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Comparison of Smart City Standards, Implementation and Cluster Models of Cities in North America and Europe

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Abstract: Sustainability in Smart Cities is a current and trendy topic in a global sense. The primary impetus for writing this article was to create a general implementation model for the smart governance of European Smart Cities based on the American best practice. The ambition is to be able to modify the generally created model to meet the local conditions of all countries. The aim of the article is to point out the essential elements and differences between the implementation standards, models and clusters in the cities of North America and Europe, including their benefits and limitations. This article compared standards, implementation and cluster models for Smart Cities in North America and Europe through a secondary analysis from Arcadis and IDC consultants, standards agencies, and relevant sources. In addition, comparisons and summaries of the results were used. The results of this article point out the fundamental differences between the American and European approaches to building Smart Cities. American models are more centrist-oriented to people and complex in their simplicity, thus achieving a higher degree of reputation. Europeans are less consistent and top-down oriented. The new model will make European Smart Cities more focused on the needs and expectations of all stakeholders. The main results of this article are the answers to the research questions and the general implementation model, the verification of which will take place in practice in the future.

Keywords: Smart Cities; sustainable development; smart governance; quality of life; cluster

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1. Introduction

The purpose of this article is to propose a general implementation model for the governance of European Smart Cities based on a comparison of Smart City standards, implementation and cluster models of cities in North America and Europe. The main task is to identify the key elements of these frameworks and models that could be used for the strategic governance of European cities. The answers to the set research questions will be determined using the methods of secondary analysis, comparison and summarization. Two research questions have been created for the purposes of this article:

What are the key elements of US and European Smart City standards, implementation and cluster models for the recommended strategic governance of European Smart Cities?

How is it appropriate to strategically manage European Smart Cities in general?

1.1. Defining the Terms Smart City and Cluster

In order to achieve the set goal of this article, it is necessary to explore the issue through further analysis of the concept of clusters in relation to the concept of Smart City according to the views of the identified international authors (Tables 1 and 2).

There are currently different definitions of "smart city", some of which are listed in Table 1 below.

Table 1. Defining the concept of Smart City.

Authors	Smart City
Giffinger et al. [1]	A prosperous city that achieves a high level in the management of limited resources, energy, mobility or health based on strategic decision-making processes, independence, innovation and citizen awareness can be called Smart City.
Caragliu, Del Bo, Nijkamp [2]	Investments in the so-called Smart City contribute to economic development, harmonizing ICT (information and communications technology) with the human aspect. A Smart City has a high level of quality of life.
Lombardi et al. [3]	A Smart City not only includes a holistic aspect of technology, but the key element is, in particular, the level of knowledge of citizens and their attitude to change. The term refers to the dependence between the management of the city and its inhabitants.
Mitchell, Villa, Stewart-Weeks, Lange [4]	Over time, many people think of a Smart City as something completely different. The component with the smart attribute consists of information, ICT, IoT (internet of things) and intelligent devices that communicate over the Internet. The human factor is often underestimated.
Manville et al. [5]	The definition of a Smart City provides an insight into the efficient and interactive implementation of urban processes, activities and services by individual actors.
Glasmeier, Christopherson [6]	A Smart City consists of two attributes—technology and the creation of added value for stakeholders. The city governance wants to ensure the quality of life, business opportunities, competitiveness and cost reduction in the defined geographical area.
Ministry of Economy Slovak Republic [7]	A new approach in the development of cities and regions used for management and planning. It represents the introduction of innovation and ICT and increases the quality of business, mobility, security and economy.
Government of United Kingdom [8]	A dynamic and endless concept in the form of a process that helps cities' resilience and efficiency.
European Commission [9]	The possibility to make effective use of traditional urban networks through digitization.
Business Dictionary [10]	A Smart City influences key aspects of the economy, transport, and energy and contributes to the environment by building a strong infrastructure.
Stratigea [11]	A Smart City is a territorial system of innovations based on the cooperation of communities, clusters and regions.

Differences in definitions represent the phase in which a particular city is located. Some authors or institutions prefer a technical view on the topic (Table 1, for example, the definition of the European Commission). Others extend their perceptions to the human factor and the aspect of social and managerial influences and culture.

The common elements of the views of world and domestic institutions (Table 1) include two general objectives: to increase the quality of life of citizens and to support the competitiveness of the selected city or region.

