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THE ROLE OF UKLO AS A CATALYST IN THE PROCESS OF CO-CREATION FOR THE DEVELOPMENT OF BITOLA AS A SMALL SMART CITY

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ABSTRACT

The main driving forces behind the concept of “smart city” are information and communication technologies, with the focus on the Internet of Things and artificial intelligence, as well as the local government and all the different social actors that make up a city’s ecosystem. The smart city as a concept implies the creation of e-services that facilitate the lives of citizens. The transition of cities towards becoming smart involves changing the role of all social actors (citizens, service providers and local authorities) from passive to proactive. Such a transition requires the creation of a climate for collaboration and participation in the process of creating the smart city, known as co-creation. The current focus in the creation of smart cities is on large

cities, while the transformation of smaller cities which also need to become smart is neglected. This research paper has its focus on the possibility of the city of Bitola becoming a smart city. The paper is inspired by three smaller cities in Finland that have become smart, which serve as the main research method – case study. The specific examples highlight the role of applying the model of co-creation and point out the university as the most significant actor in the city's ecosystem, which must be necessarily involved in the process whereby a city, in this case Bitola, can become a smart city.

KEYWORDS: smart city, information and communication technologies, university, co-creation, Bitola.

1. INTRODUCTION

The period in which technology and innovations in science experience maximum acceleration is depicted as the 'fourth industrial revolution' or 'Industry 4.0'. The combination of artificial intelligence with big data is pointed out as an opportunity to create a seamless world of communications, collaboration, and interaction, and that not only among people, not only among machines, but also between people and machines (Salminen, Kantola, and Ruohomaa 2016). Thus, considering that the basis for creating smart city services involves activities related to the collection, interpretation, and analysis of real-time data, and Industry 4.0 defines the context for digitalization and industrial Internet of Things (IoT), then (as noted by the authors (Lom, Pribyl, and Svitek 2016)) Industry 4.0 provides a detailed and robust framework for the development of activities related to smart cities.

The two most important driving forces of changes in a society, the social and technical achievements, contributed to technology being seen from two aspects, both as responsible for creating value and as responsible for achieving interconnectedness among different actors in society. Today's information society is described as participatory and networked, in which, thanks to technology, a lot of new concepts related to social interaction are born. Two concepts related to the collective experience and developed as a new paradigm in the management literature at the beginning of this century are: the concept of co-creation (Burdon, Mooney, and Al-Kilidar 2015) and the concept of multi-creation (Petrevska Nechkoska, Tactical management in complexity: Managerial and informational aspects 2020). According to certain authors (van der Graaf, Nguyen Long, and Veeckman 2021), co-creation is based on combining knowledge, actions, tools, and the distribution of ideas and information that are put to function in creating complex solutions for a given problem in smart cities. Additionally, multi-creation is a model that is a primary driver of the co-creativity process. For certain authors (Mayangsaria and Novania 2015) who view the smart city as an ecosystem composed of multiple parties involved, the co-creation process represents the basis for providing and delivering e-services where information and communication technologies (ICT) are just a "new technological enabler in the smart city" that creates conditions for a new form of collaboration among involved parties.

The aim of this paper is to make a practical contribution to the literature on the development of smart cities, with a focus on small towns. The contribution consists of presenting three case studies on the development of smart cities in Finland. The main focus of the paper is the role of the co-creation process in the city's ecosystem, with special emphasis on the university as the

bearer of innovations in a society. The rest of the paper is organized as follows: part two provides a description of the three mentioned concepts, part three offers insights into the methodology used in the research, the fourth part contains the case studies of the three small smart cities in Finland and the city of Bitola as a potential smart city and a comparison between them, and part five presents the conclusion and contains the discussion on the possibility of such solutions being applied in Bitola.

2. CONCEPTS

The creation of a smart city as a process significantly differs from other processes that have occurred in cities in the past. Key to the concept of smart cities, which is also a trend in this type of development, is that it involves a transition from global to local level, and encourages a shift from competitive to collaborative service provision (Öberg, Graham, and Hennelly 2017) which means the inclusion of two new concepts, the concept of co-creation (van der Graaf, Nguyen Long, and Veeckman 2021) and the concept of multi-creation (Petrevska Nechkoska, Angeloska Dichovska, et al. 2023).

