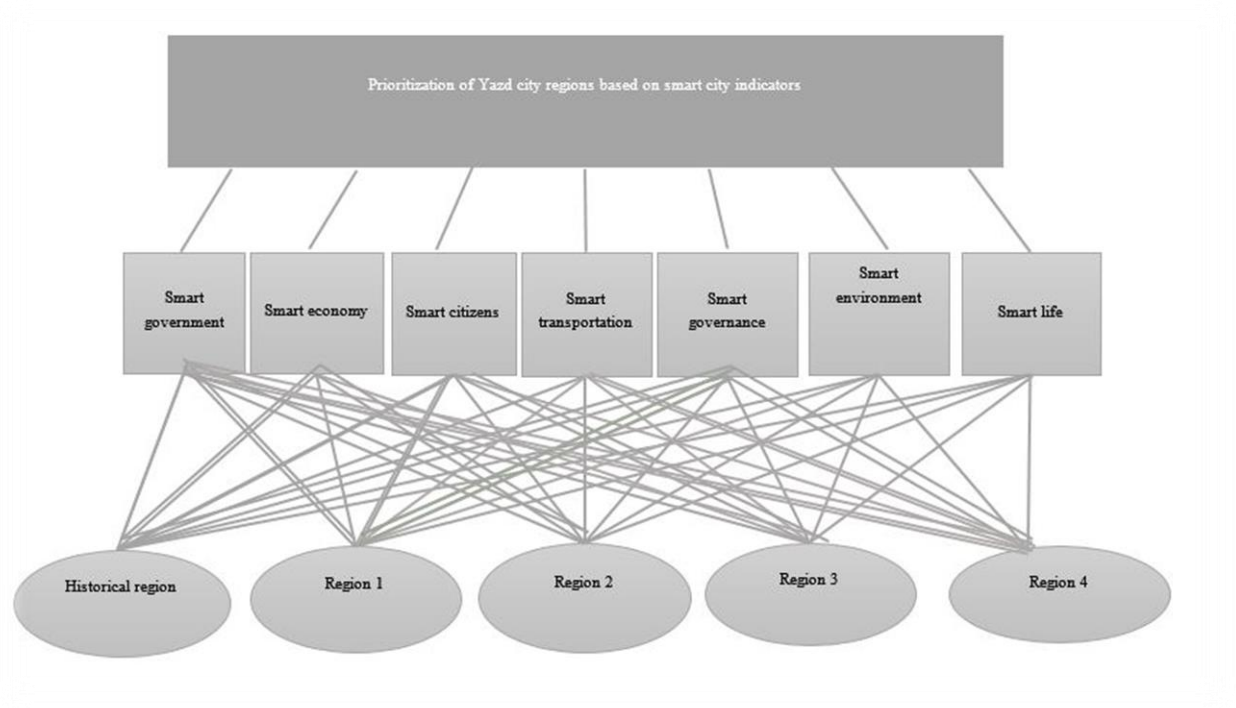


Fig. 4 - Tree diagram of decision hierarchy for prioritizing regions of Yazd city

Table 2- The pairwise comparison scale in AHP

Explanation	Definition	Score
Two criteria are equally important	Equal importance	1
One criterion is a little more important	A little more importance	2
One criterion is more important	More importance	5
A criterion is much more important	Much more important	7
The importance of one criterion has been proven much more conclusively.	Absolute importance	9

Table 3- Arbitration matrix of pairwise

Smart life	Smart environment	Smart governance	Smart transportation	Smart citizens	Smart economy	Smart government	Criteria
1.7	1.9	3	1.5	1.7	1.3	1	Smart government
1	5	5	3	1.5	1	3	Smart economy
1	1	1	7	1	5	7	Smart citizens
1.5	1.3	5	1	1.7	1.3	5	Smart transportation
1.7	3	1	1.5	1	1.5	1.3	Smart governance
7	1	1	3	1	1.5	9	Smart environment
1	1.7	7	5	1	1	7	Smart life

