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Evaluation of smart urban growth components in Zahedan

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ABSTRACT

Many problems such as population growth and physical development of cities have raised the concept of smart growth in recent years. A city is smart when there are heavy investments in its information and communication technology infrastructures and a variety of technologies is applied to improve the quality of life of citizens. This paper investigates and ranks the urban districts of Zahedan in terms of smart urban growth indicators. The research method is descriptive-analytical and the quantitative planning models such as TOPSIS and VIKOR multi-criteria decision, AHP weighting method, and Kruskal-Wallis test have been used. The results represent differences in Zahedan's districts in terms of socio-economic, physical, environmental, and availability indicators. TOPSIS results in each indicator show that districts one and two have a significant advantage over other districts. This is due to the new texture and administrative applications in these areas. This superiority can be observed in these two urban districts in the indicators of quality of life and housing in the city of Zahedan. According to the results of smart urban growth indicators in TOPSIS model, the final indicator has been evaluated with combining the results in VIKOR model and Kruskal-Wallis test. The superiority of districts one and two can be observed in the final model.

Keywords*: smart growth, ranking, five districts, smart city.*

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INTRODUCTION

Statement of the problem

Today's world that we are living in is a global city, which is unfortunately resulted in the separation of the natural environment and the unwanted reception of imbalances that stems from the uneven relationship between humans and urban areas (Ebrahimzadeh, & Mojiri ardekani, 2006, 43). Population growth in large cities has led to the expansion of the city toward the surrounding and destroying agricultural lands and natural ecosystems around the cities. However, so much land has been abandoned within the city and lagged behind the development process. This has led to inefficiency and obsolescence of inner-city areas (Kalberer, 2005: 5). This urban sprawl shows that population growth does not keep pace with the growth and physical development (Ghanghermeh et al, 2013; 5). In contrast, this incongruous urban development became the sustainable urban development, which is followed today as one of the most important strategies for urban management. According to Williams, the sustainable urban development model is in contrast to past patterns with indicators such as spatial balance, environmental protection, balanced economic development, social justice, etc., which is defined with low residential density, increasing the single building, horizontal expansion, construction and development of open land and other parameters. Past pattern caused ethnic and economic segregation, environmental destruction, loss of agricultural land and the progressive destruction of valuable architectural monuments (Ligmann et al, 2005). Since the seventies, new approaches have been proposed in urban planning literature responding to the phenomenon of uncontrolled urban expansion regarding sustainable urban development against the outsized growing and dispersion of cities in seeking solutions to redevelop the remaining areas of development (Caves, 2005: 247). One of these approaches is smart urban growth (Terrence, 2001, 12). In fact, the problems of the cities caused by the global growth have raised the concept of smart growth in recent years. The smart of growth creates consequences such as higher density, integration of activities within the city, inner development, combining land use, land saving and reducing the distances between home and work, making more efficient use of space, reduction of energy consumption, reducing the use of private transport and increasing the use of public transport, maximum access to urban services, etc. to help improving the quality of urban environment (Rahnama and Abbaszadeh, 2008: 61). Therefore, urbanization policies have changed to smart growth pattern from the horizontal growth pattern and the idea of the compact city, which requires construction in height and changing patterns of urban construction, has been considered (Adeli and Sardarreh, 2011). In accordance with the definitions and indicators provided by the smart urban growth, a city is smart

that has so much investment in its information and communication technology infrastructures and a variety of technologies is applied to improve the quality of life of citizens (Caragliu et al, 2009). Given the characteristics of the smart city, it can be said that the majority of cities in Iran are alien with this type of urban growth and their physical development is a great problem for urban planners and managers. As an example of the case study, the present research has evaluated Zahedan, which has dispersion, especially dispersion commercial, administrative, and residential sectors of the city center to elsewhere, in terms of smart urban growth components.

Literature

The concept of smart growth has been appeared in the 1990s following the growth management issues in the 1970s and 1980s in the planning system. Smart growth has been created as a response to the continuing distributed development problems and its negative results and it has numerous historical references that can be traced back to decades ago. One of them is Mitt Van who has mentioned national land use planning, state growth management law, and changes in housing planning, etc. (Edwards, 2007: 49).