2.1. Smart city

The concept of a smart city unites technology and representatives from various sectors of society at the local level, utilizing technological enablers such as the Internet of Things, artificial intelligence, and large databases and their real-time processing, combined with dimensions of creativity and humanity. This concept represents a new way of organizing the functions of the city and urban life within it based on digitization (Öberg, Graham, and Hennelly 2017). The smart city is built on six areas (pillars) where the application of technology facilitates and improves the functioning of the city (the representation is given in figure 1).

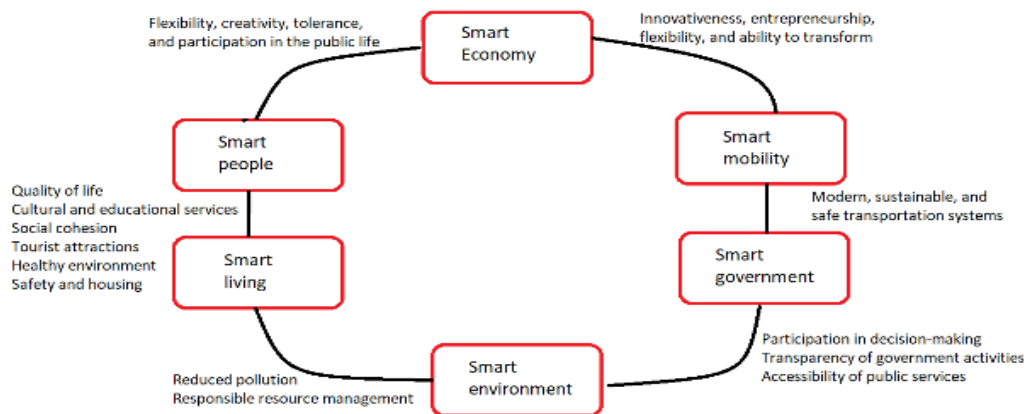


Figure 1. The six dimensions of the concept of a smart city (Ruohomaa, Salminen and Kunttu 2019)

Introducing the concept of a smart city aims to achieve efficiency, technological advancement, sustainability, and social inclusiveness (Vanolo 2014). The development of smart cities does not just focus on technological enablers but also represents a new way of collaboration among cities and all actors within it: businesses, citizens, and the academic community where "innovation, participation, collaboration, and coordination" are activated (Herschel 2013).

The concept of a city's "smartness" (Lom, Pribyl, and Svitek 2016) can be understood at three conceptual levels: (1) from a user perspective, which implies conceptual adaptation to the needs of the end-users and interfaces tailored to the needs of the residents of the specific city; (2) from an urban planning perspective, meaning that local governments use the concept of smartness in creating new strategies, development programs, and policies as guidance for the development of urban environments from the aspect of economic growth, sustainable development, and improved quality of life; and (3) in the context of technological development, the enablers of the smart city concept use the methods of artificial intelligence, the internet of things, and machine learning (a sophisticated way of collecting and analyzing data) to apply in the direction of creating smart services for the residents of the smart city.

2.2. Co-creation and multi-creation

The concept of co-creation is a new paradigm in the management literature (Ind and Coates 2013) that emerged at the beginning of this century and refers to "creating value through interaction" (Galvagno and Dalli 2014). The foundation of this concept is the Triple Helix model (Etzkowitz and Leydesdorff 1995), which refers to the relationships between the university, industry, and government/state, depicted in figure 2.

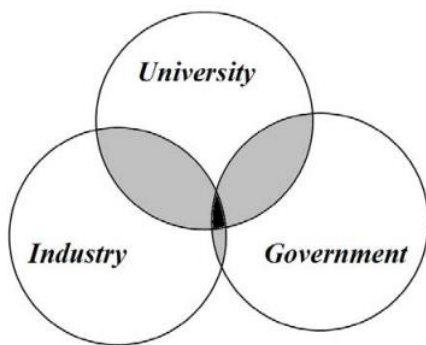


Figure 2. Triple Helix model (Etzkowitz and Leydesdorff 1995)

This concept serves to explain the structural events in "knowledge-based economies" where the transformation is based on the application of new ICTs towards achieving "new knowledge production." Co-creation as a process finds significant application in developing solutions for smart cities, resulting in the creation of new value. The application of co-creation as a process implies different roles for the people involved in the process: employees in local government, companies, university... or citizens. Regardless of the role people occupy, they combine their knowledge, actions, tools, and distribute ideas and information.

