

## ADOPTION OF INFORMATION TECHNOLOGIES FOR BLACK SEA REGION MUNICIPALITIES' SMART DEVELOPMENT

*Nikolay Tsonkov\*, Kamen Petrov, Tzvetelina Berberova-Valcheva*

<sup>1</sup> University of National and World Economy, Sofia  
Bulgaria

\* Corresponding Author, e-mail: kolio\_tsonkov@abv.bg

**Abstract:** This exhibition is dedicated to the need to impose the geoformation model of development of the Bulgarian Black Sea municipalities. At the beginning, the need to impose intelligent development of the regions and in particular the Black Sea coast in Bulgaria was justified. Then the methods and the model of research are outlined. After that, the results of the research were outlined, recommendations and trends were made in the Black Sea municipalities. Aspects related to the imposition of the model of development of intelligent systems for management of the urban environment and the formation of a smart region on the Bulgarian Black Sea coast are considered.

**Key words:** information technologies, smart (intelligent) development, Black Sea region, municipalities.

### 1. INTRODUCTION

In recent years, information technology has expanded its application in all areas of government, economy, and people's lives. Thanks to them, the world is moving rapidly from economy 3.0 to economy 4.0 and is set to enter 5.0. The main feature that distinguishes the economy 5.0 from the previous ones, is smart development. At the heart of this development is information technology. Evidence of their advanced development is the rapid adaptation of the economic system to the new conditions of a global pandemic. In this sense digital world development is the basic process that impacts on smart cities formation. This process creates opportunities and challenges. The key challenge is personal data protection and security [1]. Of course, to achieve a high degree of connectivity and economic efficiency in the economy, it is necessary to implement universally new information technologies in all areas of social and economic life of countries. For this purpose, it is important to create a digital space in the municipalities and between them. At the same time, with the advent of information technology, interest in territorial and regional issues is

growing, which partly explains the resurgence of interest in regional science and the regional economy. This requires the modelling of regional development as a function of territorial and innovation (information) policies. In Bulgaria, statistics shows a high degree of access to the Internet. However, digital connectivity and smart development in municipalities is still at a low level. That is why it is important to study the innovation policy of the municipalities, directly related to the application of modern information and communication technologies. Thus, local specifics and local tangible and intangible assets become strategic elements on which the competitiveness of the regions is based. This means that it is very important to adopt information and communication technologies for territorial planning and socio-economic development of territory. In this sense the use of intelligent technologies for decision making management of territory and cities is crucial. In this context we need to pay attention to the publication about the use of intellectualization management decision making in the interaction of territorially connected systems [2].

In our research we explore larger Black Sea municipalities. In Bulgaria these are the municipalities of Shabla, Kavarna, Balchik, Aksakovo, Varna, Avren, Dolni Chiflik, Byala, Nessebar, Pomorie, Burgas, Sozopol, Primorsko and Tsarevo. Their total territory amounts to 5,737.3 km<sup>2</sup>, which represents 5.2% of the country's territory. It includes 202 settlements with a population of 726,745, or 10.4% of the country's population. The centre in the northern part - the city of Varna, is the third most populous, and the centre in the southern part – the city of Burgas, is the fourth most populous city in the country.

## **2. SCIENTIFIC PURPOSE AND METHODOLOGY**

Considering the theoretical trajectories followed in the regional economy, one of the main trends that accompanies the theoretical development in the field is the need for more realism in sometimes quite abstract conceptual approaches. This predetermines the focus of our research on the innovation policy of a group of municipalities with tourist potential in Bulgaria, and their adoption of different information and communication technologies. Their territorial concentration is at the Black Sea region of the Bulgarian state. As a limitation, it is necessary to mention that we consider only the larger municipalities with a population of over 15,000 people on the Black Sea coast. They are the focus of evaluation and analysis, because they can put into practice the individual activities and innovations related to the construction of intelligent systems of public administration and connectivity. An important aspect is to check the extent to which these municipalities have the necessary regulatory environment to create conditions for them to conduct innovative policies. In order to analyse the degree of application of modern information and communication technologies it is necessary to use a systematic approach, comparative analysis, evaluation of statistics, geoeconomic analysis and other scientific approaches to clarify problem areas in the field of smart development

of municipalities in the Bulgarian maritime region' space. Thus, the methodological framework of research requires more detailed and in-depth monitoring, analysis and evaluation, which will allow us to make qualitative assessments. The model of regional development of the Black Sea coast has its own specifics and features that make it sufficiently debatable. This suggests that a multidisciplinary approach is needed in assessing the innovation policies in this region.