In the following, various studies have been done in the field of smart urban growth and urban evaluation based on its indicators. One of the most important studies is surveying 72 cities of Europe by the Europe Union's Economic and Social Research Institute. The cities have been ranked based on six indicators (Ranking of European medium-sized cities, October 2007: 12). In recent years, the theory has been much criticized. The most important of which is that this theory has not focused on citizens. The concentration is on a set of buildings, infrastructure, and information services and the issue of intelligent citizenship, which is laid in the nature of citizens, is neglected. Therefore, there are many differences in various countries to accept this theory. In this part of research, it has been tried to discuss the most important studies that have criticized the idea of smart growth. In addition, it should be noted that the principles of smart urban growth are acceptable in many ways. It just criticizes and evaluates the cases related to smart citizenship and social and cultural characteristics of citizens, which neglect this issue.

Littman (2015) has evaluated and criticized the smart urban growth, which theoretically discusses the smart growth. This study provides critics associated with citizens along with countless benefits to society from the smart growth. One of them is that smart growth is a social trap because it prevents citizens from decision-making in local decisions. Thus, citizens do not have the power to change the situation.

Edward and Haynes (2007) have evaluated the smart urban growth and its consequences on local communities in 30 small communities in America. The results suggest that communities do not welcome the smart growth identically and the reason is that the access to the benefits is not the same for everyone. Smart growth does not seem appropriate for small communities and passive citizens are its most important consequence. However, we need to follow the theory that makes the citizens pragmatic.

Hussey (2004) has conducted a study on the smart urban growth in New York City. The results show that the value of the land and land speculation in New York City have increased due to the approach of city management, which is the smart urban growth. Meanwhile, a recent survey showed that most residents do not support smart growth and they are interested in living in the same old streets with heavy traffic and social interaction and the sense of belonging that they in the past. Choosing a district dominated the local elections and policies are run in the top-down and centralized form. Thus, participations and social interactions are also declined.

There are many types of research in conjunction with smart urban growth in Iran in the past two decades. A few examples have been mentioned in this study. Kiani (2004) conducted a research on Electronics City and Electronic Municipality with a comprehensive approach focusing on geo-data. He has tried to raise a system in the form of electronic maps of cities and the complex condition of the natural and human environment, which automatically and intelligently responds to needs. Veysi and Gheysvandi (2011) in a study entitled Smart City, a new urban revolutionary, Electronics City, the reality of tomorrow's cities, concluded that the existing realities i.e. the development of cities in terms of electronic and virtual power in the future are necessary for the future cities. Ghorbani and Noshad (2008) in a study entitled a strategy for smart growth in urban development, principles, and guidelines to evaluate the advantages and disadvantages of this type of urban growth stated that the deficiencies and the consequences of smart urban growth are increasing the density, decreasing the freedom of citizens, reducing the purchasing power of the people as well as increasing the rules in urban areas.

Kiani (2011) in a study examined the Smart City in the third millennium in municipal integrated electronic interactions (providing a conceptual model - emphasizing the execution in Iran). The results indicate that the smart city, electronics city, and electronic municipality have followed the usual procedures with ICT in many popular cities. This situation in Iran due to various factors, especially interorganizational cooperation and related aspects of electronic citizen has not passed a desirable course. Sajadian et al (2014) have described the smart city and the obstacles to its formation in the cities of Iran (Case Study of Urmia). The first part of the research seeks to provide a smart strategy consist of principles and guidelines for planning and identifying obstacles. Then, Urmia was compared with the cities in the world in this respect. Results have shown the horizontal distribution of Urmia city and a weak urban smart grid.

RESEARCH METHODOLOGY

This research follows a descriptive - analytical method and the method of data collection is based on a questionnaire. The empirical data are the result of a survey that was collected in 2016 in Zahedan. Respondents are Zahedan citizens and experts. Data collection was done in a survey method to evaluate the components of smart urban growth in the city. Questionnaires were filled based on random sampling (districts of Zahedan). The statistical population in this study is 575,116 people residing in Zahedan in 2011. In this study, the random sampling method is used to select the sample size. The sample size is calculated using Cochran formula. 383 samples have been determined based on Cochran formula and with a confidence level of 0.95% and the error level of 0.5%. Finally, 385 people were selected to achieve perfect results. In addition, AHP, TOPSIS, VIKOR model, Kruskal-Wallis test and GIS and excel and Expert Choice and SPSS applications were used to analyze the data.

