

# Innovative Way of Solution of “Smart City” in Azerbaijan – City Problems

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*Abstract:* - Considering the application of “smart city” conception with change of modern town-building priorities in the liberated territories (in Karabakh) in Azerbaijan, the opportunity of this conception for improvement of economic opportunities, infrastructure and services, management created before town-building has been elucidated in the article.

The main features of “Smart city” conception, its development and evolution, standards and solutions, factors and obstacles stipulating its application have been analyzed by author. The capacity and structure, application stages and scenario of “smart” market is given in the article.

The application of this conception in Azerbaijan has been investigated.

*Key- words:* - smart city, smart village, smart city conception, smart ecosystem

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## 1 Introduction

The theory of “smart city” has found practical application in the last 10 years. The opening of new technological opportunities with the development of big data processing technologies, IoT, and the Internet has made the “Smart city” from a dream to a reality. The main features of “Smart cities” include: sustainability and environmental compliance, participation of publicity in management, efficient use of information, improving the quality of services and living standards.

A “Smart” (smart city/village/network/etc.) approach to economic development could help Azerbaijan improve economic opportunities, infrastructure and services, and management.

Consequently, the issue of establishing new cities or towns within the liberated areas becomes actuality. In the Republic of Azerbaijan, extensive work is taking place in this area. At the same time, orders have been signed and related working groups have been established. President Ilham Aliyev remarked in his speech on January, 2021 that “the residential points liberated from the Armenian occupation would soon be reconstructed on the basis of a smart city/village concept” (Caspian News, 2021).

The application of Smart conception in Karabakh is one of the actual factors for establishment of the zone on the basis of modern requirements, provision of sustainable development and

development of the region. To do this, we should analyze all aspects of the “Smart City” approach.

### 1.1 “Smart City” – Approach

Though “Smart city” approach is used widely in the world, its single definition is not available. But, the interpretation of this conception may be different in various countries, organizations and literature. IBM Company, which is considered one of the main authors of smart city solutions, explains it with three main quality indicators: provided, related and intellectual.

The Russian government describes the smart city as “innovative city” applying the solutions comprehensively for welfare of environment and residents. The European Parliament thinks that a “smart city” is a city that tries to solve social problems by using information and communication resources. The EU sure that, such cities have strategic significance for poverty, inequality and fight against unemployment, effective management of energy flows.

The European Union (EU) explains the smart city as “city areas and communities established on the basis of existing strong parties and assets, as well as established on new opportunities improved with better use of digital, telecommunication technologies, innovations and knowledge in which traditional and new network and services exist”. By summarizing what has been said, we can say that the term “smart city” usually refers to urban and

rural networks that use innovation, knowledge, and technology to promote development.

According to it, we determine the smart cities as follows by using the simplified definition: A "Smart City" is an organism having ears, eyes, and senses.

"Smart city" – is inversely related urban environment. The collection of operative and exact different information about all processes affecting its element (the life of the population) in a "smart" environment is provided and management is formed on the basis of that information.

"Smart" - considers the use of ICT, large information massive, the regulated mutual organizational activity system of all subjects (government, business, population) of processes happened.

The conception of "Smart" brings new conceptions with itself to town-building: internet of things (IoT), big data (Big Data), information management, etc.

The main features of smart city conception may be given as follows by combining the thoughts of International Organization for Standardization, International Electrotechnical Commission, International Telecommunication Union, European Telecommunication Standards Institute and other relevant organizations [9]:

- Oriented to people - urban residents, businesses, employees, tourists;
- Well managed;
- Accessible and open to people and new ideas;
- Information about city activity is open;
- Protects private information;
- Bases on integrated services and infrastructure;
- Is active in enlightenment and development of citizens;

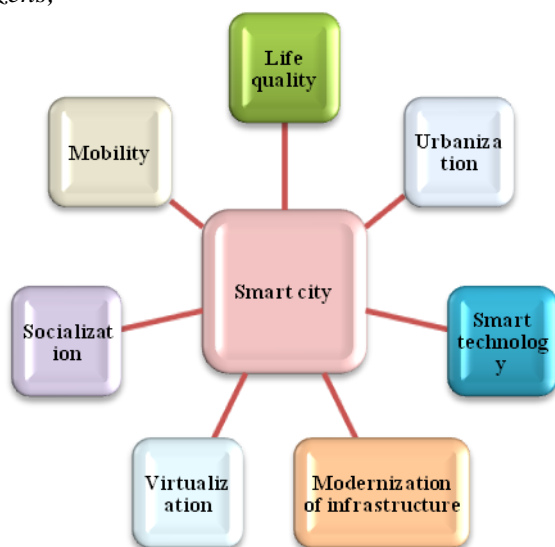


Fig. 1: Features of smart city  
Source: Compiled by the author.