### **3. THEORETICAL FRAMEWORK**

The smart city is a technologically advanced urban area that uses various types of electronic methods, voice activation methods and sensors to collect specific data. The information obtained from this data is used for effective management of assets, resources and services. In return, this data is used to improve operations in the city. In the present study we analyse the implemented innovation policies. In the Bulgarian conditions the concept of smart city is blurred, because the activities related to the combination of information and communication technologies take place spontaneously and rarely in proportion to the existing information and physical environment. In the Bulgarian conditions new software and technological solutions are required, but the process is not sustainable and the management decisions do not have the necessary rationality. This necessitates the use of limited resources, improvement of infrastructure and the environment for work and living as a condition for the entry of intelligent systems in cities. In this sense we can assume that smart city uses a framework of information and communication technologies to create, deploy and promote development practices to address urban challenges and create a joined-up technologically enabled and sustainable infrastructure [3]. This definition gives us sufficient reason to assume that the smart city is a set of territory on which there is a system of hardware, software (modern information and communication technologies) connected in a network, through which modern problems of urban management are solved. At the heart of smart cities is connectivity, a reliable information environment that allows optimal life-related decisions to be made in the urban system. Therefore, the smart development combines modern information and communication technologies with decision making system' management that improves the environment, economic processes and the use of limited resources. We can conclude that smart management solutions combine connected information and communication technologies with the database and information flows for optimization of management processes. In this regard, we can give the example of gamification. It is one of the many tools that have a successful application in many cities around the world. Simulation of certain situations and the ability to offer solutions from a wide range of countries is computer simulation. At this stage, a number of cities apply this tool in the process of urban planning and smart cities, such as Istanbul, Chicago, Amsterdam, New York and others.

Important condition for smart development of municipalities and application of modern information and communication technologies is the construction of networks and platforms. These are WAN technologies, Z-Wave, the Internet of Things, the 5G network, cyber physical networks and others that we will look at. It should be noted that WAN technologies are characterized with a low power (ZigBee, Bluetooth, Wi-Fi), as they are one of the solutions that creates conditions for the implementation of intelligent technologies in the urban environment, which transform the city into an intelligent system. Other technological solutions, related to the construction of an urban system or a separate city are 3G, 4G and the incoming 5G network. In terms of space, most Bulgarian municipalities are currently focused on the Wi-Fi system, which has a wide public application in public buildings and facilities in cities by creating a network for Internet consumption and other public services. In this sense, Wi-Fi is a step that sets priorities for the development of systems in urban environments. This model of imposing information technologies within the urban environment imposes the term "smart city", which was initially perceived as a model of urban management of lighting, urban transport, waste, intelligent parking systems, traffic management and more. In regions where agglomeration areas are being created, the implementation of smart systems is advancing due to the need to improve connectivity and define the framework of public services. This creates a new vision of a "smart region", which means a single system of services that are provided over a larger area with a radius of up to 40 kilometres. Another important technology is Zig Bee, which allows the creation of personal local area networks. They are also characterized by low power, which is done by digital radio stations. The use of this technology allows the transfer of data over short distances. Of course, Zig Bee also allows for long-distance data transfer, which, however, occurs from intermediate devices via a network [4]. Z-Wave, which is similar to Zig Bee, and it is a communication protocol, also finds scope. In practice, Z-Wave makes it possible to communicate between individual devices via low-energy radio waves. Important for building networks in modern society is IoT (Internet of Things) technology, which is important for some of the systems for building a smart city. This technology makes it possible to connect many devices to each other, which allows data to be collected from them. Such devices that can be connected are measuring sensors, sensors that detect movement or sound, etc. The Internet of Things makes it possible to collect real-time data that gives local authorities an idea of the current state of urban infrastructure or certain services, which is very important information in terms of the needs of residents, consumption, or use of a particular type of service [5]. Recently, efforts have been made in Bulgaria to develop the 5G network, which is a fifth-generation technology. It provides more opportunities for urban development in order to overcome certain challenges. It is important to note that 5G technology operates at higher speed, which allows faster data transfer between many devices simultaneously and less time lag [6]. All smart services provided in cities will change significantly through this new technology - traffic monitoring, smart traffic lights, smart lighting, waste management and more.