Caragliu, Del Bo and Nijkamp, together with Glasmeier and Christopherson and also the Ministry of Economy of the Slovak Republic, argue that the contribution of Smart Cities is especially in a higher quality of life. As we connect various aspects of Smart Cities used in the definitions of the term, such as the stakeholder dependence (Lombardi et al.), the cooperation of actors (Manville et al.), the creation of strong infrastructure (Business Dictionary) and the definition of Smart Cities as a dynamic and continuous concept (the UK Government), this overall evokes a connection between the term Smart City and the term Cluster (Table 1). A particularly significant connection of the two concepts is reflected in Glasmeier and Christpherson's definition of Smart City, which perceives a Smart City as a cooperation of stakeholders in a selected geographical area in order to improve the quality of life. Similarly, Stratigea understands Smart City as a cluster-based territorial system (Table 1). A closer connection between the terms is argued by the following definitions in Table 2.

Table 2. Defining the term Cluster in general and in connection with the concept of Smart City.

Authors	Smart City
Muller et al. [12]	A cluster generally represents a group of collaborating stakeholders in a given area or region based on synergistic effects.
Porter [13]	A cluster is a geographic concentration of interconnected industries.
Alaverdyan, Horák, Kučera [14]	Clusters provide smart solutions to problems, especially in the area of intelligent transport, infrastructure and city management, thus mediating cooperation between the private and public sectors.
Smart City Cluster [15]	The aim of a cluster is to increase the quality of life of citizens, improve long term sustainability, support effective governance, knowledge management and the value chain of current and future Smart Cities.
European Commission [16]	A cluster represents a combination of current and new methodological guidances for the creation of a unified set of critical indicators of performance, strengths and weaknesses of a Smart City. The existing standards of managing and generating new methodologies are used in various technological areas such as energy management, the integration of renewable resources or a reduction in negative impacts of businesses on the environment.
European Cluster Collaboration Platform [17]	Smart City Clusters are generally seen as alliances for the long term sustainable development of Smart Cities that achieve their goals on a cooperative basis. They are based on research and scientific activities such as Smart Living Labs.
Muro, Katz [18]	Clusters promote specialization and create opportunities and new jobs. They represent dynamic and interactive groups of associated participants.
Rivas [19]	The so-called city making clusters seek new activities that will suit the local conditions and the strengths of the selected city in connection with building the concept of Smart Cities and project management focused on six areas: mobility, health, government, citizens, environment and housing.

The paradox of clusters in the global era of the 21st century is that their competitive advantage is actually the local specifics such as knowledge, relationships or stakeholder motivation [13].

In general, based on the opinions of foreign and domestic authors, we can conclude that it is not possible to simplify the term Cluster or apply it too generally across the globe. However, it is important to define it with respect to the local understanding in order to remove the negative factor of ambiguity for the stakeholders of the selected city or region. The technological orientation of the definitions has transformed over time so that it prefers the human factor, i.e., citizens of the city.

In general, the cluster in the Smart City concept is a heterogeneous development factor that acts as a driving force for sustainability [1,20,21]. In this article, the authors perceive the term Cluster as a group of similar objects with certain characteristic archetypes that distinguish them from other cluster categories and groups of cities and also play an important role in the potential development and management of a particular Smart City in a given geographical area. Cluster archetypes have distinct principles of cluster management in selected cities in North America and Europe.

1.2. Differentiation of Smart City and Smart Sustainable City

The global challenges of the 21st century, such as migration, demographic changes, technological development, and environmental pollution, are causing higher consumption of limited resources, and this in turn undermines the sustainability of urban development. Traditional Smart Cities, as defined in Table 1, give priority to the structural elements of government, health, security, culture and education, and prefer economic aspects related to profit generation. Selected key indicators will influence the selection of archetypes in clusters [22–24].

The superior term to Smart City is Smart Sustainable City, which complies with all the basic elements of the concept of Smart City with the extension of indicators related to the management of limited resources (environment, waste and water management, eco-friendly energy, etc.) [22,23].

Smart City initiatives focused on long term sustainability adopt strategies and projects in cooperation with citizens. In a 2017 article, Rasha Elgazzar and Rania El-Gazzar analyzed more than 100 Smart Sustainable City definitions. The main findings are the following [24]:

- The use of information and communication technologies creates the Smart City, but not the Smart Sustainable City, i.e., the mere existence of technologies is not enough;
- Technologies can be used to create, support and develop sustainability, only then they generate a Smart Sustainable City.

A common feature is the effort to increase the quality of life, the reputation of the city and the satisfaction of citizens [22,23]. The hallmarks of a Smart Sustainable City are sustainable principles of community-based or cluster-based strategic government, adherence to standards, and the conservation of resources for future generations [24].