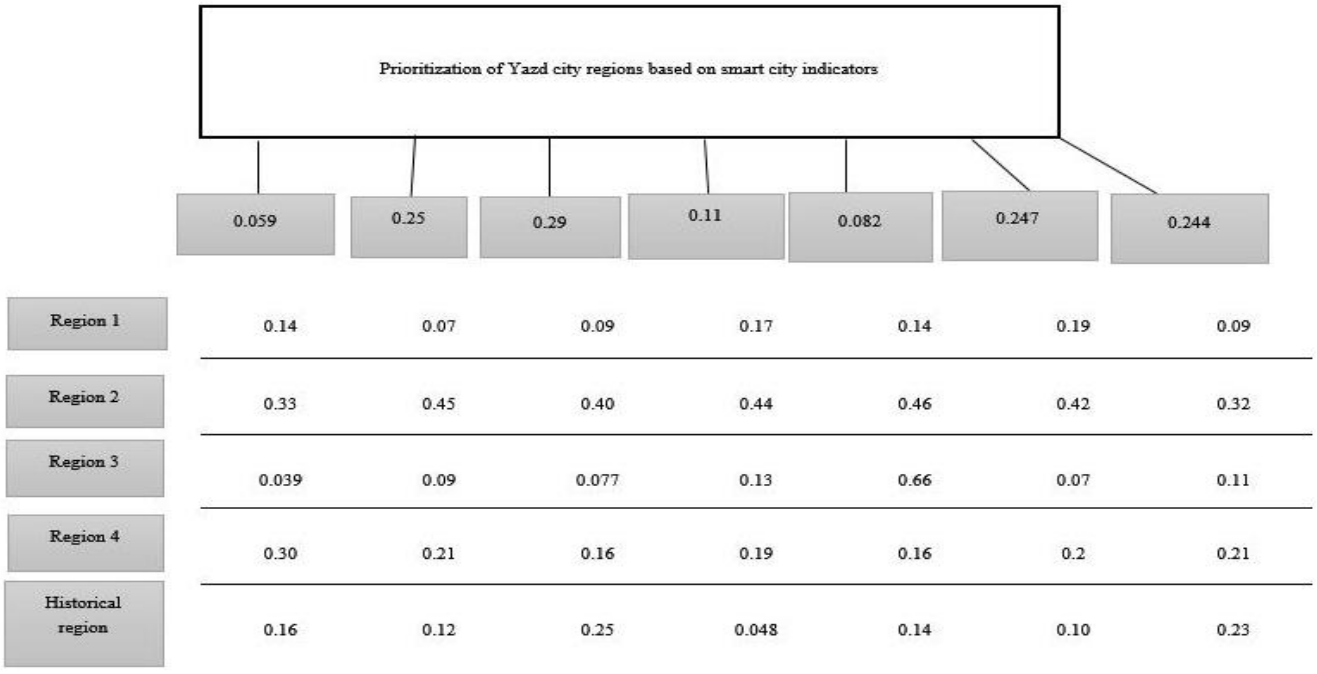


Fig. 5 - Final importance coefficients of criteria

Table 4 - The coefficients of final importance of criteria

Historicalrgion=(0.14×0.59)+(0.14×0.25)+(0.29×0.09)+(0.17×0.11)+ (0.14×0.82)+(0.248×0.19)+(0.09×0.244)=0.242
Region1=(0.39×0.59)+(0.09×0.25)+(0.77×0.29)+(0.11×0.13)+ (0.66×0.082)+(0.247×0.07)+(0.11×0.244)=0.157
Region 2=(0.30×0.59)+(0.25×0.21)+(0.16×0.29)+(0.19×0.11) +(0.16×0.082)+(0.247×0.21)+(0.244×0.21)=1.48
Region 3=(0.33×0.59)+(0.45×0.25)+(0.40×0.29)+(0.44×0.11) +(0.46×0.082)+(0.247×0.42)+(0.244×0.32)=0.415
Region 4=(0.16×0.59)+(0.25×0.29)+(0.048×0.11)+ (0.14×0.082)+(0.247×0.1)+(0.244×0.23)+(0.12×0.25)= 0.209

