SMALL CITY LIKE SMART CITY – PROPOSAL FOR TOWN OF VIS

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Abstract

Is the concept of Smart Cities only for big cities? When we talk about Smart Cities, we usually mean big cities. The concept of a Smart City enables us to solve the complex traffic and other problems of such cities. But what about small settlements? Does the Smart City offer something new to a town of a few thousand people? What is the best path for developing islands with several cities and small settlements? In this paper we want to show – what the Smart City model can bring to the small Municipality of Vis on the Island of Vis.

Key words: smart city, smart island, small town, IoT, Vis

Introduction

European island regions face several challenges: loss of population, isolation, vulnerable environments and limited economic activity. One of the largest islands' threats, is population loss due to limited work opportunities, especially regarding young people and talent. However, the islands have their advantages compared to the mainland: they must be more self-reliant, with stronger community involvement and isolation can trigger innovations and provide a distinct, resourceful environment for experimental implementation of innovations (INNOVATION POLICIES FOR SUSTAINABLE EUROPEAN ISLANDS).

Most Croatian islands are focused on agriculture and tourism and have similar problems of depopulation and lack of employment during winter time.

From an economic point of view, apart from tourism, fisheries, olive growing and vineyards – which do not bring the expected earnings – the island of Vis is economically lagging and has been stagnant for a long time. Specifically, the island economy does not meet the limit of eligibility for real development opportunities (VOJKOVIĆ et al., 2013).

By adopting the concept of 'small city like Smart City', the population will benefit by attracting the interest of investors and European organizations which will increase the possibility of employment and increase the number of highly educated working people. Also, the Smart City concept will raise ecological consciousness which is very important in ecologically sensitive areas like island Vis.

In order to start developing small city like Smart City, it is important to identify local priorities, establish local projects and partnerships and to collaborate with universities, companies, NGOs and authorities. The assumption is that if small urban areas share the same enterprise solutions for water, transportation, education and similar public services, they could share the same Smart City solutions, which can be implemented for several islands in the same archipelago.

The aim of this article is to provide a critical review of the issue of how-to Smart City concept can be usefully applied to small cities in order to improve life on the islands. The aim is also to indicate the possibilities of cooperation in the integrated management method for implementing the smart city policy for the introduction of sustainable tourism.

Island Vis

Vis is a small Croatian island in the south of Adriatic Sea, situated 29 nautical miles from Split. In 2011, Vis had 3.617 inhabitants and 1.410 households (CENSUS 2011). According to the 1910 Census, Vis had almost 10.000 inhabitants. Due to decennial depopulation, the islands as well as the mountainous areas of the country are the least populated parts of Croatia (NEJAŠMIĆ et al., 2006).

Although the communal infrastructure of the island is well – developed there is a need to improve it. Some infrastructure improvements can be implemented with Smart City intervention, especially in the part of water management, waste management as well as sea and soil pollution control.

"The water supply system of the Vis is characterized by considerable water losses, high energy consumption, low throughput of individual pipelines, but also the equipment of modern metering and regulation devices. (…) Lack of water for more intensive agricultural activities is the most significant natural limiting factor for the development of market agriculture, and reserves and opportunities for groundwater exploitation are limited. (…) Coastal sea pollution is higher in built-up areas along the coast when the number of inhabitants without a built-up drainage system is multiplied in the summer. In these areas, the wastewater is disposed into watertight "black pits" which is not an acceptable solution in the long run. (…) Vis has no facilities for the separation and treatment of municipal waste, and there is no infrastructure for the disposal of liquid waste from ships and nautical vessels." (GRAD VIS – RAZVOJNA STRATEGIJA ZA RAZDOBLJE 2016-2020, 2016).

Some of the infrastructure problems facing the Vis can be solved by applying Smart City models. The water resources management of the Vis can have a direct impact on water savings and reduction of water losses in the distribution network, and indirectly on the development of a sustainable island economy. The waste management and pollution control can help biodiversity and environment preserve of the island and thus create the conditions for better living conditions and the development of sustainable tourism.

Water management is a very close to land use management and uses of land determine the diverse socioeconomic activities that occur in a specific area, the patterns of human behavior they produce, and their impact on the environment. "The close relationship between water resources management and land use management is emphasized as a key issue for the integrated management of water in the region" (VIOLA et al., 2014).