We can justify this precisely by maintaining virtual reality, the Internet of Things, which will lead respectively to the emergence of new innovative solutions in the services offered, which we have not had so far. Cyber-physical systems are also very important technology in urban development. It can be defined as smart systems, which are composed of software and hardware, with integrated physical components. Throughout this system, the components interact with each other. This interaction allows them to reflect various changes occurring in the real world [7]. Recently, cloud computing became increasingly applicable in the management of smart cities. They work in the form of web services provided through software applications, on the one hand, and on the other hand, they also apply to services provided by data centres [8]. In practice, the generation of large databases in cities for various operations poses major challenges for their storage, management, and protection. The ability to analyse large data sets in real time helps city authorities to make effective and adequate decisions, as well as new innovations in the field of services offered, in order to improve and facilitate access to data for city residents. In this regard, it is important to see in Figure 1 in the Bulgarian Black Sea municipalities the extent to which strategic policies are in place.

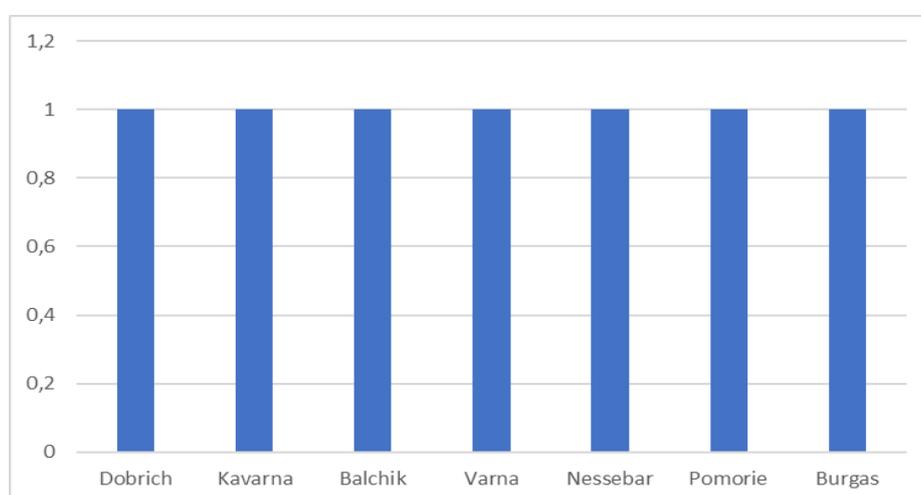


Figure 1. Adopted strategies, content intelligent development as part of the document.

In virtually all major municipalities, more than 15,000 people have adopted strategies or programs for the development of smart systems. Another important argument for the introduction of intelligent systems in these regions is the presence of a temporary population, concentrated mainly in the coastline, climatic national and local seaside resorts, cottage areas and holiday villages. These are holidaymakers and people related to tourism. This means that through intelligent management systems, a higher level of security and rational service of the population in them will be created. This can be seen from Figure 2, where the implemented projects in the seven largest municipalities in the region are presented.