Compatibility coefficient: 0.097 CR = 1.32

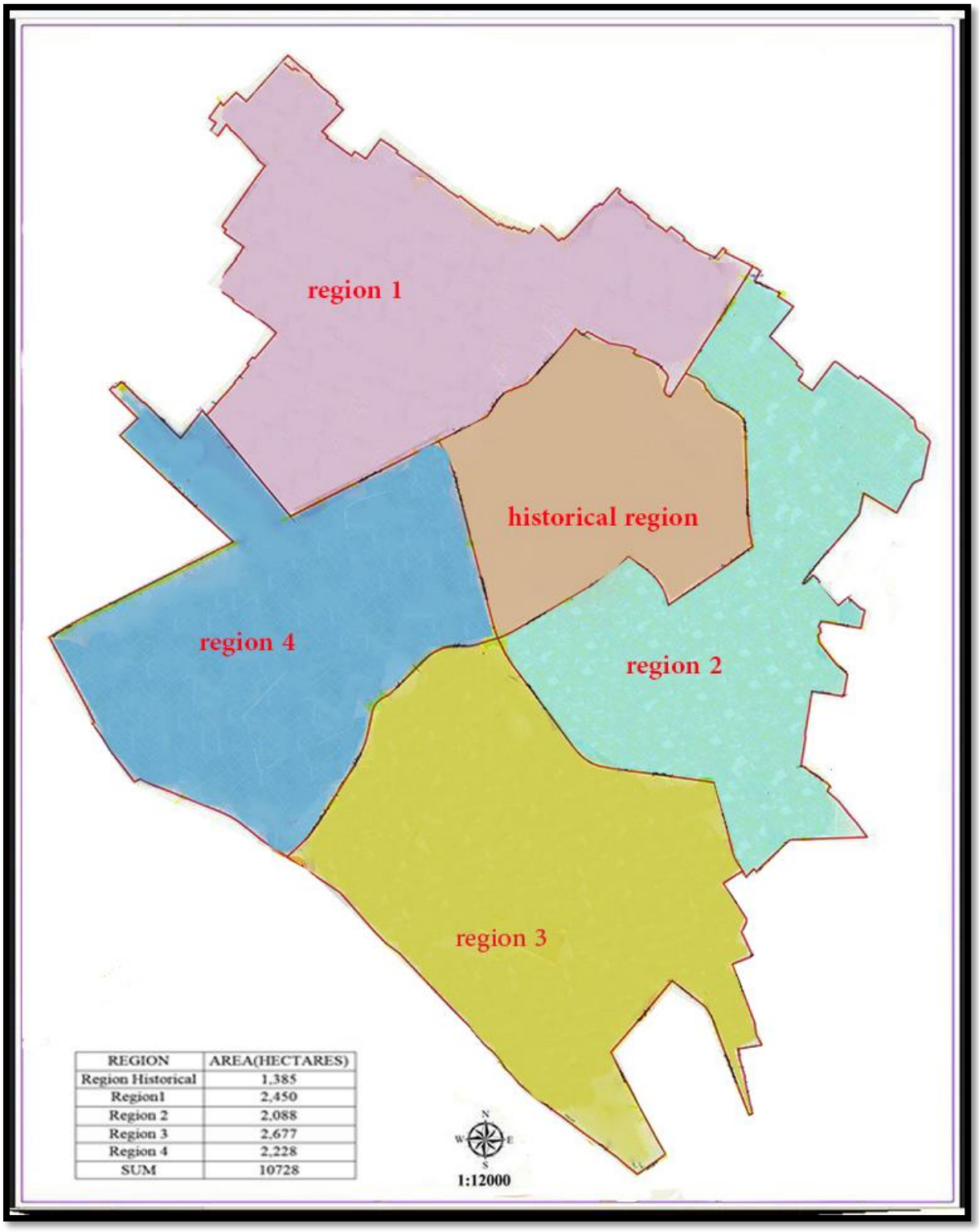
0.73<1.0

3.Results and Discussion

The article "Text and analysis of how to make cities smarter in the context of key components and effective factors Molaei et al. (2016) has tried to examine in detail the key factors affecting the smartening of cities, one of which is the presence of smart residents in the city, which in the study is considered as one of the key cases. Another article that has been studied in this regard in the case study of Yazd city, entitled "Evaluation of Yazd city smartening indicators using GIS and ANP model " (Hassanabadi et al., 2021), in this article, considering that the network analysis method is used, the final results are based on the fact that the status of indicators in the five regions of Yazd are at different levels, which is the same as the result of the present study.