The study area

Zahedan is the capital of Sistan and Baluchestan as the largest province in the country. Zahedan is limited to Sistan from the north, Kerman from the west, Pakistan from the east and Khash city from the south (Ebrahimzadeh et al., 2004: 129). The legal area of Zahedan is 6413 of which, about 20 percent i.e. 1325 hectares are old texture back more than 30 years. The south and southwest of the city are tall while its height is reduced by moving to the north. The city is linked by many communication lines to different locations. Nosrat Abad and Bam road, Zabul and Hormak – Mashhad road, Khash – Iranshahr road, Mirjaveh and other secondary roads, especially railways to Mirjaveh are

some of them. Zahedan is located at the end of Mashhad-Zahedan, Bam-Zahedan road, 83Kmaway from the shared border of Iran and Pakistan.

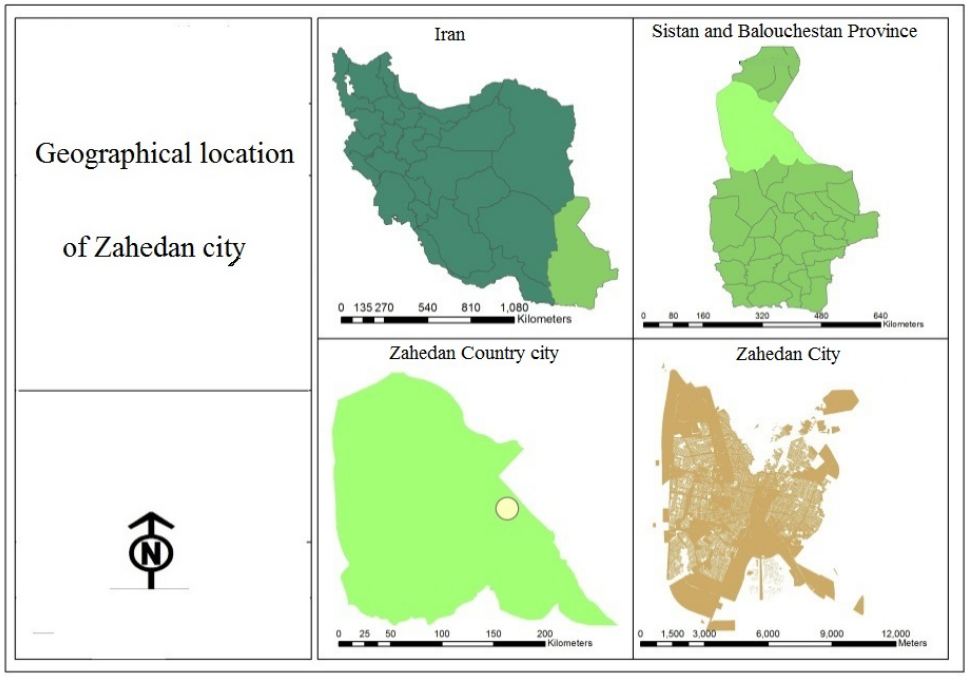


Figure 1: Geographical location of Zahedan

Theoretical Foundations

Since the origin of "urban renaissance" as a contemporary narrative of conservation and urban regeneration is the UK, some currencies can be found for it in other countries. If urban renewal in the United States of America can be considered as a constitutional equivalence, adding the concept of "smart development" in the final years of the twentieth century was a new window of urban regeneration and conservation in the American narrative. Smart development represents the kind of development, in which the promotion of civic life and social vitality, public transport and reducing the adverse environmental effects are the forefront considerations of urban planners and designers and restoring the city as an active and healthy environment for all citizens to be able to provide the desired future is the main objective (New urban News, 2003). Currently, the urbanization policies in developed countries have changed from horizontal growth pattern toward smart growth pattern. Development from the inside in front of development to the outside is considered, which finally leads to the idea of the compact city (Rahnama, 2008: 61). Smart growth refers to the principles of planning development and operations, which have created the effective land use pattern and transportation. This method encompasses numerous strategies whose result is more access to applied patterns and multiple transport system. Smart growth is a proposed method for correcting dispersion (Litman, 2005: 21). The Planning Association of America has defined the smart growth as planning, design, development and modernization of communities to promote the sense of place, preserving natural and cultural resources and equitable distribution of costs and benefits. Smart growth increases the ecological integrity in the short and long term periods and the quality of life through the development of a range of transport, employment, and housing options by financial valid methods (SGN, 2002).