Croatian Local Government

According to the census 2011, there were 4.284.889 citizens living in Croatia (CENSUS 2011). Despite a relatively small population, the organization of regional and local government is quite complex. The subdivisions of Croatia on the first level are 20 counties (*hrv. županija*) and one city-county with special status (City of Zagreb). On the second level, there are 428 municipalities (*hrv. općina*) and 127 cities (*hrv. grad*) (LOKALNA I PODRUČNA (REGIONALNA) SAMOUPRAVA).

It can be concluded that the Croatian local government is very fragmented. Such small urban environments are often in significant financial trouble which is often the result of insufficient knowledge as to the how to use financial mechanisms for economic development and to a lack of knowledge of advanced technologies that can create better economic conditions.

These problems make the implementation of any smart model challenging. Information Technology has been "a powerful catalyst" in addressing economic challenges for cities, and it has simply become the "foundation of every sector of every economy" (KRAMER et al., 2007).

Smart City vs. Small Smart City

In the Republic of Croatia, there are still no smart-cities as these are defined in the smart-city key indicators within the Horizon 2020 Program named "CITY keys indicators for smart city projects and smart cities" (BOSCH et al., 2017). Nevertheless, it should be emphasized that more than 40 out of 128 total cities in Croatia use smart solutions. Some of them are trying to use the EU funds potentially available to Croatia to introduce smart solutions. These EU smart infrastructure funds, such as those for smart lighting, cover between 40 and 100% of the investment needed to realize such projects. There are few examples:

- Zagreb is a leader in promoting high-tech start-ups and encouraging Smart City solutions in specific areas.
- One example of the implementation of Smart City technologies in Dubrovnik is the monitoring of 30 parking spaces by modern magnetic sensors. This is linked to an app so users are made aware of available spaces to park.

As you can see, most of the smart projects were launched by the largest Croatian cities. The development of smart initiatives in small urban areas such as the islands has its own specific requirements and

challenges. It is not easy to translate the experience and knowledge acquired in major cities' smart projects into small island environments.

European islands are often isolated and do not develop with the same dynamics as mainland areas. The Adriatic islands are the most vulnerable Croatian areas in that they are continually losing their population (FRIGANOVIĆ, 2001). In Croatia there are 48 inhabited Adriatic islands with 122.418 inhabitants (CENSUS 2011).

In 2017, representatives of the Croatian Adriatic islands, together with representatives of islands from other European countries, signed the Smart Islands Declaration adopted by the European Parliament. The Smart Islands Initiative lists ten action points islands must adopt in order to become smart, inclusive and thriving islands societies (SMART ISLAND DECLARATION, 2017).

City size can be relevant for the development patterns of Smart City initiatives for a variety of reasons. For example, large cities also have critical masses of ICT users, and this may favor a more rapid scaling up and breaking-even for new digital services. Small towns also can have advantages. Small towns might be ideal settings for pilot projects, as they can deal with shorter installation times when projects requiring investments in distributed infrastructures (e.g. street lighting, smart waste) are needed. As such, they can more easily attract technology vendors who are willing to undertake the experimentation of new technologies (NEIROTTI et al., 2014)

Smart City definition and architecture

There are several definitions of Smart City. "From the technology perspective, Smart City has been defined as a city with a great presence of ICT technologies (…). From the "people" perspective, creativity is recognized as a key driver of smart city, and thus people, education, learning and knowledge have a central role in a smart city" (ALBINO et al., 2015).

The Smart City concept technical solution is organized on three levels; the Smart City network infrastructure, the Smart City platform, and the Smart City applications. The Smart City is commonly based on IoT solution. The IoT network architecture is based on the OSI (*Open Systems Interconnection*) model, on the Physical Layer, Data Layer, Network Layer, Transmission Layer and Application Layer.

The Physical Layer – enables data transmission via media such as radio links (types of transmission vary by modulation and frequency range), copper pair, fibre optic cable or coaxial cable, depending on how the infrastructure owner realizes the service. Physical Layer protocols are 802.3, 802.11 or 802.15.4e.

The Data Layer – or associated MAC sublayer, sends incoming packets to recipients via network nodes. From the transmitter to the receiver, the data can pass through different parts of the network where different transmission protocols are used. The processing is done over a MAC address, which represents a unique physical address of the network device.

The Network Layer – is responsible for correctly forwarding the packet (datagram) through the network. IoT uses IPv6 and 6LowPAN protocols.