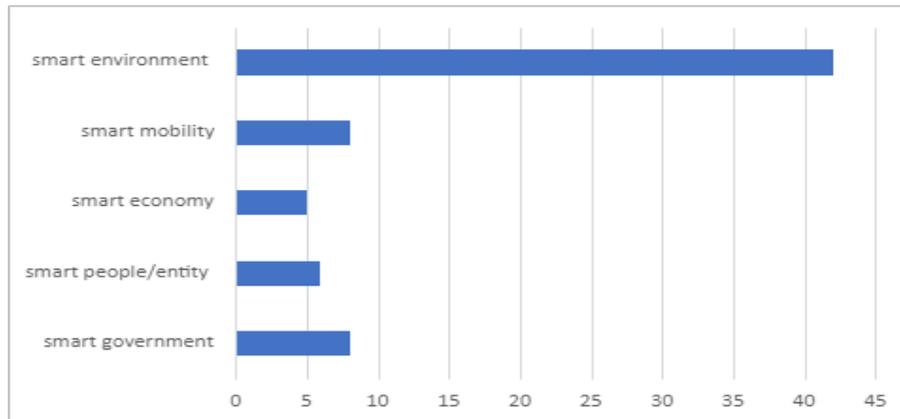


Figure 2. Projects and initiatives that is implemented in the key areas for smart development in 7<sup>th</sup> cities.

### 3. RESULTS

The focus of the study is on the Black Sea municipalities as leading tourist destinations in need of the application of information and communication technologies for increasing their competitiveness. In order to streamline the processes, we will outline the key areas and indicators according to which we could make a relatively objective average analysis of the innovation policy and smart development of the Black Sea municipalities. According to more of the leading specialists working in smart city analysis field consider that we must use indicators in following directions - smart governance, smart mobility, smart economy, smart environment, smart people, and smart living. These six key indicators are consistent with those developed by Rudolf Giffinger and his European Smart Cities research group at the Centre of Regional Science of Vienna University of Technology [9].

An important element for deriving regularities in urban areas is the need for applicability of intelligent systems. The evaluation of their effectiveness can be measured with a set of indicators to help us characterize the quality of urban sustainability and applicability of intelligent systems. In addition, the indicator framework must meet certain standards that can impose a sustainable model of development of intelligent systems in Black Sea municipalities. According to some authors the high efficiency of the digitalization of the society and application of the technologies cannot be denied in the field of e-government, e-learning, as well as with the offer of many e-services (e-banking, e-business, e-voting, etc.) [10]. There are currently three international institutions responsible for international standardization - the International standardization organization, CENELEK (European Committee for Electrotechnical Standardization, responsible for European standards in the field of electrical engineering), ETSI (European Telecommunications Standardization Institute). This predetermines the need for the applicability of smart systems to have an appropriate indicative framework, while

meeting international urban indicator standards relating to the assessment and reporting of progress and the achievement of smart city goals. This determines that with regard to the Bulgarian Black Sea municipalities we can define the following indicative framework, focusing on: smart economy (circular economy); smart environment; smart mobility; smart community / smart governance; smart urban environment (improvement of urban spaces) / innovation; intelligent education; smart healthcare; security and digitalisation [11].

In this direction, the review of the municipalities on our Black Sea coast shows that the entry of intelligent systems has made some progress. In practice, it is necessary to conduct a number of structural and organizational activities and strategies at the municipal level, despite the experience gained, as evidenced by Table 1, which shows the strategic understanding of the problem by municipalities.

*Table 1. Implemented smart projects/initiatives, conducted strategies and platforms in Bulgarian maritime municipalities with 10 000 population above*

Cities	Number of implemented or in process smart projects / initiatives	Existing local strategy and policy for smart city	Smart city' platform
Dobrich	8	1	0
Kavarna	3	1	0
Balchik	4	1	0
Varna	10	1	1
Nessebar	7	1	1
Pomorie	9	1	0
Burgas	25	1	1

The analysis shows that all municipalities has conducted and implemented strategies for the development of smart systems, including several projects and initiatives. But there is some delay in building and facilitating platforms for a smart city. This shows that municipalities are ready to apply a wide range of electronic and digital technologies. This will lead to the transformation of the living and working environment in the region. At least, because the incorporation of such information and communication technologies requires the training and sustainable management of these processes. The analyses of the development of specific strategies for a smart city in the Black Sea municipalities shows that they have to catch up. Only the municipality of Burgas has prepared such a document. At the same time, the municipalities of Nessebar, Varna and Burgas have made their own platforms for a smart city.