Given the complexity of the co-creation process in developing solutions for problems associated with smart cities, (Petrevska Nechkoska, Angeloska Dichovska, et al. 2023) highlight the model of multi-creation as the primary driver of the co-creativity process. According to this group of authors, multi-creativity is "an iterative process of collaboration among academic circles, policy-makers, the business community, and non-profit organizations as the main actors" in the process. In this model, it is particularly important that these actors often change their roles throughout the process, as many times as necessary to achieve the best and mutually accepted decision for all parties involved, by taking one of the possible roles as initiator, facilitator, and implementer, in

which each of the different types of entities can be represented by an unlimited and diverse number of actors (depicted in figure 3).

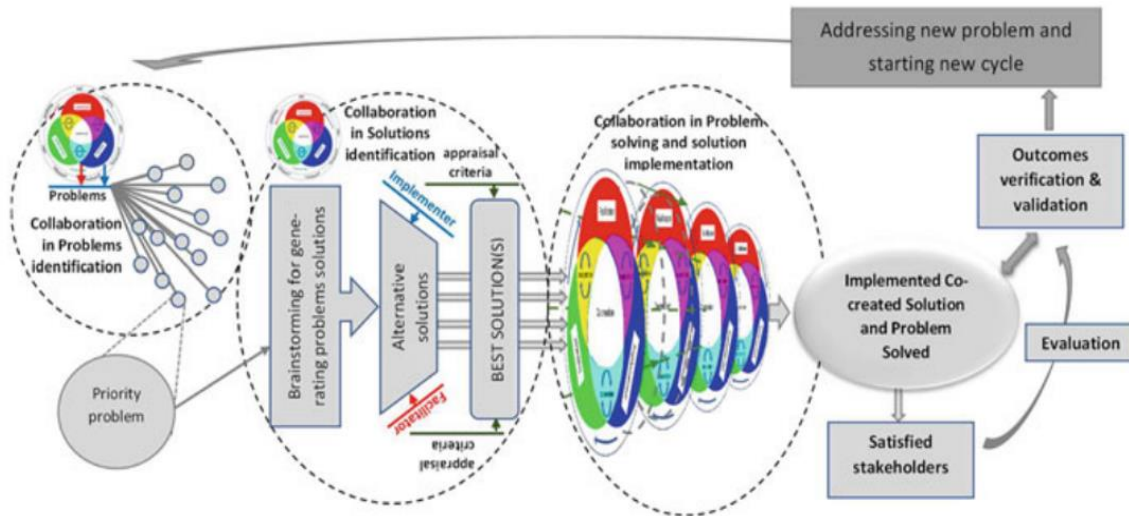


Figure 3. Multi-creation model (Petrevska Nechkoska, Angeloska Dichovska, et al. 2023)

In the process of generating multi-creation as a method, the authors conducted iterations of conceptualization and learning, involving the university, system institutions, businesses, the community, the civic sector, and all actors in social life that are affected by the addressed problems. Such iterations of implementation and learning are repeated, thereby solidifying, expanding, and profiling the method, and its effects are multiplied, with the university positioned as a driving force in society.

3. METHOD

Within the scope of the research, multiple standard research methods were used. Content analysis as a method was utilized in the review of existing literature related to the topics of "smart cities," "co-creation," and "multi-creation." The Google Scholar search engine was used to access the works, where the "snowballing" technique was employed to locate the papers. The case study method (Lesley and Vavrus 2016) was used to present and analyze four case studies, of which three were adopted, while the fourth study was developed and created for the needs of this paper. Further, the comparison method was applied, in which a comparison of all four cities was made, and finally, the processing of the obtained results was approached. Through the use of the synthesis method, conclusions were created. Fundamentally, this paper is based on qualitative analysis with the application of a descriptive method to present the findings and conclusions.