In connection with the concept of smart growth, it should be noted that smart growth perspective is one of the new ideas in the concept of growth management (Talen, 2003: 346). In fact, smart growth is a tool-based concept that there is no agreement on definitions, but fans of smart growth are agree on the ten principles of proposed by the US Environmental Protection Agency (Cowan, 2005, 357; Yang, 2009, 134).

- Creating mixed land uses;
- Emphasizing the advantages of compact building designs;
- Providing different options for housing selection;
- Creation of neighborhoods with pedestrian access;
- Far and attractive neighborhoods with high identity;
- Protection of open spaces, farmland, natural beauty and critical environmental areas;
- Strengthen the development towards existing communities;
- Providing a variety of transportation options;
- Predictable development decisions;
- Encourage communities and stakeholders to participate in development (Zarabi et al., 1390: 5).
-

Measurement indicators of urban smart growth

The aim of this study is to evaluate the smart urban growth and the factors affecting it. In fact, the purpose of the indicators in this study is a qualitative and quantitative measure of urban growth in technology and smart city to assess the consistency of the city's characteristics. In Table 1, the evaluated criteria and sub-criteria are expressed in the research.

Table 1. Indicators used in Zahedan urban areas to evaluate the smart urban growth

Social - economic indicators	Population share of the district, the number and percentage of households, reversed family aspect, the number of households in housing units, reversed dependency ratio, the percentage of literacy in the region, the percentage of male literacy, the percentage of female literacy, the percentage of the employed to the ten years population and more, the proportion of male employees, the proportion of female employees, the participation rate, the participation rate of men, the participation rate of m women, the percentage of students
Physical and land use indicators	Gross population density, the area of the district in the city, share and per capita of residential users, business users and commercial mixed share and educational contributions and per capita, cultural – religious contributions and per capita, healthcare contributions and per capita, recreational center contributions and per capita, tourism contributions and per capita, higher education contributions and per capita, office and the police contributions and per capita, social services contributions and per capita, workshop and industrial use contributions and per capita, installations use contributions and per capita, transport and storage contributions and per capita, urban contributions and per capita. the number of building permits to tens of thousands Reverse extent of worn out tissues, the percentage of housing units from 100 to 150m to total housing units, the percentage of housing units over 200 meters in total housing units.
Environmental indicators	The number of public parks in the tens of thousands, public park contributions and per capita, green space (trees, agriculture and green space protection) contributions and per capita, water channels (rivers, material, atmospheric water, canals) contributions and per capita, open spaces, waste, and agriculture spaces contributions and per capita, reverse waste generation capita, waste production.
Accessibility indicator	Passageways contributions and per capita, parking use contributions and per capita, the number of parking in the tens of thousands, the capacity percentage of parking lots, the ratio of parking to car, the ratio of asphalt passageways in the area, the ratio of walking passageways in the area, car ownership per capita, total generated trips, trip generation rates.

Research findings

As mentioned in research methodology, AHP model was used for weighting sub-criteria to determine the weight and importance of the selected indicators of smart urban growth using expert opinions. Finally, the obtained weight for the indicators was multiplied by the data (items) obtained from the questionnaire for citizens. Then, the ranking of neighborhoods in each of the indicators of life carried out separately using TOSIS model. Table 2 shows the final results of TOSIS model for each indicator, which represents the ranking of Zahedan's five districts in taking advantage of smart growth indicators.