The Transmission Layer – includes specific protocols: TCP (*Transmission Control Protocol*) and UDP (*User Datagram Protocol*) add header with the required information to the message. TCP enables client and server connectivity by exchanging control information used by both entities. This protocol also allows data flow control, adaption of transfer rate, network overload control with control mechanism, speed correction, detection and repair of lost packets. Because of the special fields in the TCP header, a control sum can be created to ensure the integrity of the received message and therefore TCP is considered a trusted protocol. The UDP protocol is less reliable because it does not establish a connection between source and destination data. Unlike TCP protocols, UDP does not have built-in overload control mechanisms so that packets, regardless of overload are trying to reach the destination and can come in a different order than they are sent from the server. UDP also uses a sent control count to determine whether all message segments have reached the destination.

The Application Layer – defines the protocols used by applications, usually HTTP (*Hypertext Transfer Protocol*), or CoAP (*Constrained Application Protocol*).

Figure 1 shows the complexity of the Smart City eco system in cross-sector cooperation and interaction. Such complex technology solutions are often expensive to developing in small environments. In underdeveloped economies, there are not strong enough economic forces to singly financially invest in smart projects.

Smart City concept

Based on the following model we can compare examples of Smart City solutions for urban areas with possible Smart City solutions for small urban areas to determine whether it is possible to introduce Smart City solutions to the Adriatic's islands. The Smart Islands Declaration encourages islands to

embrace alternative, long-term, sustainable and responsible development of inland, coastal and maritime tourism.

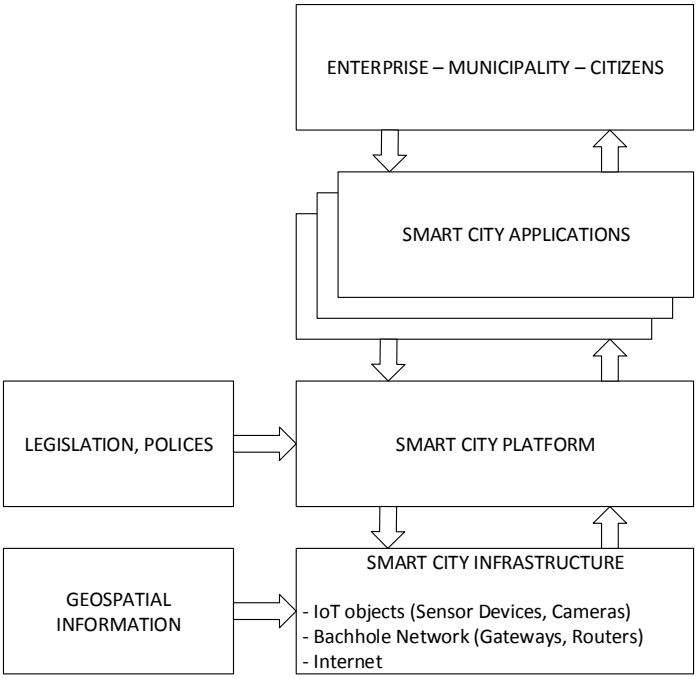

Fig. 1. Smart City interaction and cross-sector cooperation. *Source: Authors.*

Given the current educational structure, degree of economic development, present human and biological potential, recent weather patterns, and larger economic trends in the Mediterranean, it is necessary to encourage sustainable agriculture and farming, as well as develop sustainable tourism to keep the population on the islands (see Table 1).

Table 1. Comparison Smart City solutions in urban areas and Smart City solutions in small urban areas

Smart City solutions in urban areas	Smart City solutions on the **islands in the Adriatic** Sea
Smart living, building & home	Smart living, home & tourist facilities
Smart lighting	Smart lighting
Smart transportation, Carpooling, Car sharing	Seamless traffic, Carpooling, Car sharing
Smart parking	Smart parking
Electric vehicle charging station	Electric vehicle charging station
Smart metering	Smart metering
Smart water management	Smart water management
Smart waste management (recycling of waste, residual management, recovery of waste organics & energy)	Smart waste management (recycling of waste, residual management)
Smart education (e-education)	Smart education (e-education)
Urban mobility	Alternative transport solution
Smart crisis management	Smart crisis management
Smart governance (e-governance)	Smart governance (e-governance)
Smart medical facility (e-medical)	Mobile health
Smart industry	Smart agriculture and farming
	Smart fire prevention
	Smart tourism
	Smart marine

Source: Authors.