1.3. The Relationship between Smart City and Clusters

According to Muller et al., clusters represent an innovative ecosystem for the development of a Smart City. The cluster's collaborative environment with stakeholders brings forward new innovative solutions, feedback, transparent information and interoperability to Smart City governance [12].

Smart Cities are seen as boosters of clusters that affect the city, according to Kraus et al., as so-called magnets for new job opportunities and the development of human potential. Technologies are at the core of a Smart City's development and serve as the basis for building the social, economic and environmental benefits that a Smart City naturally uses to its advantage [12].

Clusters are used for [12,25,26]:

- The transformation of data into information and the support of the government and decision-making of a Smart City;
- Effective stakeholder participation;
- The use of intelligent applications to grow business opportunities;
- Increasing the attractiveness and reputation of cities.

The link between the Smart City concept and Clusters can be understood on the basis of the elements of planning, cooperation between citizens, the public and private sectors, and the support of education and sustainability.

Affiliated constraints result in the reluctance of stakeholders to participate in the development and government of a Smart City, in the lack of investments or in the feeling of insufficient protection of personal data [12].

Clusters help cities to promote and fund research projects and increase education and innovation, with the primary goal of developing sustainability through uniform standards, implementation and cluster models for the strategic management of a Smart City [12].

1.4. Standards and Implementation Models for Strategic Governance of Smart City

1.4.1. North America

Canada and the United States form the two largest parts of North America. When building and creating Smart City concepts, a separate standard was set for each area. In the USA, ANSI (American National Standard Institute) is used, in Canada, SCC (Standards Council of Canada) is preferred [27,28]. In a broader sense, the model from NIST (National Institute of Standards) can be used, which consists of four key categories.

The cross-sectional and core issues category includes information on the basic structure of the physical infrastructure, data, sensors, technologies, and the implementation framework from IES-City (Internet of Things Enabled Smart-City) to a comprehensive introduction to US Smart Cities and key performance indicators [29]. The second category consists of identifying problems and goals for specific Smart City areas and their solutions tailored to local aspects and requirements. The third category focuses primarily on implementation processes, creating cooperation with selected regions, a strong focus on the needs and expectations of the population, adopting a model of sustainability and building innovation capacity. The last category contains the results of secondary surveys in the form of case studies of developed Smart Cities in America, such as Washington DC, Virginia, and Bellevue, for data portals or platforms from Portland, Oregon. The last model and framework update took place in 2019 and is constantly evolving [29].

1.4.2. Europe

With the changing perception of important aspects of Smart Cities, people-oriented standards and needs are beginning to play a primary role. The standard for the intelligent governance of European cities is a model from BSI (British Standards Institution). According to the BSI, the central element of the general framework for the implementation of the principles of the Smart City concept for a selected European city or region is the determination of the future expected state, i.e., vision, which will be achieved by the gradual implementation of the evolutionary process [30]. The next step is to set long-term goals, from which short-term so-called partial goals are derived, which should be of the SMART type (i.e., specific, measurable, acceptable, realistic and time-bound). The way to achieve these goals is a strategy. The vision, goals and strategic intent generate the purpose of the Smart project in the selected area. Due to the negative impact of urbanization, it is important according to BSI to manage the city with the principle of portfolio [30].

The current implementation model for the integration of Smart City approaches of world cities contains several shortcomings, which relate in particular to low efficiency of the results, insufficient support for change, reputation, the absence of best practices and

innovation. An important element is a separate focus on groups of citizens, whose management will facilitate change and support their new identity and inclusion with the Smart City plan for the development of sustainability. The technological layer will ensure the proper functioning of IT (information technology) architecture and resources to fulfill project programs. Monitoring and measuring KPIs (key performance indicators) is an essential step for continuous improvement. Critical success factors include, for example [30]:

- Citizens' awareness,
- The commitment of stakeholders,
- The supply of smart solutions,
- Predictions of future needs,
- Effective leadership principles,
- Focus on human capital and its development,
- The creation of new knowledge,
- Cooperation with universities, science and research or the private sector,
- Understanding the principles of the Smart City of the selected city/region and the benefits resulting from it.

Managers must constantly evaluate, review and subsequently modify the model if it does not reflect current objectives and dynamically changing conditions [31]. Together with the feedback between the individual levels, it represents the optimal approach of the strategic management of the city/region. The European implementation model is interconnected, open, and focused on people, their preferences, values and expectations. In this way, cities can build not only an IT base but also sustainable long-term development [31].