Any city is characterized by a huge capacity of structural and non-structural information formed by the flow of information about the processes happened there (traffic flow, trade turnover, environmental situation, etc.). This information is not used fully in management in a traditional city. The work with big data in a "Smart city" is a source of the key information in the formation of efficient management solutions.



Fig. 2: Information sources in decision-making about "Smart city"  
Source: Compiled by the author.

But the majority applies a "smart city" technology to traditional city system by stages. A "Smart city" combines all possible innovation products in itself. Therefore, each city may choose its own solution. The application of "Smart city" solutions is in the stage of active growth in the world. In a short time, this conception will be applied in 2500 cities and with different solutions project. One of the application models – is construction of the city from "zero" (in empty area).

For example: Masdar city in UAE. It is the first carbon-free green city project of the world. A city provided only with solar energy and other renewable energy sources. Completion of the projects is considered as the first eco-city sample in 2025 [4].

We should note that, different technologies constituting the basis of a "Smart city" conception are in different stages of life cycle. The speed of application of Smart City solutions is significantly distinct in various regions of the world.

In 1990, it is understood that, future IT is related to the development of technologies. Even then, IT-dependent a "smart city" conception was proposed firstly. Then, a "smart city" was considered as an opportunity for protection of environment from human impact. "Smart house" conception formed at the beginning of 2000 was oriented firstly to the

development of technology and infrastructure. It caused to the development of new technologies. In most cases, original innovative product applied was not accepted by population; therefore it was not produced afterward. After tests and errors for many years, urbanists have proposed a new smart city model. This model considered an active participation of residents in application and development of smart technological solutions. Modern smart city model is not just advanced technological infrastructure. This is a place where people get new opportunities thanks to smart solutions. By efficiently and productively using the technologies and resources and time on the account of digitalization traditional services, people become smart city residents.

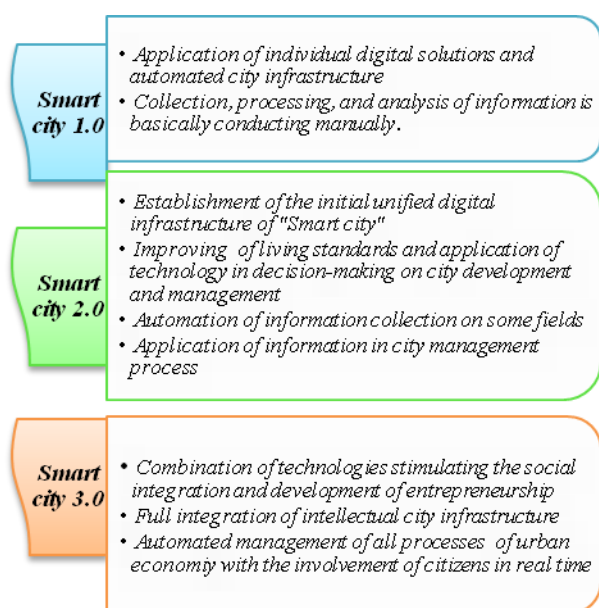


Fig. 3: Evolution of "Smart city"  
Source: Compiled by the author.

Technological aspects of numerous "smart cities" are considered in the research concerning them. In fact, economic and social aspects of "smart city" approach are one of the main factors of technological application. According to calculations of McKinsey Global Institute, the use of smart city technologies can increase sensitivity 20-35% to extraordinary situations and as a result, may decrease the number of the dead ones 10% as a result of accidents, average time spent on the road 15-20% and morbidity of urban residents 8-15% (McKinsey Global Institute, 2018). "Smart city" technologies are very efficient in solution of individual and management issues too. The city's digital twins allow to make certain forecasts for city management, to find solutions based on it (to determine the population growth, tourist flow, future communal and housing requirements, to save

resources, to create social and transport infrastructure, etc.) and make decisions, the increasing of the quality, productivity and interactivity of city services, decreasing of costs and resources consumption improves the relation among city residents and state.