4. CASE STUDIES

In this part of the paper, four case studies will be presented. Three case studies pertain to small towns in Finland on their way to becoming smart cities, and the fourth case study is a city in the Republic of North Macedonia, which in characteristics is similar to the three previously mentioned cities and could be considered a small smart city. Figure 4 provides the location of these cities within the countries they belong to.



Figure 4. Presentation of the geographical location of the cities covered by the research (Google Maps)

Cities covered by the research are: a) in Finland: Hämeenlinna, Riihimäki and Forssa, and b) in Republic of North Macedonia: Bitola.

4.1. The city of Hämeenlinna in Finland

The city of Hämeenlinna, in its endeavor to become a small smart city, began activities to develop an ecosystem aimed at improving the city's competitiveness in the region and enhancing its living environment. All key actors in the ecosystem were involved in these activities: city authorities, local companies, the university, and the city's residents. The goal was digitization and development of smart urban services in construction works as key objectives of this ecosystem. In this process, several pilot projects were initiated; one presented is the pilot project for an electronic bicycle service. This type of e-service within smart cities is often represented in large smart cities (Namiota and Sneps-Sneppé 2019) and is very often one of the first projects with which a city begins its transformation towards smartness. As part of the concept for smart transport - pillars of the smart city, also known as smart mobility, includes establishing an operator and an application for bicycle sharing so that city residents have the opportunity to use "city" bicycles as a means of transportation within the city. Introducing such a solution is directed towards saving resources, preserving the environment and clean air, and reducing the problem of a lack of free parking spaces. According to global practices, public bicycles are placed and available at selected locations throughout the city where there is the highest frequency, and residents can check the availability of bicycles and rent one using an application available on a smartphone.

In addition to the availability of bicycles and achieving the aforementioned benefits, the data provided by the bicycle-sharing service were further utilized for: (1) the users - to track the

availability of bicycles in the city, (2) bicycle operators - to use the data in terms of maintenance information for bicycles (if a bicycle is not used for an extended period – it indicates it needs repair), and (3) city authorities - the collected data from the use of bicycles are used in planning bicycle routes for the construction of paths and possible future services for cyclists - the citizens.

4.2. The city of Riihimäki in Finland

The city of Riihimäki based its development strategy on robotics as a field and strategic focus for the city, following the European framework for Industry 4.0. To achieve this goal, the city authorities encouraged an open and friendly atmosphere among the interested parties with the opportunity to participate in the development of robotics and innovative activities in every field. The city authorities were aware that only the inclusion of more parties could contribute to reducing resistance to changes, increasing commitment, as well as generating new development ideas.

Considering that exploiting the opportunities provided by robotics and digitalization requires new skills, not only technical but also multidisciplinary, the city has focused on investing in robotics education: introducing subjects and training for children in elementary schools, at universities, lifelong learning courses for adults, and opening hubs where innovations include robotics. In this way, the city has made an effort to integrate the needs of various sectors, including industry, healthcare, education, and transportation, and to see education not just as a way of building knowledge but as an activity through which initially resistance to change can be reduced, and later accelerate the implementation and promote a positive attitude towards robotics.

Given that education is fundamental for innovations that take place in "real-life" environments, in pilot studies and research, the city's focus has been precisely on using education to stimulate and support the process of building Riihimäki as a smart city. Thus, the city organized several events related to robotics, including competitions and developmental challenges for students. Throughout the process and in all activities, the city closely collaborated with the local university (Ruohomaa, Salminen, and Kunttu 2019). The HAMK Häme University of Applied Sciences (Finnish: Hämeen ammattikorkeakoulu), as a higher education institution with seven locations in Finland, offers research and development services, professional teacher education, as well as lifelong continuing education. This university, among other things, offers education in computer applications, civil engineering, electrical engineering and automation, information and communication technology, bioeconomy, smart and sustainable design, smart organic agriculture, business management, entrepreneurship, and sustainable technologies.

The three main areas of robotics development in Riihimäki were: robotics in manufacturing with a focus on industrial automation and production, robotics in services, and robotics in healthcare. One of the examples is the implementation of pilot projects in the scope of service robotics, which pertained to the care and assistance of elderly people.