2. Materials and Methods

The basic archetypes by Batten from consultant's institution Arcadis that determine the development and governance of Smart Cities are based on cluster groups, which are modeled through the following three pillars of a sustainable city [32]:

- Social aspects (people)—mobility and quality of life.
- Planet (environmental protection)—management of limited resources.
- Economic aspect (profit)—economic performance and GDP (gross domestic product).

The results of the selected city in the individual pillars form the assumption and input data for determining one of the 8 archetypes of city management [32,33]:

- Sensing—Smart City management via sensors that collect data in the field.
- Accessible—infrastructure connecting people on a daily basis.
- Automated—the use of elements of artificial intelligence and automation.
- Balanced—a healthy, successful city that pursues harmony between private and working life.
- Disrupted—an archetype of a city experiencing economic decline.
- Enterprise—the priority is the business sphere.
- Informal—citizens create their own structures and personalized services.
- Resilient—reducing threats to support resilience.

Research activities by Arcadis led to the definition of four following Smart City types [32].

"Balanced innovators" have a strong focus on people and profit, dominated by archetypes such as business support, automation using artificial intelligence and the integration of sensors into the smart infrastructure. These include cities such as Amsterdam, Zurich, Vienna, Paris, Prague, London, New York and San Francisco, etc. [32].

The "Post-industrial opportunists" cluster initiates support for the social aspect and environmental protection, with representatives mainly from American cities, Australia

and a few cities in the European Union. Access, automation, flexibility and sensor archetypes are important. These include Birmingham, Chicago, Los Angeles, Moscow, Warsaw, etc. [32].

The "evolutionary cities" in a given cluster have a low level of profit, predominantly the cities of Western Europe, such as Athens, and they focus on reinvestment, people and the primary sector, e.g., Sao Paulo, Lima, Rio de Janeiro, etc. [32].

"Fast-growing megacities" are characterized by low profits and large areas, such as China and India. The archetypes of flexibility, citizen-centered models and support for a competitive environment are significant, e.g., Dubai, Wuhan, Beijing [32].

After classifying the city into a specific pillar, archetype and cluster model, it is possible to analyze the essential elements of Smart City management in North America and Europe.

The selection of Smart Cities best practices was carried out on the basis of a secondary analysis by consultant´s institution Arcadis with the following selection criteria:

- Participation in one of the four cluster groupings from Arcadis, i.e., balanced innovators, post-industrial opportunists, evolutionary cities or fast-growing megacities;
- Geographical relevance, i.e., Smart Cities were selected only from the areas of North America and Europe for the needs of comparison and the achievement of the set goal of this article;
- Time relevance, i.e., data not older than the year 2017.

In 2018, experts from Arcadis created a study on clusters in 100 Smart Cities, which they divided according to three pillars of a sustainable city and four cluster groups [32,33]. In the ranking by Arcadis were 21 Smart Cities from the USA, 5 from Canada, 35 from Europe, 22 from Asia, 4 from Australia, 8 from South America and 5 from Africa.

The list of surveyed and compared cities includes the given specification in Table 3. The article compared 24 cities in North America (of which 5 were Canadian) and 21 European cities which had highest ranking according to publicly available data from the consulting firm Arcadis (Table 3) [32,33].

Table 3. List of compared Smart Cities used in this article.

Smart City	**North America (USA)**
	Atlanta, Baltimore, Boston, Dallas, Denver, Detroit, Houston, Chicago, Indianapolis, Jacksonville, Miami, New Orleans, New York, Philadelphia, Phoenix, Pittsburgh, San Francisco, Seattle, Washington
	North America (Canada)
	Calgary, Montreal, Ottawa, Toronto, Vancouver
	Europe
	Amsterdam, Antwerp, Athens, Berlin, Brussels, Budapest, Copenhagen, Frankfurt, Geneva, Hamburg, Lisbon, London, Moscow, Munich, Paris, Prague, Rome, Rotterdam, Stockholm, Vienna, Zurich

Source: [32,33].

In the analysis of the currently used Smart City cluster models in North America and Europe, in addition to the secondary analyses, the methods of comparing clusters, implementation models and standards were also used (comparing their common and different elements, advantages and limitations in Section 3), including findings and the synthesis of findings. Smart Cities in the USA and Canada use different standards for city governance (Section 1.4.).

In the discussion section, the authors explain their view of the topic based on the knowledge gained from studying the literature and based on the results of the research (Section 4).

