Social factors of sustainability for a smart city development

Nina Danilina and Alireza Majorzadehzahiri
Moscow State University of Civil Engineering, Yaroslavskoe shosse, 26, Moscow, Russia

E-mail: DanilinaNV@mgsu.ru

Abstract. Sustainable development of smart cities is based on the consideration of many areas of urban life in which the implementation of modern innovative technologies is taking place. Urban planning is aimed on providing citizens’ life and ensuring their daily needs in comfortable and safe living. The problem is that urban environment and the population must be ready to accept the idea of a smart city in order to organize its greatest efficiency. On the other hand, smart technologies should address both global and local challenges and threats to the urban environment in the wide range from environmental problems caused by climate change to the possibility of easy orientation and service search on city streets. The article proposes an approach to strategic urban planning of the environment based on a socially-oriented smart city model that combines social factors, their reflection in urban environment and defines the set of smart technologies that are in citizens’ demand. On the example of the Monirye district in Tehran, Iran the developed method is applied using analytical methods of SWOT and VMOSA analysis. This application provides a systematic approach for smart cities planning in accordance with the needs of the population and the existing level of development of the urban environment and to determine the strategic directions of its sustainable development in the interests of the population.

1. Introduction
The modern approach to smart cities development dictates the need for a comprehensive approach to urban development. The technologies that make a city be smart are only tools for its managing. The goal of a smart city is to create a comfortable urban environment and minimize the problems that residents may face in their daily lives. That is why information systems, time planners for transport and walking trips are popular. Form the other side urban environment faces with global challenges of climate change, world migration, social and politics crisis, natural and anthropogenic hazards that have their reflection in daily life. In this case smart technologies can prevent and increase this damaging impact [1-6].

However, it is necessary to understand that all innovative urban solutions are the strongly connected with a city territory, its planning and spatial organization. Therefore, any smart city will be based on a rational system of land use, the organization of urban infrastructure, transport, pedestrians, engineering, landscaping, and many other urban systems. For example, digital management of population mobility will be effective for the intermodal passenger transport system, the introduction of smart engineering life support systems is possible only under certain conditions of their construction in cities, the formation of information models of territories is possible only in a certain spatial planning order of territories. Thus, there is a city-building task of land use and spatial development of the city.
so that it is possible to introduce technologies for managing urban processes. Also, the effectiveness of smart city is not possible without creating a new generation of residents who can and are interested in using modern technologies [7-12].

The aim of the article was to consider approaches to the formation of a smart urban environment based on an social anthropocentric approach, which puts the main priority of social factors on the development of a smart city. This idea determines the main hypothesis of the study, in which the digitalization of an urban environment becomes the most effective in creating sustainable spatial planning solutions that will allow managing a city as efficiently as possible in the interests of its users.

2. Methods
The social anthropocentric approach to designing a smart urban environment is aimed on the acception the needs of residents as the initial information that will determine the strategic direction of urban development and the actions on smart technology implementation. The model defines interconnections in the system "smart people - smart urban environment - technologies" is shown in Fig. 1. It indicates the order of relationships between elements that define a smart city:

- "Smart people - smart urban environment" connection is defined by social sustainability as life-enhancing condition within communities, and a process within communities that can achieve that condition. The goal is to create an environment that will respond to the requests of the population.
- "Smart people – smart technologies" connection is defined by the presence of a certain level of prosperity, education, self-awareness and moral readiness for the use of digital technologies in everyday and working life.
- "Urban smart environment – smart technologies" is the final link of the model, which combines the needs of the population and digital technologies. The urban environment acts as a place to implement the idea of an anthropocentric approach to the development of smart cities. Therefore, its spatial planning solutions should reflect the main directions of development of the smart urban environment.

Table 1 shows the results of decomposition of the developed model into its component parts, where the initial reference is based on the basic needs of the population in a comfortable urban life.

The next step was to develop practical approach to implement the Smart urban environment model for design solutions in several stages:

- **Stage 1** includes the area situation analysis and analytical SWOT - analysis to identify the advantages, disadvantages, strengths and weaknesses of smart city development for each component of the model according to table 1;

- **Stage 2** includes VMOSA analysis to determine activities for each of the strategic directions of smart city development according to the model based on data collected during the first stage of work;
Stage 3 includes project proposals for the development of a smart urban environment that will meet the basic needs of the population and is ready for the implementation and effective operation of technological and personnel solutions.