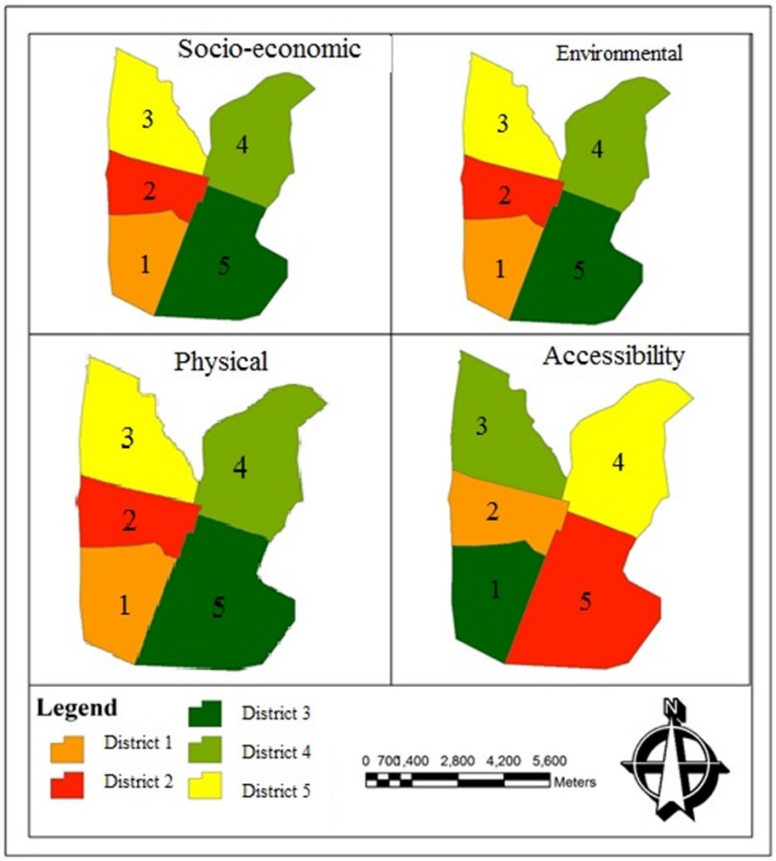
Table 2: Results of life quality indicators in TOPSIS model

Indicator	Socio-economic indicators		Environmental indicators		Physical indicators		Accessibility and communications indicator	
District	TOPSIS	Rank	TOPSIS	Rank	TOPSIS	Rank	TOPSIS	Rank
District 1	0.52	1	0.58	1	0.84	1	0.45	3
District 2	0.49	2	0.56	2	0.57	2	0.58	1
District 3	0.35	5	0.45	4	0.12	5	0.46	4
District 4	0.37	4	0.37	5	0.18	4	0.37	5
District 5	0.43	3	0.46	3	0.21	3	0.55	2

Source: Research Findings, 2016

Surveys show that, District 1 is in the first rank in socio-economic indicator with the score of 0.520639 and District 3 is in the last rank with the score of 0.347755. The results of TOPSIS in this indicator represent the relative distribution of 5 districts in Zahedan. In land use and physical indicator, District 2 in the first rank with the score of 0.836343 and District 3 is in the last rank with the score of 0.122228. District 1 due to the diversity of utilities and the almost planned physical structure has a relative balance in this indicator, but District 3 has the worst v in terms of physical structure and land use per capita indicators. This district is one of the most densely populated districts in Zahedan. Population growth, while high density reduces the per capita land use in this area. Another point in this indicator is that all the marginalized areas of the city in terms of physical and land use have the worst rating.

District 1 is in the first rank in environmental indicator with the score of 0.583595 and District 3 is in the last rank with the score of 0.122228. Accessibility and communication indicator as vital arteries of the city play an important role in improving the quality of smart growth. According to calculations, District 2 is in the first rank of accessibility with the score of 0.58181 and District 5 is in the last rank with the score of 0.369369.



Ranking of districts with VIKOR model

According to the expressed indicators, the final indicator of smart growth over the five districts of Zahedan is an adaptive weighted combination of the four criteria mentioned in the present study. These indicators, which includes environmental, physical, socio-economic, and accessible aspects, have been prioritized based on the opinions of experts and the final weight of each indicator has been calculated using AHP model. Whatever the calculated weight is greater, a higher priority is assigned to it. Thus, it is possible to choose the best option. Finally, the districts were ranked and the final map of the city was drawn by VIKOR model. The results show that District 1 has a good quality and District 3 has the most undesirable quality in the urban smart growth. In other words, district 1 has the highest quality as a relatively newly built area with proportional distribution of land, proper population density, economic and social structure, convenient access and the desirable urban environment. District 3 was ranked as the most disadvantaged and the most adverse due to informal and turbulent settlements. Therefore, according to TOPSIS model, there is a difference among urban districts in terms of the smart growth indicators in Zahedan.