The main instrument of a "Smart city": City and communal infrastructure is the large application of digital and engineering solutions.

#### The main issues of "Smart city":

- to form the efficient system of the management of city economy;
- creation of safe and comfortable condition for life of citizens.
  - The main principles of "Smart city":
  - Human orientation;
  - Technology of city infrastructure;
  - Increase of management quality of city resources;
  - Comfort and safety;
  - Economic benefit, also efficiency of services.

#### The main features stipulating the application of Smart City solutions are follows:

- High growth rates of urbanization in several countries of the world;
- Application of new mobile communication standards;
- Internet of things (IoT), high development rates of the world market;
- Decrease of application costs of Smart City solutions;
- State support to the development of "Smart city" ecosystem in several regions of the world, the increased demand and other factors to the ways of solution at the level of city administration.

#### The main obstacles to the application of Smart City solutions are as follows:

- Many part of Smart City solutions are still in the testing and market stages and are not ready to expand;
- Sustainable high price for large-scale application of Smart City solutions in undeveloped countries;
- A weak development of ecosystem to support the application of Smart City solutions in developing countries;
- Lack of strategic view on perspectives of Smart City in significant part of middle and small cities;
- Lack of qualified personnel and several other factors.

## 2 Problems

The change of development priorities of the society on the basis of technological development in the modern time causes to change the base of economic development.

The cities that increase social, economic, and environmental sustainability face many problems: climatic changes, population growth, and urban flow; political and economic instability; increase in transport and road traffic organization; establishment of communications; energy and water supply; security issues; growth of urban economy; increase in population demand, etc.

These problems pose completely new issues before urban economies. Changing the cities leads to sustainability to problems, the application of digital solutions and technologies, and improving lifestyles and comfort.

In its turn, this expedites the learning of the world's tendency on the improvement of town-building and the living standards of the urban population, through the use of practice accumulated, optimization of infrastructure, and application of technological and organizational innovations.

According to forecasting of UNO, the world's population will increase from 7.6 billion to 9.2 billion till 2050, 6.8% of them will live in city [2].

56% of the population lives in urban or suburban areas in Azerbaijan (at present, the number of population is more than 10 million in Azerbaijan) [3].

High rate of urbanization requires the optimization of transport infrastructure, medical services, energy resources and development of security areas.

Innovative technologies, artificial intelligence and machine learning, processing of large information, internet of things (IoT) is used widely on the stated areas, especially for the purpose of public security in the developed countries. The Economist ranks safe cities annually on 76 indicators (2021 report includes 60 cities). The rating includes digital, medical, infrastructure, environmental and personal security and other applied areas of modern technologies.

Thus, according to the world tendency, innovation way of development of territorial unit is "Smart" (smart city/village/network/etc.) conception.

## 3 Analysis and Evaluation

Smart City solutions have a high growth rate in the world market in recent years. According to forecasts, the total capacity of Smart City market in the world may pass 2,5 trillion USD till 2025 [11].

At present, smart city solutions have priority in the markets of the North America and EU. Also, the Asian market may be the most dynamically developing regional market for Smart City solutions in the medium term. The use of smart technologies in the world increases. "Smart" services and "smart" government have become the main elements of the world market. According to Frost & Sullivan, the smart energy and smart transport is the fastest applied solutions. The condition in the world dictates the game rules of the market. Therefore, the solutions in the medical field become actual for smart developments with the initiation of the corona virus pandemic. In the future, this view may change depending on the economic-social condition of the countries and the change of demands for smart solutions.

Also, the market of Smart City solutions is one of the fastest developing and most promising markets and is characterized with high dynamic competition environment. Thousands of corporations, medium and small companies, as well as startups in market niches work in the industry.