3. Implementation

The developed model of anthropocentric development of the city can be tested on the example of one of the districts of Tehran, Iran. The city policy of Iran is aimed at creating smart cities and making efforts to improve the urban environment, involving the population and possible introduction of modern digital technologies in the life of the city.

Monirye neighborhood is one of the 11 districts of Tehran municipality with a population of 24,000 people located in the south of Tehran.
According to the data (field survey, questionnaire and documents dominant), the neighborhood of Monirye is the neighborhood with a history of history. This history has led to the creation of historical identity and authenticity of the residents who are very religious. There are a lot of problems in the neighborhood of Monirye from the point of view of its inhabitants, including problems related to pollution and lack of services or the low quality of these services. The results of area situation analysis are presented on the figure 3.

Also, there are the results of SWOT – analysis (table 2) that evaluates four main elements of a urban project and aims to identify the key internal and external factors seen as important to achieving an objective into two main categories: internal factors (strengths and weaknesses internal to the urban development) and external factors (opportunities and threats presented by the external challenges).
### Table 2. SWOT analysis of Monirye area situation

| Strengths | Weaknesses | Opportunities | Threats |
|-----------|------------|---------------|---------|
| Land use  |            |               |         |
| 1-Varieties of local scale land uses | 1-Lack of park and green spaces per capita (1.484 meter per person) | 1-Having rusty texture | 1-Gradual process in constructing |
| 2-Proportional dispersion in local land use distribution | 2-Lack of sport services per capita (0.47 meter per person) | 2-Irregular growth in dwelling and renting prices | 2-Irregular growth in dwelling and renting prices |
| 3-Proportional family index in residential unit-1/005 | 3-High dwelling price | 3-Historical texture were lying unattended | 3-Historical texture were lying unattended |
| 4-Proportional person index in residential unit-3/001 | 4-High renting price | 4-High renting price | 4-High renting price |
| Access   |            |               |         |
| 1-Special location in Tehran's structural plan | 1-Traffic centre and spots in main street's intersection | 1-Gradual increase in traffic jam | 1-Gradual increase in traffic jam |
| 2-Hierarchy access | 2-Traffic jam in rush hour | 2-Traffic jam in rush hour | 2-Traffic jam in rush hour |
| 3-Public transportation: bus, subway | 3-Air and sound pollution arising from vehicles | 3-Air and sound pollution arising from vehicles | 3-Air and sound pollution arising from vehicles |
| 4-Public parking | 4-Inappropriate sidewalks and streets | 4-Inappropriate sidewalks and streets | 4-Inappropriate sidewalks and streets |
| 5-Easy access | 5-Proportional connection to the Central district and bazaar | 5-Proportional connection to the Central district and bazaar | 5-Proportional connection to the Central district and bazaar |
| Urban infrastructure | 1-Disorder in visual features | 1-Increasing in activity density and gradual activity penetration in residential parts | 1-Increasing in paying attention to historical elements (in order to increase the dependency sense) |
| 2-Dispersion in identical elements distribution | 2-Increasing in using the space | 2-Increasing in using the space | 2-Increasing in using the space |
| 3-Historical elements | 3-Regional accesses and high traffic | 3-Regional accesses and high traffic | 3-Regional accesses and high traffic |
| 4-Connection centers | 4-Increase in population density | 4-Increase in population density | 4-Increase in population density |
| 5-Finding places easily because of indicators elements | 5-Increasing in Population density. 3-High residential price. 4-Population growth rate: 0.174 | 5-Increasing in Population density. 3-High residential price. 4-Population growth rate: 0.174 | 5-Increasing in Population density. 3-High residential price. 4-Population growth rate: 0.174 |
| Urban Environment | 1-Tree rows on main streets | 1-Beeing in the central district | 1-Increasing in pollution process |
| 2-Environmental pollution | 1-Possibility of increment in green spaces | 1-Possibility of increment in green spaces | 1-Possibility of increment in green spaces |
| 3-Residents Dissatisfaction | 3-Residents Dissatisfaction | 3-Residents Dissatisfaction | 3-Residents Dissatisfaction |
| Social and economic involvement | 1-Sence of dependency | 1-Low public participation | 1-Increasing in population density. 3-High residential price. 4-Population growth rate: 0.174 |
| 2-Historical identity | 2-Social crudity | 2-Social crudity | 2-Social crudity |
| 3-Social solidarity | 3-Lack of open spaces | 3-Lack of open spaces | 3-Lack of open spaces |
| 4-High literacy percentage | 4-Population growth rate: 0.174 | 4-Population growth rate: 0.174 | 4-Population growth rate: 0.174 |
| 5-Lower unemployment rate | 5-Lower unemployment rate | 5-Lower unemployment rate | 5-Lower unemployment rate |
| 6-Relativity safety | 6-Relativity safety | 6-Relativity safety | 6-Relativity safety |
On the second stage we use VMOSA (Vision – Mission – Objectives – Strategies – Action) method as the strategic instrument in urban planning. VMOSA is a practical planning process that can be used by any community organization or initiative. This comprehensive planning tool can help your organization by providing a blueprint for moving from dreams to actions to positive outcomes for your community.