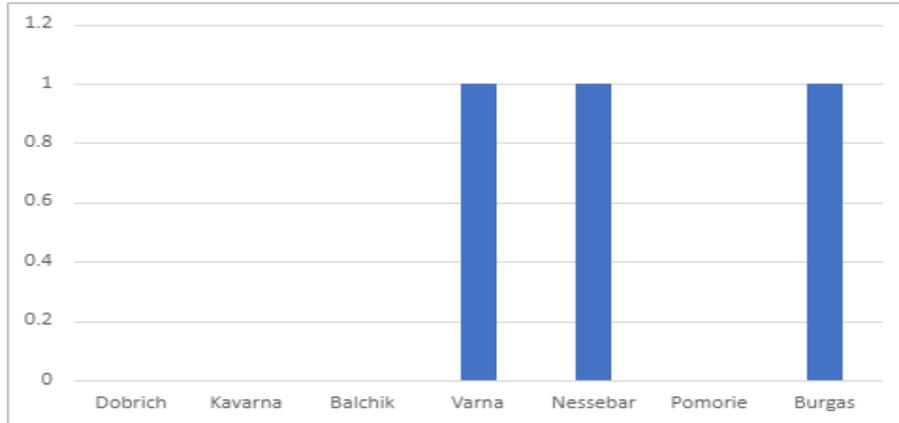


Figure 4. Conducted smart city' platforms. Source.

Given the peculiarities of the development of the Black Sea municipalities and their tourism activities, it is necessary to look for opportunities for the implementation of platforms for smart cities in all of them. Moreover, in almost all municipalities in the last five years projects related to the implementation of smart systems have been implemented. Based on our own research, Figure 5 shows the implemented projects.

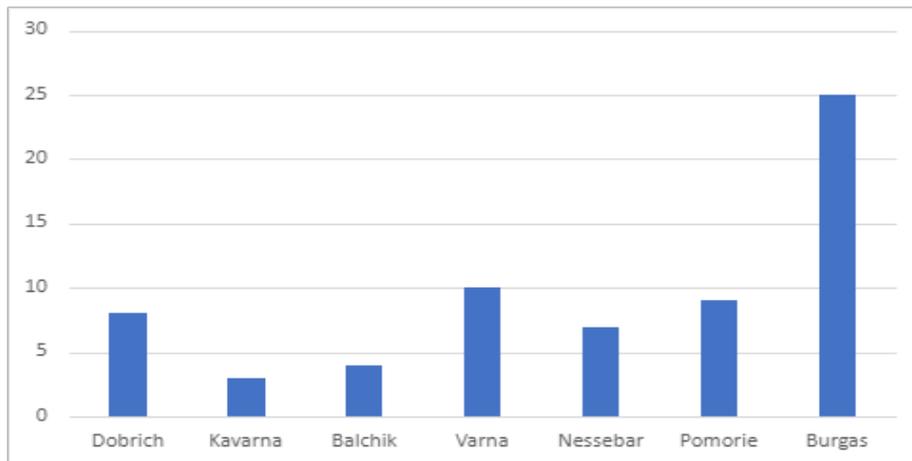


Figure 5. Realized smart initiatives and projects.

Considering the opportunities for socio-economic development of the Black Sea municipalities, it is necessary to develop smart systems in them. This means that the focus of the smart system is to rest on people, processes and technologies as the principle of managing the processes to achieve a smart territory. In addition, cities need to study their citizens and communities, to know the processes, the drivers of business, create policies and goals to meet the needs of citizens. This will help to strengthen regional potential. Smart systems can be deployed to meet the needs of

citizens, to improve the quality of life and to create real economic opportunities. This requires a comprehensive personalized approach that takes into account urban cultures, long-term urban planning and local regulations.