In comparison with large cities, the transformation of small urban areas into smart environments brings some new challenges. In the context of Smart Cities, the focus is on traffic management and parking, health, alternative transportation forms, energy and water consumption telemetry systems, public lighting management, reduction of energy consumption, energy resources utilization, reduction losses in water distribution networks, smart waste management and mechanically separating waste. When considering the introduction of smart solutions into smaller environments, such as the Adriatic islands which are

additionally exposed to depopulation and financial vulnerability it is necessary to analyze which smart city elements would justify their introduction on the island of Vis as well as in the wider context of the island archipelago.

Concept for Smart City Islands

According to all definitions, the island is part of the land surrounded by the sea and completely isolated territory. "Although each Adriatic island is an isolated area that represents a unique ecosystem, the development of islands should be seen in a wider context. For the past decades' agriculture has been significantly reduced and the Adriatic islands have turned to tourism and the model of "mixed economy". However, as they are isolated, islands are at the same time parts of a larger island and the island – municipal systems beyond which they cannot exist. Only in this wider island-coastal system, the islanders can meet their ever-increasing need" (DEFILIPPIS, 2001).

The islands of the northern part of the Adriatic have begun the transformation towards smart sustainable environments. Their model of development low carbon and sustainable environment can be used as a model for implementing new sustainable technology on the islands. The islands of Kvarner archipelago jointly promote their development, collaborate and share their knowledge. "Specifically, in the conservation and resource management sectors, knowledge exchange is increasingly recognized as a key factor facilitating the social, environmental and economic impacts of research thus improving the sustainable management of natural systems and the goods and services they provide, and in turn ensuring the safety and well-being of the people that depend on them" (CVITANOVIC et al., 2015).

"Smart City concept is conceptualized with the following characteristics: (a) An enhanced administrative and economic efficiency that enables the development of culture and society by utilizing networked infrastructures; (b) An underlying emphasis on business oriented urban development; (c) A strong focus on the goal of realizing the social inclusion of different kinds of urban residents in public services; (d) An emphasis on the significant role of high-tech and creative industries in long-term growth; (e) A perspective to pay close attention to the function of social and relational capital in city development, and; (f) A vision to take social and environmental sustainability as an important aspect of smart city development" (CARAGLIU et al., 2011).

For the further development of the Adriatic's islands, the focus is on tourism, agriculture and farming development as dominant island activities. The smart concept can be implemented as follows (see Table 2).

Transformation of a small urban area into a small islands Smart City area implies large investments. Because the islands cannot function entirely independently as eco systems, it is necessary to devise action plans for islands within the same archipelago as the northern Adriatic islands. "Several studies and action plans were completed regarding islands in the Adriatic Sea, mostly focused on mapping and suggesting measures for the implementation of sustainable technology for achieving a low carbon and sustainable environment. The most advanced islands in this aspect are Kvarner archipelago islands" (MANDIĆ et al., 2019).

According to the above-mentioned themes regarding smart needs and for the purposes of implementing Smart City solutions for the Adriatic's islands, it is essential to collect all relevant geodetic data.

Proposal for the Island of Vis

Smart Island Declaration quotes in economy enabling factors:

- We will build on our tradition of enhanced social capital to nurture innovative forms of collective financing such as cooperatives, crowd-funding, crowd-lending and public-private-people partnerships.
- We will diversify our economic activities to foster the creation of sustainable local jobs, overturn the population decline and ageing and transform our islands into territories where people can live and prosper (SMART ISLAND DECLARATION, 2017).

These goals are logical and necessary – demographics are getting worse on most of the islands.

We propose several smart models for the Island of Vis.

In the two largest cities in Vis, 438 people employed in seven activities have potential for using Smart City solutions (Table 3).

On Vis it is necessary to promote the development of agriculture and farming in order to create better living conditions for the islanders. Products created in these activities should ensure the island sustainability, especially because of increasing tourism. Smart agriculture and farming, with investment in smart technologies, would contribute to increased yields and thus to economic stabilization on the island. The digital transformation of public services would lead many benefits for the local community.