4.3. The city of Forssa in Finland

The city of Forssa is located in the middle of an agricultural region in Finland, between the three largest cities in Finland (Helsinki, Turku, and Tampere) and hosts the largest national institute for agriculture and bioeconomy, as well as the regional University of Applied Sciences. The

history of business with a circular economy in the Forssa ecosystem dates back to the 1990s, when the directive for waste treatment in the EU was first launched. Because of this, the city of Forssa and the surrounding municipalities decided to create a large landfill where all companies dealing with waste treatment could be located, which attracted several companies that operate in the waste management business. Being located in this area facilitated the collaboration process among the companies, thus creating a circular economy ecosystem that was ranked as the best in Finland, achieving industrial symbiosis.

Thus, the strategic focus of Forssa on the circular economy entailed financing research and development in the circular economy, and the local university adapted all its programs to profiles incorporating education and orientation towards the circular economy. The local government supported initiatives and the development of new startups focused on economic activities related to the circular economy. The industrial symbiosis of the circular economy ecosystem in the city of Forssa in Finland is visualized in figure 5.

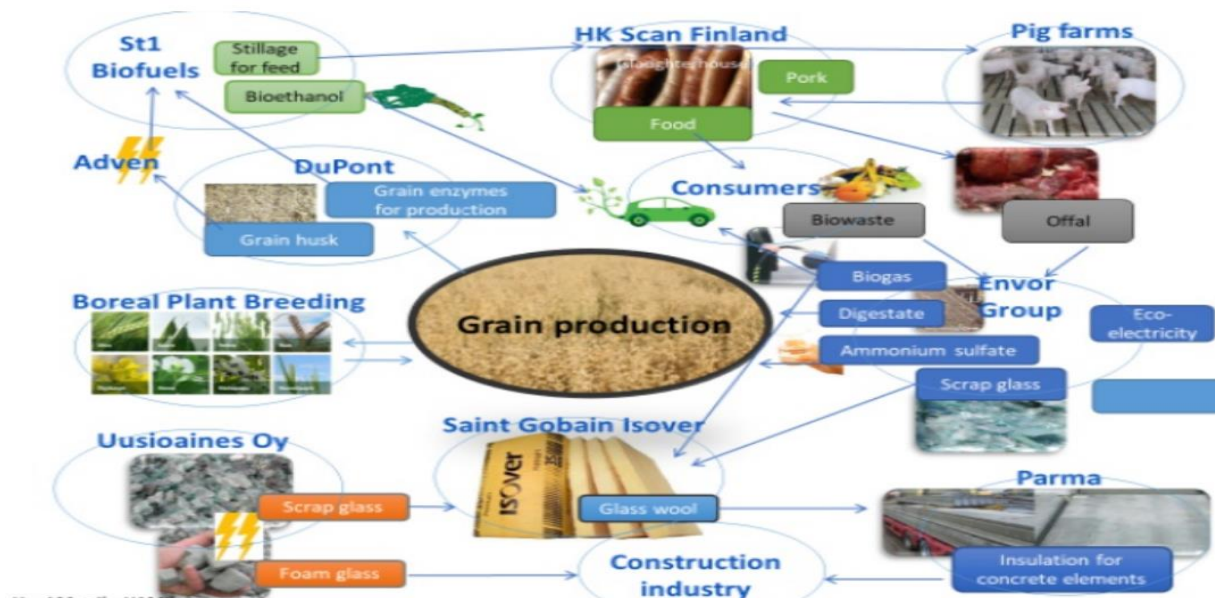


Figure 5. Visualisation of Forssa's circular economy developed by HAMK University (Ruohomaa, Salminen and Kunttu 2019)

Thus, the city of Forssa and the entire region are designated as the "Smart Green Region Forssa"; the city hosts an annual event for circular economy startups and other enterprises (FRUSH) with the aim to promote and make visible its activities that are implemented to further increase citizen awareness, and to attract investors to existing or new businesses related to the circular economy.

The reason why the city of Forssa chose the circular economy as a strategic focus for the development of a smart city is the fact that although the circular economy and industrial symbiosis were largely driven by the industry right from the start, the strategic determinations of Europe, including the concept of a smart city, led to intensive thinking and support among citizens because they recognized that if they support resource efficiency and the development of the circular economy in daily activities, then it would have a significant impact on various areas such as education, the environment, living, services, and tourism. A concrete example of this is

the facility that serves for local waste management, which continuously produces new users and innovations for smart recycling and efficient use of waste as a resource.