#### 4. CONCLUSION

The new opportunities for urban infrastructure planning and development offered by smart cities are particularly important in the context of over-urbanization process in the developed world. In addition to the emerging negative climate problems, the need for green transformation is also a goal that promotes the development and use of smart systems at the municipal level. On the other hand, the emerging regional disparities between municipalities and regions create difficulties in terms of the development of smart systems. At the same time, it is necessary to plan the smart city rationally, as a scientifically planned city to consider the fact that the real development in cities is often accidental and based on market principles. Thus, smart systems in the future may pose more challenges than solutions for the rational management of urban systems.

\* This article presents some of the results of research conducted under a research contract № SRA NI - 4/2021, funded by UNWE with a subsidy from the state budget. The topic of the study is: "Trends in the regional development of the administrative centres of municipalities from 10,000 to 30,000 people in the Northeast and Southeast planning regions."

#### REFERENCES

- [1] Romansky, R. A Survey of digital world opportunities and challenges for user's privacy. *International Journal on Information Technologies and Security*, ISSN 1313-8251, Vol. 9, No. 4, December 2017, pp. 97-112.
- [2] Goryachko V.V., Choporov O.N., Preobrazhenskiy A.P., Kravets O.Ja. The use of intellectualization management decision-making in the interaction of territorially connected systems. *International Journal on Information Technologies and Security*, ISBN 1313-8251, Vol. 12, No. 1, 2020, pp. 87-98.
- [3] <https://www.twi-global.com/technical-knowledge/faqs/what-is-a-smart-city#SmartCityDefinition>. (visited on 11.12.2021).
- [4] <https://smartarena.bg/wifi-zigbee-zwave-sravnenie/> (visited on 11.12.2021).
- [5] Atanasova, A., Internet of Things in the context of smart cities' concept. *Geography BG*, ISSN 2534-949X, Vol. III, No. 3, 2018 (in Bulgarian), Available at: <https://geograf.bg/sites/default/files/emagazine/emagazine2018.pdf>
- [6] <https://www.vivacom.bg/bg/5g>. (visited on 11.12.2021).

[7] Damyanov, D., Geshev, T., Chukalov, K., Cyber physical systems, base of 4<sup>th</sup> industrial revolution. *XXV ISTC "Automatization and discreet production"*, Technical University of Sofia, pp 340-346, 2016. (In Bulgarian)

[8] [https://cio.bg/softuer/2018/04/04/3433299\\_umnite\\_gradove\\_se\\_nujdaiat\\_ot\\_oblaka/](https://cio.bg/softuer/2018/04/04/3433299_umnite_gradove_se_nujdaiat_ot_oblaka/) (visited on 11.12.2021).

[9] <https://hub.beesmart.city/en/smart-city-indicators> (visited on 10.01.2022).

[10] Romansky R. Privacy and data protection in the contemporary digital age, *International Journal on Information Technologies and Security*, ISBN 1313-8251, Vol. 13, No. 4, 2021, pp. 99-110.

[11] Atanasova A. *Smart cities – new opportunity for city infrastructure planning and development*. Doctor thesis, Sofia University. 2021. (In Bulgarian)

#### ***Information about the authors:***

**Assoc. Prof. Nikolay Tsonkov**, PhD, Regional Development Department, Faculty of Management and Administration, University of National and World Economy, Sofia, Bulgaria, [n.tzonkov@unwe.bg](mailto:n.tzonkov@unwe.bg)

**Assoc. Prof. Kamen Petrov**, PhD, "Regional Development" Department, "Management and Administration" Faculty, University of National and World Economy – Sofia, Bulgaria, ORCID 0000-0002-6295-0664, [petrovkamen@abv.bg](mailto:petrovkamen@abv.bg), [petrovk@abv.bg](mailto:petrovk@abv.bg).

**Chief Assistant Tzvetelina Berberova-Valcheva**, PhD, "Regional Development" Department, "Management and Administration" Faculty, University of National and World Economy – Sofia, Bulgaria

**Manuscript received on 22 January 2022**