Table 2. Purposes of smart needs on islands

Smart needs	Purpose
Smart living, home & tourist facilities	Using network systems, smart devices like refrigerators, heating systems, cooling systems or door controls are linked up for users to access and control through their tablet or smartphone devices. This access is possible regardless of the user's distance from the connected devices. All users need is a web-based app downloaded onto their smartphone, tablet or PC to access information. With the information, users can make more informed decisions as to how to improve the way these devices work and make their lives easier.
Smart lighting	Public lighting of streets and parks represent between one-quarter to one-half of the city's energy bill. Implementation of public electricity consumption savings is necessary.
Seamless traffic, Carpooling, Car sharing	Optimized transportation will reduce the number of cars, fuel consumption and CO2 impact. Seamless connection of ferry and ship timetables to public urban transport on land reduces transport time and number of traffic accidents.
Electric vehicle charging station	Increasing the number of tourists. Decreasing global environmental CO2 footprint.
Smart metering	With real – time cost control, households reduce energy consumption and CO2 footprint. Reducing global environmental CO2 footprint because energy distributors do not have to use motor vehicles to read consumer counters.
Smart water management, rain water sewerage	Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources. It is a sub-set of water cycle management needed for tourism, agronomy and farming.
Smart waste management (recycling of waste, residual management)	Optimizing waste collection routes, frequencies and vehicle load. Reducing global environmental CO2 footprint.
Smart governance (e-governance)	Providing information and public services on communication and collaboration between government and citizens on the principles of good governance.
Smart education (e-education)	Smart education, remote access, on-line education, new smart technologies education.
Alternative transport solution	Increasing number of EV charging stations. Increasing the number of tourists. Reducing global environmental CO2 footprint.
Smart crisis management	Secure communication. Early Warning System. Reduces number of accidents.
Mobile health	Mobile health clinic bus, diagnostics and prevention on the island, possibilities of high diagnostic accuracy in emergency cases.
Smart fire prevention	Fire detection with cameras and IoT solutions, connected with secure communication systems. Reduces number of accidents. Reducing global environmental CO2 footprint. Reduces damages.
Smart tourism	Smart supply chain for hotels and restaurants. Smart transportation, energy consumption forecasting, water quality, UV index measurement, visitors counting, coast surveillance It has relationship with the so-called sustainable tourism.
Smart marine	Monitoring the availability of berths in the marina. Increasing the number of tourists. Decreasing maritime traffic reduces fuel consumption and global environmental CO2 footprint.
Smart agriculture and farming	Using smart technologies to increase the quantity and quality of products. Farmers have access to GPS, soil scanning, data management, and IoT technologies.

Source: Authors.

Table 3. Number of employees by field of activities with smart potentials

	Vis	Komiža
Agriculture, forestry and fishing	64	109
Transportation and storage	27	19
Tourism	94	102
Other service activities	9	14
Total (Vis + Komiža):		**438**

Source: (CENSUS 2011).

A. Water

Vis is an island that meets its water supply by pumping its own aquifer (TERZIĆ, 2004). This yields a limited amount of water. There have been no reductions in recent years, thanks to good management (VIS I LASTOVO – UZOR OTOCIMA KOJI SE SUOČAVAJU S REDUKCIJOM VODE). However Smart water metering can help optimize water consumption, leading to reduced household costs and increasing investment opportunities in other areas of the island. Water resource management is directed at optimizing the use of water and in minimizing the environmental impact of water use on the natural environment. The observation of water as an integral part of the ecosystem is based on integrated water resource management, where the quantity and quality of the ecosystem help to determine the nature of the resources. It is necessary that Vis continuously implement water-saving systems in order to have enough water for economic activities.

B. Lighting

Implementation of a smart lighting solution for public electricity consumption is necessary for municipality cost savings.

C. Traffic

There is no need to implement expensive transport solutions on the island, but through the education of inhabitants, it is necessary to educate about the benefits of carpooling and car sharing practices.

D. Waste management

Optimization of waste collection routes is necessary for municipality cost savings.

Vis and three bigger islands of the same archipelago have a set of similar problems that smart solutions could solve (Figure 2). Therefore, it is necessary to analyse the benefits of investing in a common Smart City solution for multiple islands in the same archipelago, especially for the development of the smallest Adriatic islands and their equal development with other Croatian communities.