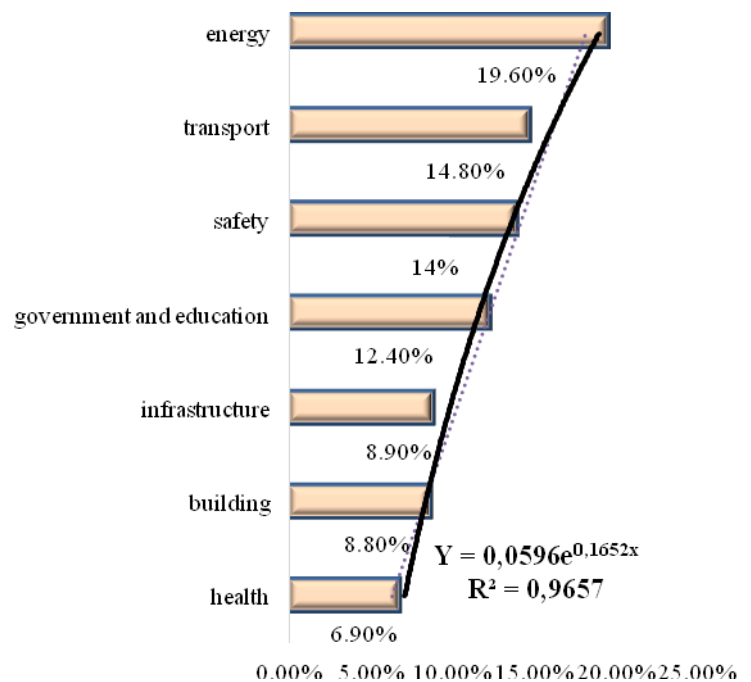


Fig. 4: Frost & Sullivan  
 Source: Compiled by the author

Today, the corporations such as Huawei, IBM, Cisco, AT&T, Siemens, Oracle, Microsoft, Schneider Electric, Hitachi and Ericsson are among the leaders of the market for global smart city technologies.

The application perspectives of certain elements of "Smart City" solutions in Azerbaijan are determined by the following factors:

- The most actual problems and calls faced by city administration;
- City resources existing for application of Smart City elements;
- Level of competence of city administrations and their interest in application of Smart City solutions;
- Economic efficiency of “Smart City” projects in the condition of Azerbaijan;
- Existence of appropriate equipment and software in the market of Azerbaijan.

Today, by considering the most promising complex of technical, economic, social and political factors in regard to application potential in the Republic of Azerbaijan, Smart City solutions may be those we have mentioned below:

- elements of “smart” housing-communal economy, also intellectual management systems of lighting of streets and “smart” calculation of energy;
- elements of “smart” city transport system;
- solutions in the field of intellectual technologies for management of city environmental quality;
- smart health solutions.

### 3.1 Implementation stages of Smart City Conception

There are 3 principal scenarios for the implementation of the “Smart City” conception in the world: centralized, non-centralized and local activity variant. The selection of scenario is determined depending on concrete condition of city, identity of the main subject and investor of town-building processes.

Let's look through each scenario:

– **According to the centralized scenario**, the state representing local government or regional government undertakes the role of the principal organizer of all processes, it becomes the holder of the formed databases, digital platforms to be used in analysis and management and unified digital city ecosystem formed on their basis.

The government mobilizes all existing resources and attracts all interested parties – business structures, technology and service companies, different type associations in implementation of projects, coordinates the interested parties for application of “smart” technologies in all fields of city economy.

As a whole, the government acts as a preparation initiator for the complex project or large-scale technological modernization project of infrastructure for implementation of smart city conception. In this case, a single center is established for the monitoring of existing condition

in the city on the basis of information entered in real time regime.

– **According to the non-centralized scenario**, the separate corporative technological projects are prepared and implemented. For example, the construction of smart houses and smart estates, intellectualization of energy assignment and management, intellectualization of separate elements of transport infrastructure and water supply systems, etc.

Local management authorities provide investment attractiveness for the application of smart city technologies.

Investors combine the information presented by city services and individual users.

As a result, the decisions are made and new solutions and services are created as a result of the processing of this information.

– **Local activity scenario** – local joint activity was implemented on application of smart city technologies of local self-management authorities and other interested parties.

So, non-centralized management system of the application of smart city technologies was formed. Besides local self-management authorities, the unions and partnerships of different subjects play an important role in this system.

The projects on application of smart city technologies were implemented in pilot regime.

The followings may be examples for such projects: street lighting, monitoring of parking, video shooting and transport management, monitoring of air quality, fullness of garbage containers, waste utilization navigation, passenger traffic information, analysis of social media information.

Such technologies may be tested in different combinations within allocated zones, it allows to develop an integration system of different types of data on a single platform.