Table 4: The impact factor of the final indicator Using AHP model

Indicator	Physical	Accessibility	Environmental	Socio-economic
Impact factor	0.601	0.249	0.104	0.046
CR	0.04			

Source: Research Findings, 2016

Table 5: The status of Anbarabad city neighborhoods in the final indicator

Level	Quality degree	District	Rank
desirable	0	1	1
	0.25	2	2
Relatively desirable	0.68	5	3
Average	0.90	4	4
Undesirable	1	3	5

Source: Research Findings, 2016

Ranking the districts with the Kruskal-Wallis test

In the following, the analysis of the obtained results to assess the status of smart growth in the five districts of the city of Zahedan was discussed for physical access, social-economic, and environmental items.

Table 6: Comparison of Zahedan's five districts in terms of smart urban growth using the Kruskal-Wallis test

Smart growth aspects	Average					Significant coefficient
	District 1	District2	District3	District4	District5	
Physical	274.1	223.94	200.9	162.25	126.5	0.000
Accessibility	246.23	214.46	201.06	150.03	107.43	0.000
Socio-economic	245.12	224.88	178.95	158.66	112.2	0.000
Environmental	236.09	221.34	207.45	146.31	109.97	0.000

Kruskal-Wallis test was used to compare the dimensions of smart growth in five districts of Zahedan. Table 6 shows that district 1 has the highest average ranking than other districts in all aspects of smart growth. The significance level shows differences between the five districts of Zahedan on all aspects up to 99%. The discrepancy between the smart growth based on the Kruskal-Wallis test for the five districts specifies that District 1 is in the first rank with an average of 253.901, District 2 is in the second rank with an average of 216.44, and District 5 is in the third rank with an average of 165.287 according to people's opinion. The fourth rank belongs to District 4 with an average of 157.26 and District 3 has the last rank with an average of

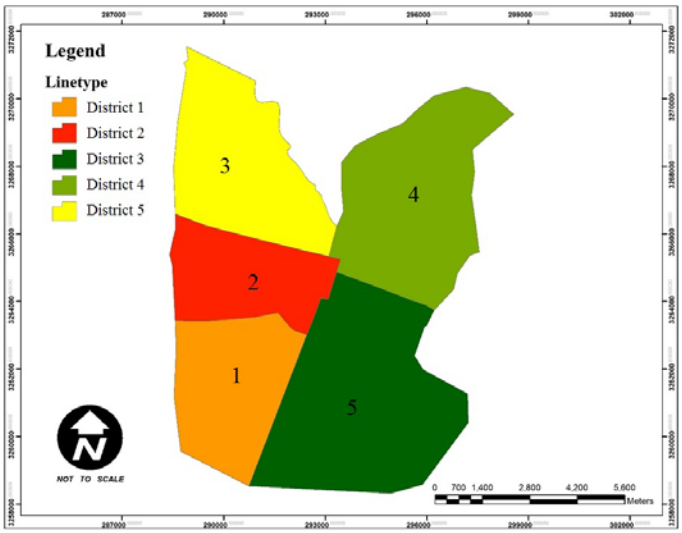


Figure 4: Final indicator of smart growth

Conclusion

This paper reviews and ranks Zahedan's districts in terms of smart urban growth using TOPSIS and VIKOR model and Kruskal-Wallis test. The results represent differences in districts of Zahedan in terms of socio-economic, physical, environmental, and accessibility indicators. As is clear in TOPSIS results in each of the indicators, Districts one and two have a significant advantage over other districts. This is due to the new texture and administrative applications in these areas. This superiority can be observed in these two urban districts in indicators of quality of life and housing in the city of Zahedan. According to the results of smart urban growth indicators in TOPSIS model, the final index has been evaluated with combining the results in VIKOR model and Kruskal-Wallis test. The superiority of districts one and two can be observed in the final model.

The differences among districts are also related to a variety of reasons. Zahedan as well as other cities in Iran witnesses socio-

economic and service disparities among districts. This is highly observed in the center of provinces than other cities. Therefore, the border city of Zahedan has distinct problems considering this common problem in all cities in Iran in the field of smart urban growth. This city always has security problems in the South East of the country and this issue is the clue for all local and urban managers' failure and excuses. The city's poorest neighborhoods that have significant size are deprived of any form of communication and technology.

Smart urban growth indicators in Zahedan are generally lower than the average of other provincial centers located across the country. This level of inequality in is clearly visible in a city with security reasons, mismanagement, and lack of citizen participation. Technology and creating smart cities require

specific infrastructures to run communication and exchange. These infrastructures in some districts of Zahedan are in the lowest grade, which is the main factor of imbalances and inequalities in the field of smart urban growth indicators.

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