- The vision communicates what urban policy presents as the ideal conditions for your neighborhood. This utopian dream is generally described by one or more phrases or vision statements, which are brief proclamations that convey the community's dreams for the future.
- Developing mission statements are the next step in the action planning process. A mission statement describes what is going to be done and why. Mission statements are similar to vision statements, but they're more concrete, and they are definitely more "action-oriented" than vision statements that convey the community's dreams for the future.
- Objectives are focused on specific measurable results according to the Mission. These objectives should be looked on the changing of the population behavior according to the smart city specifics. Also, these objectives should be addressed to the community level and involving people in urban development processes.
- Strategies explain how to reach the objectives. In the case of smart city the instrument will be innovative technologies implementing in every area of urban life and addressed to provide population demands. They include providing information and management tools, modifying access to city infrastructure and services and create new policy addressed to the sustainability of urban environment.

The last step is developing of the action plan that will describe in details all city activities. These activities will be the base of Design concept of smart and sustainable city development in string accordance with strategies, objectives, mission and the whole vision of smart and sustainable city.

There are the short results of VMOSA plan for Monirye area in the table 3.

| Table 3. VMOSA method for strategic urban planning |
|-----------------------------------------------|
| **Vision** | Monirye is a neighborhood with identity with emphasis on historical land with cultural aspects, a green and lively place for work and leisure, a clean and safe place to live full of smart technologies supporting people’s life |
| **Mission** | Pursuing social development's indicators through effective land use and smart technologies. |
| **Objectives** | Increasing safety, Strengthening identity and dependency sense, Moderation in dwelling prices, Organizing traffic and sound pollution, Reducing environmental pollution, Increasing social interaction systematizing the building construction |
| **Strategies** | Managing city processes and people’s mobility for sustainability of urban environment. |
| **Action plan** | Urban infrastructure development, environment and pollution protection, security and safety, social and cultural development, sustainable transport planning, comfortable housing, effective city management, interactive urban services. |

The third stage of the developed approach consists of the project proposals for the development of a smart urban environment in accordance with the developed strategic plan for the vision of a smart city presented in the table 4.
Table 4. The Strategic Plan of Monirye Neighborhood

| Smart people demands | Monirye area development strategy | Smart city technologies |
|-----------------------|-----------------------------------|-------------------------|
| **Environmental Strategies** | ![Environmental Strategies Diagram](image) | - Green design solutions for open spaces, public places, schools and kindergartens;  
- Green environmental technologies;  
- Smart waste collection;  
- Ecological monitoring of urban environment and air quality. |
| **Transportation and Traffic Strategies** | ![Transportation and Traffic Strategies Diagram](image) | - Managing streets and road hierarchy access;  
- Traffic management;  
- Smart parking systems;  
- Smart public transport;  
- Easy geolocation systems;  
- Informational support systems. |
| **Security Strategies** | ![Security Strategies Diagram](image) | - Police managing;  
- Public safety solutions;  
- Smart lightening;  
- Video surveillance systems for traffic;  
- Smart emergency system;  
- Hazard identification |
| **Infrastructure development strategy** | ![Infrastructure Development Strategy Diagram](image) | - Smart infrastructure development;  
- E-services;  
- Improving and preserving historical elements;  
- Access management;  
- Information support systems. |

The developed Model and approach can be used as the guide to action the development of a smart and sustainable city concepts on the base of social factors that will play the role of the accelerator for ensuring a high quality of life for the population and the urban aspects of sustainable development of smart territories.
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