It would be more advisable to use the approaches that are combination of the 2<sup>nd</sup> and 3<sup>rd</sup> activity scenarios in the condition of Azerbaijan, because these variants allow to phased development of smart city on the base of existence of necessary opportunities for the attraction of financial and material resources, private and public funds in the territory.

So, the phased implementation of “Smart city” conception is more advisable. The period of stage was determined depending on existence of the attracted financial and material-technical resources and social-economic condition of the region.



### 3.2 The following steps should be made for phased implementation of “Smart city” conception:

- formation of organizational structure for implementation of conception;
- selection of priority pilot projects and areas
- Preparation of road maps on certain areas of implementation of “Smart City” conception;
- formation of project groups;
- to conduct a joint examination of projects, to select priorities and to seek for partners for their implementation;
- implementation of results of pilot projects on different fields of activity and increasing of their scale;

## 4 Literature Review

### 4.1 Works Performed on “Smart City” Conception in Azerbaijan

Works on the “Smart” conception were initiated from the beginning of XXI century in Azerbaijan. Let's look through the chronicle of the works performed.

Table 1. Chronicle of works performed according to “Smart” conception

| DATE           | REMARK  |
|----------------|---|
| 2008 -2011     | <i>Intelligent Transport Management Center</i>  |
| 2010 August    | <i>Order on “State Program for the development of communications and information technologies in the Republic of Azerbaijan in 2010-2012 (Electron Azerbaijan)”</i> |
| 2011 May       | <i>Decree on “Some measures in the field of provision of electronic services by public authorities”</i>   |
| 2017 March     | <i>“Public Wi-Fi” project</i>   |
| 2018 March     | <i>Decree on “Measures for development of e-government and transition to digital government”</i>  |
| 2018 March     | <i>Establishment of “E-Government Development Center” public legal entity</i>   |
| 2018 September | <i>Decree on “Expanding the use of electronic services in the field of labor, employment, social protection and social security”</i>                                |
| 2019           | <i>Transition of some organizations and education to online regime</i>  |
| 2020 February  | <i>“National Action Plan for the promotion of open government for 2020-2022”</i>  |
| 2020           | <i>Starting to build airports and other objects in the liberated areas with a “smart” approach</i>  |
| 2021 February  | <i>Order on “Azerbaijan 2030: National Priorities for Socio-Economic Development”</i>   |
| 2021 April     | <i>Order on “Preparation of “Smart City” and “Smart Village” conception”</i>  |
| 2021           | <i>Starting to build “smart village” project in Aghali village of Zangilan region</i>   |

In 2008, the project was initiated to be prepared with “SK C&C” Company of the Republic of South

Korea in regard to application of intelligent transport management system in Baku. The foundation of the center was laid in 2009 and Intelligent Transport Management Center was opened in Baku in 2011. The Center engages in movement regulation of public transport in Baku and optimization of movement routes [8].

Since 2010, the works were performed on formation of electronic government that was one of the main parts of “Smart” conception. The legal base of the activity was established by means of Order of the President of the Republic of Azerbaijan on approval of the “State Program for the development of communications and information technologies in the Republic of Azerbaijan in 2010-2012 (Electron Azerbaijan)” (10 August 2010), “Action Plan on formation of “Electronic government” in the Republic of Azerbaijan in 2010-2011” approved under order of the Cabinet of Ministers of the Republic of Azerbaijan (14 May 2010), Decrees on “Some measures in the field of provision of electronic services by public authorities” (23 May 2011), on “Measures for development of e-government and transition to digital government” (14 March 2018) and on “Expanding the use of electronic services in the field of labor, employment, social protection and social security” ( 05 September 2018) and other normative legal acts [1].

These have a great importance not only for the development of electronic government and services in the Republic of Azerbaijan, but also for the transition to the “smart” conception, improving the living standards of citizens, expanding the fight against corruption [1].

In accordance with decree No 1885 dated on 14 March 2018 of Ilham Aliyev, the President of the Republic of Azerbaijan, on Measures for the development of e-government and transition to digital government, “E-Government Development Center” public legal entity established under the State Agency for Public Service and Social Innovations under the President of the Republic of Azerbaijan acts closely with other public authorities on formation of “E-Government” as a coordinator of works performed in this field and provides the activity on establishment of proper infrastructure [1].