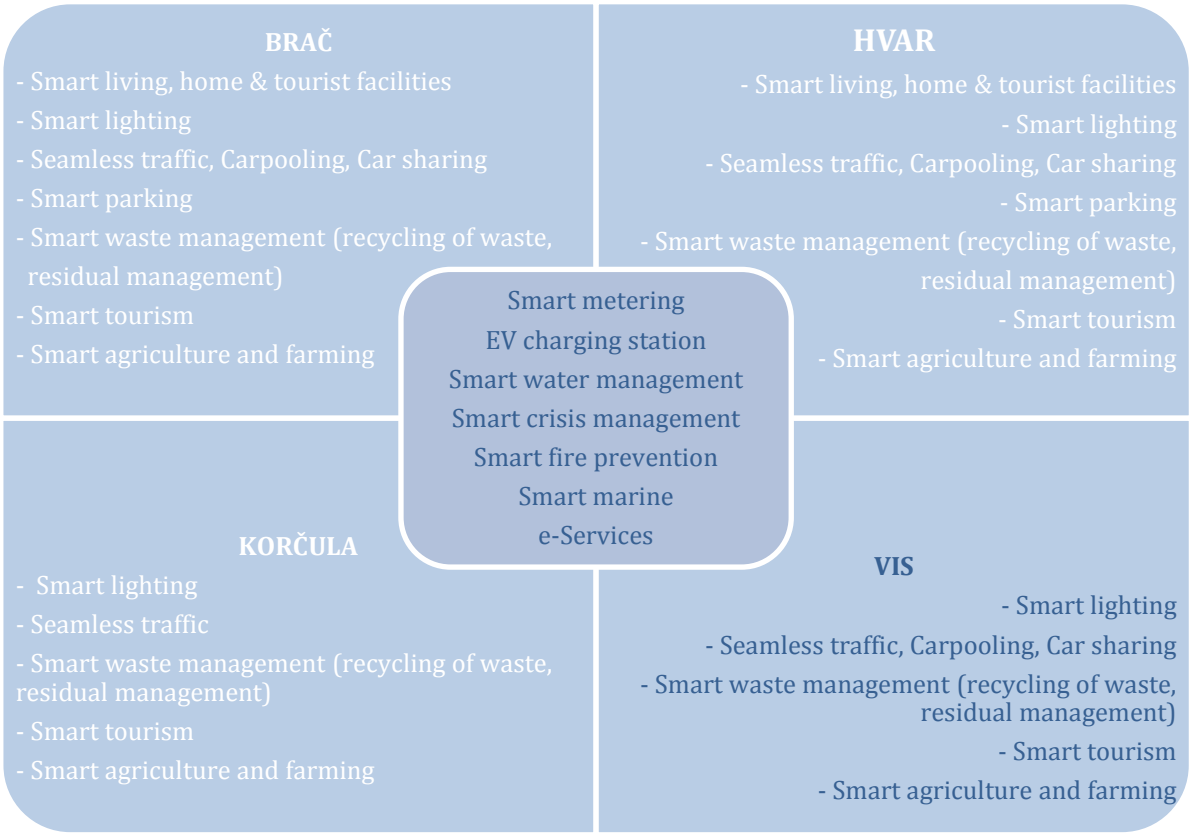

Fig. 2. Set of smart solutions for the islands of the same archipelago including Vis. *Source: Authors.*

Conclusions

The island of Vis is one of the most naturally inhabited Croatian islands. Military bases have been located on the island for decades, and strangely tourists have been denied access to the island. This is the one of the reasons why the island is not as tourist developed as the other Adriatic islands. At the same time, isolation contributed to the preservation of the authentic landscape, the smaller number of housing units built, but also the poorer development of the island.

In the last decade, there has been a significant increase in tourism and disorganization is noticeable when the number of people on the island has tripled in the summer. There are major problems with water supply, inadequate medical care, lack of parking, traffic jams on arrival and departure of ferries, lack of public transport on the island, inability to keep the beach clean, etc. The island of Vis has started tourism development or neglect of other economic activities. The island is at a turning point in the sense of stability. Unless the approach to nature conservation and the enlarged components of the smart city in small island Croatian cities is changed, there is a possibility of destroying natural resources and reducing profits from tourists. If the island does not start sustainable development, It could become unfavorable for tourism. Smart solutions that are available as technology advances are used as a solution to these problems.

Small Adriatic islands like Vis have great economic potential. Due to financial problems, depopulation and insufficient knowledge of new technologies, the dynamics of digital transformation do not follow the tendencies of big cities. It is necessary to introduce a smart solution on Vis, but due to its small number of inhabitants, this process will not start soon. For this reason, Vis should find common cause with the islands in the same archipelago, and through shared collaboration, become a smart island.

Some of the infrastructure problems facing the Vis can be solved by applying Smart City models. An intelligent city is not only computer systems controlling media (water, light, waste) and communication (transport), not only cooperation, but also the creativity of residents who are able to use local unique environmental and cultural resources.

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