4.4. The city of Bitola in Macedonia

The city of Bitola is located in the southwestern region of North Macedonia. For a long time, the city has lost its status as the second largest city in the country, lost a good part of its industry, and as a result of poor local governance as an administration, severe pollution, unfavorable economic climate, and lack of prosperity, the city faces massive emigration. The city is increasingly dominated by an older population who are often alone in their homes, and the available capacities for accommodating elderly people are quite limited and expensive. Additionally, the mentality of the citizens does not support the placement of elderly people in nursing homes.

In Bitola is located the second oldest and largest university in the country, which is situated in several cities and offers a wide range of faculties in technical and social sciences. The study programs create traditional profiles of personnel, which rarely follow global trends in interdisciplinarity or trends in circular economy, smart technologies, etc. The city has been trying for a long time to become a tourist destination, but success has been limited despite having a good location and a large number of cultural and historical sites, specific and relatively well-preserved architecture, and artifacts that constitute the cultural heritage of Bitola. The ecosystem in the city is relatively incoherent, fragmented, with the desire but without success in functioning. Industries represented in the city include the mining-energy sector, the dairy industry, parts of the automotive industry, commerce, service activities, and the public sector. In the last 15 years, IT companies have achieved significant growth.

Bitola faces a relatively disorganized urban transport system that is predominantly car-based; there is significant pollution, especially during the winter months; low awareness of the existence and importance of smart solutions and smart cities; and the utilization of the university's capacities by the local government in the area of encouraging innovative solutions to improve the citizens' quality of life – in general, and with the help of technology as an enabler – specifically, is still in its infancy.

4.5. Comparative analysis

The examination of the four cities used as case studies within this work highlighted the need for consolidating the insights into a tabular representation as the most comprehensive way for comparative analysis, presented in Table 1.

Table 1. Key characteristics of cities – case studies

	Hämeenlinna	Riihimäki	Forssa	Битола
Number of Residents	67.000	28.000	20.000	55.000
University	Yes	Yes	Yes	Yes
Industry	Light	Light	Light	Light
Connectivity	Railways, Roads	Railways, Roads	Railways, Roads	Railways, Roads
Significance of the City	Regional	Regional	Regional	Regional

Smart City Focus	Smart Mobility - Transport	Smart Living	Smart Environment - Circular Economy	?
Pilot Projects	City Bike Sharing Services	Robotics in Education and Elderly Care	Recycling, Waste Management	?

The observation of the data given in the table leads to the conclusion that these four cities have many common elements. However, when analyzing the qualitative information towards the essence of smart cities and their effect on the quality of human life, businesses, and nature within them, the comparison would show completely different aspects of incompleteness, especially the comparison between the Finnish cities on one side and the city of Bitola, on the other side.

5. CONCLUSION

The purpose of this paper is to demonstrate how small cities have become smart cities, highlighting the transformation as a result of changing the way the city's ecosystem functions through co-/multi-creation, where technology is used as an enabler. As a result of analyzing three cities in Finland, the collaboration between city authorities and the local university as a bearer of knowledge and innovation is emphasized.

Given the experiences presented in relation to planning small smart cities, this paper can be useful from the perspective of sharing information based on "learned lessons", relevant to all actors involved and interested in participating in the development of smart cities. The presented studies were not chosen randomly, but rather for the similarity in characteristics of the cities. The studies showed that local authorities play a fundamental role in the ecosystems of the smart city; that the process of co-creation changes the way local governance is organized and that it is just a part of the ecosystem where technology enables the process; and that connectivity with the university is the foundation for successful transformation into a smart city.

As a recommendation for the city of Bitola, it is suggested that the local authorities connect with the university as soon as possible; to build strategies towards becoming a smart city; focus the university on integrating smart elements into all study programs; steer the profiles towards interdisciplinarity; use technology as an enabler that will activate both the faculty and local companies for the development of centers that will collect and analyze real-time data; use the data for the implementation of projects with a wider application, such as: tracing bicycle paths based on data obtained from the system for the most frequently used bicycle paths.

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