“E-Government Development Center” fulfills the functions of coordinating body in order to realize the coordination in the field of formation, conducting, integration and effective management of public information resources and systems and this is also responsible for provision of promotion of services among population. The activity directions of the center mainly cover the electronic public services, e-visa issuance and services on

digital payment systems. In order to increase the service quality in the stated fields, to simplify the use of service and to increase the citizen satisfaction, the advanced international experiences were investigated and innovative novelties were applied by considering the citizen needs [4].

“E-Government Development Center” organizes the information exchanges and provision of e-services among information systems and resources of public authorities by means of “E-Government” portal. Also, this provides the management and activity of “E-Government” portal and continues the improvement measures. The said measures are implementing within the new model of “E-government”, which will cover a single e-cabinet and other functions within it. Also, multiple measures were implemented by Center in order to develop e-services, also e-services in the direction of government business (G2B – government to business), business-government (B2G – business to government) [3].

In 2017, the Ministry of Digital Development and Transport and “Huawei” Company implemented the “Public Wi-Fi” project together. The panic of the Covid-19 virus in the world in 2019 and the announcement of a pandemic accelerated the digital transformation in the world. All sectors of the economy are being forced to continue using digital technologies. Also, the pandemic has accelerated the issues posed by the world, including the Republic of Azerbaijan, in the direction of digitalization, the application of new digital solutions and modern technological development.

The conducting issues of investigation in regard to the application of “smart city” conception and determination of opportunities for implementation of pilot project were reflected in the “National Action Plan for the promotion of open government for 2020-2022” approved under Order dated 27 February 2020 of the President Ilham Aliyev. Azerbaijan Republic accepted “Azerbaijan 2030: National Priorities for Socio-Economic Development” under Order No 2469 dated 2 February 2021 of the President of the Republic of Azerbaijan which has a special importance in the direction of fulfillment of obligations arising out of “The transformation of our world: Agenda for Sustainable Development 2030” of the United Nations (Order of the President of the Republic of Azerbaijan, 2021) [1].

“Smart city”, “Smart village” is one of the solution ways of these priorities. According to the document, the following five National Priorities for the socio-economic development of the country should be realized in the next decade:

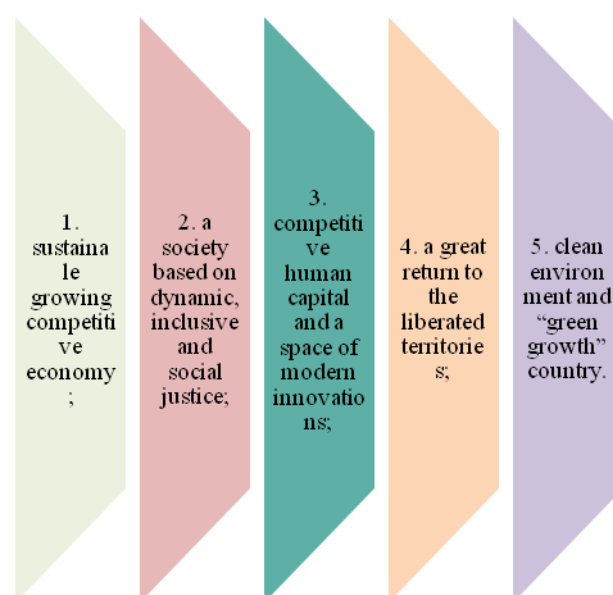


Fig. 5: Five National Priorities for the socio-economic development

Source: Compiled by the author

Also, the president signed an Order on “Preparation of “Smart city” and “Smart village” conception” on 19 April 2021. Already, the works on building the “smart village” were performed in the liberated Zangilan region. Town-building on the basis of “smart city” conception was initiated from “0” in our liberated lands after the Second Karabakh War. Here, everything started to be built from zero, therefore technological rules are kept and infrastructure is established. Construction is carrying out in Aghali village of Zangilan region. The works are performed in stages. In the first stage, the “smart” project covers 5 areas – residence, production, social services, “smart agriculture” and alternative energy areas. The works initiated as pilot project will be applied in other territories too in future. The main purpose is the usage expansion of electronic services and provision of sustainable development in villages and outlying territories of the region.

Already, 200 individual houses have been built within the “Smart Village” project in the Zangilan region of Azerbaijan.