Today, given the growth of urbanization that we face in cities, considering smart urban growth in urban development plans is a requirement to prevent the growth and expansion of the city, so smart growth indicators should be examined in the city context and relevant dimensions. The purpose of this study was to review and compare the indicators of urban smartening in the five regions of Yazd, which was done quantitatively (questionnaire and AHP analysis).

After analysis using the AHP method, the findings show that Yazd regions are in a different situation in terms of smart city indicators. The three regions of Yazd with a numerical value of 0.415 are in the first place and then the historical region with a value of 0. Two hundred forty-two in the second place and then with a smaller difference, the region four with a value of 0. Two hundred nine in the third place and regions 1 and 2 are in the fourth and fifth ranks of the smart urban growth indicator, respectively, which these findings are consistent with other findings in similar studies (Table 4). These results and methods are consistent with these researches (He et al., 2021; Jamali et al., 2021; He et al., 2020; Jamali et al., 2020).



REGION	AREA(HECTARES)
Region Historical	1,385
Region1	2,450
Region 2	2,088
Region 3	2,677
Region 4	2,228
SUM	10728

Fig. 6 - Five areas of Yazd (FAVA, 2019)

Table 5 - The final weight of options

Regions	The value of Q	Rank
Historical Region	242.0	2
Region 1	157.0	4
Region 2	148.0	5
Region 3	415.0	1
Region 4	209.0	3

4.Conclusions and Suggestions

According to the obtained results (Table 5 and Fig. 6) the research hypothesis was confirmed. One of the consequences of using the research method is paying attention to the smart citizen and people's participation in researching to acquaint more ordinary people with issues related to smart cities.

One of the principles of smart cities is the smart use of resources by smart citizens. For example, when I am a smart citizen who is properly trained on how to use energy resources wisely and not be alien to the topic of the smart day. The smart citizen saves on the use of limited energy resources, such as electricity resources, which depend on the individual's lifestyle, when and how to use valuable resources, or how to manage their lives to save. For example, how to regulate the temperature of the house or workplace or how to separate the waste will lead to the best performance of urban management in this regard. All these cases in the first place, require the knowledge and acquaintance of the citizens. In the second place, the voluntary education of the citizens can be introduced in different ways in future researche to the people and the advantages of smart cities because the world is moving in this direction as fast as possible. Suppose the developing countries do not care about smart citizens and smartening issues. In that case, they will fall behind the global caravan, and this negligence, in the not too distant future, will disrupt the functioning of urban management and the ruling order in the city.

Given the necessity and the findings of the present study, the infrastructure for the creation and development of communication networks should be provided, but the two necessary steps to reach a smart city should not be ignored. 1: Announce the municipality and other organizations; 2: Provide all urban infrastructure along with communication infrastructure.

As mentioned in the findings section, Region 3 of Yazd is first in the smart city indicators, which is somewhat consistent with the studies conducted in the comprehensive plan. This area has a well-organized urban infrastructure. Although there is a difference, this difference is less and negligible compared to other regions. The physical development of Yazd city has increased sharply in recent years. The unfortunate point is that this urban development has been done sporadically and without considering the standards of urban development plans, per capita, and spatial distribution.

In the following, according to the discussion and findings of the research, the following practical suggestions can be made. Of course, according to the research results and findings, the executive priority of these suggestions is Region 2 of Yazd.

Teach the spirit of demanding, criticizing, and participating in social issues among children and at an early age

Hold citizenship training workshops to raise awareness of the alphabet of the smart city and citizens' basics and principles of new technologies.

Promote citizen satisfaction through the improvement and performance of management organizations in the field of smart growth

Increase public transportation and promote public culture to encourage the use of public transportation

Approach areas in terms of utilizing urban facilities, developing specialized human resources, determining behavioral patterns and social needs of the smart city

Design sidewalks and bicycles together for the practical use of citizens

Create, develop and support commercial and economic activities (commercial investment, etc.) in order to make the smartening of the city

Increase the possibility of public use of communication infrastructure

Raise the indicators of smart life by providing adequate housing as well as improving the health status of citizens.

Declarations:

Funding Information (private funding by authors)

Conflict of Interest /Competing interests (None)

Consent to Publish (Authors consent to publishing)

Authors Contributions (All co-authors contributed to the manuscript)

Availability of Data and Material (Data are available when requested)

Code availability (available when requested)

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