This territory that has been founded by Ilham Aliyev, the President of Azerbaijan, on April 2016, covers 110 hectares area. The first step of the return to Karabakh region of Azerbaijan started from Zangilan within the project. A school for 360 people and a kindergarten for 60 people are expected to operate in Zangilan. Roads have already been built. All opportunities will be provided for distant education in the “Smart school” to be established in village. Here, modern town-building standards will be applied. In a word, there will be comprehensive conditions for living of

residents. The modern irrigation systems will be used in the “Smart agriculture”. Sowing plan is prepared for “Smart village” project. “Smart management system will be carried out from data and analysis center [3].

A 110 kV power transmission line has been laid to Zangilan region. Two 25-megawatt transformers have been installed in “Zangilan” substation. At present, non-residential subscribers are considered in the territory.

Electricity demand in Zangilan, which is forecasted to accommodate more than 50 thousand people, is expected to exceed 40 MW by 2040.

The geographical position of the region and the opportunities existing here creates a favorable condition to turn Zangilan into an international transport and logistics center. International Airport will play a great role in future successful socio-economic development of Zangilan. Waste management in Shusha city of Azerbaijan is planned to be managed on the basis of smart technologies. The construction of new sanitary polygon meeting international ecological standards and technical norms, collection, transportation, disposal and neutralization of all solid household wastes is provided by “Temiz Sheher” Company in the liberated Shusha city of Azerbaijan. So, the works are already initiated in the direction of establishment of modern ecological and technological management system of solid household wastes. 200 special containers were brought for disposal of wastes and were installed in the determined waste dumps.

To build the city's environmental situation and waste management system is necessary by applying the latest technological innovations according to the modern standards.

## 5 Discussion

A “smart city” is built on the basis of smart technologies. That is, these two concepts are inseparable. A “smart city” is a city built on smart technologies. Smart technologies must meet all the requirements of people living in a “smart city”. The concept of “smart city” is a broad field of research.

## 6 Result

By summarizing we can say that, the application of smart city/village conception in Azerbaijan is a requirement of the time. And here is a fertile environment. There is material and technical base and infrastructure used in different areas of activity for application of digital technological solutions. This means the existence of the

qualified personnel potential and experts on application of upcoming solutions.

## 7 Conclusion

By summarizing our thoughts on the “smart city”, we can come to the following conclusion:

– The main purpose of building smart city is to form the city ecosystem which is sensitive to the needs of residents, that allows to increase their social activity and life quality and managed on the basis of big data analysis.

– The majority of existing smart city projects remains incomplete. The smart cities are mostly the regions provided technologically with different smart solutions in city infrastructure.

The existing non-digital elements of the smart city considered when town-building strategies are prepared. Here includes: financial limitations of city budgets, inefficient and often outdated city management, problems of provision of security of private information of city residents, social justice problems and several other factors.

– The restrictive factor of establishment of smart city is to find the best ways of its establishment. The interested persons should answer to several questions prior to making of a decision about establishment of smart city:

– Will the established smart city contribute to the solution of socio-economic problems and ensuring of social justice in the cities?

Will cities be able to implement financially the smart projects or will the funds have to be used for individual solutions?

To what extent are these smart solutions required by citizens?

– Here includes: the issues of establishment and application of technical and technological standards of “smart cities”, platform solutions that provides the mutual relation of databases of different service and sections and contributes to efficiency and reliability of results, problems of ensuring the “transparency” of information, purposeful financing of these programs.

– Thanks to it, a new stage of the development spiral, which provides the formation of new standards of life quality, begins.

– As a result of the movement towards the “smart city”, new trends in the development of traditional areas of activity and new opportunities, new specialties and corresponding skills and abilities provided with complex “cross” use of information are demanded.

– Demand of the day is the establishment of a model allowing to solve the majority of issues created by rapidly changing requirements of



modern areas of activity conforming to the application strategy of smart city technology. The number of technologies applied in application strategy of smart city technology is not important criterion. Implementation of programs and projects of “smart city” activates the creative approaches and innovative solutions in the fields of economic activity.

– As we noted, implementation of separate projects requires the certain financial resources, therefore the issue of investment efficiency has a special importance in the application strategy of the conception.

– The perspectives of smart cities are great, but the systematic work of all interested parties is requested for their designing and efficient activity in future.

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