3. Results

According to Arcadis cluster model surveys, Smart Cities in North America and Europe could be classified into three of four cluster classes (Table 4), whose common and different elements are shown in Table 4. Only Asian cities belong to the fast-growing megacities (Section 1.4.) [33]. The first two types of clusters serve as the best practices for the implementation of Smart City clusters, i.e., "Balanced innovators" and "Post-industrial opportunists" in Table 4 [33].

Table 4. List of Smart Cities of North America and Europe by Cluster Management Archetypes.

Smart City	Cluster Management Archetypes						
	Enterprise	**Automated**	**Sensing**	**Accessible**	**Resilient**	**Informal**	**Disrupted**
Balanced innovators North America (USA)							
Boston; New York; San Francisco; Boston	Yes	Yes	Yes	No	No	No	No
Balanced innovators Europe							
Amsterdam; Antwerp; Berlin; Brussels; Copenhagen; Frankfurt; Geneva; Hamburg; London; Munich; Paris; Prague; Rome; Stockholm; Vienna; Zurich	Yes	Yes	Yes	No	No	No	No
Post-industrial opportunists North America (USA)							
Atlanta; Baltimore; Dallas; Denver; Houston; Chicago; Indianapolis; Jacksonville; Miami; New Orleans; Philadelphia; Phoenix; Pittsburgh; Washington;	No	Yes	Yes	Yes	Yes	No	No
Post-industrial opportunists North America (Canada)							
Calgary; Montreal; Ottawa; Toronto; Vancouver	No	Yes	Yes	Yes	Yes	No	No
Post-industrial opportunists Europe							
Evolutionary cities North America (USA)							
Detroit	Yes	No	No	No	No	Yes	Yes
Evolutionary cities Europe							
Athens	Yes	No	No	No	No	Yes	Yes

Source: [32,33].

Balanced innovators and post-industrial opportunists are accelerators for the quality strategic management of the city, profit generation, the support for digitization and a competitive business environment. At the level of the stakeholder segment, the key role is played by the harmonization of work and private life with associated quality health care from the state. The limitation is inequality in income redistribution and the creation of social disparities [33].

The primary focus of the strategic governance of the city and the cluster is protection of the environment and limited resources (air quality, greenery and alternative energy sources) [33]. Digital innovation and participation in research projects form the basis of the economic income of cities, which have largely built their governance system on the archetypes of access, connectivity, informal information sharing and the competitiveness of SMEs (Small and Medium-sized Enterprises) [33].

Under the balanced innovators archetype, urban governance supports the business sector and technology sites such as Silicon Valley in San Francisco. Strategic and innovative jobs are covered by skilled, technologically oriented citizens. Data collection via sensors enables real-time data, monitoring, increased safety and control efficiency [32,33].

Post-industrial opportunists are characterized by sensing, the use of artificial intelligence and new technologies, but also the easy availability of smart services that increase citizen satisfaction and simplify the creation and participation of local communities in Smart City concepts. Negative local conditions in terms of the environment and the declining economy create pressure to invest in sustainable development, which is lower than in the case of balanced innovators. Common elements of post-industrial opportunists with balanced innovators are elements of the technological base, i.e., sensing and automation [32,33].

There are only two evolutionary cities in the US and Europe geographies. Detroit and Athens are intelligently managed through cluster elements of business support, local communities (informal) and being disrupted, i.e., cities need to tackle high crime rates, unemployment and depopulation. No common cluster elements were identified with the other archetypes (Tables 4 and 5) [32,33].

There are common elements in the cluster models used in the practice of Smart Cities in North America and Europe. Differences can be captured through a comparative analysis of the implementation standards and models used in Tables 6–8 and Section 1.3.

Research on the transformation of Smart Cities in Western Europe (Germany, Denmark, Norway, Finland, Italy, Spain, France, Sweden and the United Kingdom) carried out in 2016 has yielded a general reference model for the implementation of Smart Cities/regions [34]. The cornerstones of building the model are technologies and pilot ad hoc projects, which require the creation of an implementation plan. Actors work together to create and mediate opportunities. The effect comes through processes in the form of outputs with a repetitive effect. With its strategy, management works to change the behavior of citizens, which will result in a comprehensive integration of continuous improvement and optimization [34]. A survey of the practice of Smart Cities in Western European cities showed that strategic urban management prioritizes the creation of pilot projects (44%), then focuses on strategy, repeatability and only in 9% focuses on opportunities and optimization. Citizens and other stakeholders' models, together with an integrated governance approach, can eliminate this shortcoming [34].

American Smart Cities are built on implementation models from IES-City (Internet of Things Enabled Smart-City) and follow general standards from NIST, i.e., National Institute of Standards (Section 1.4.1.). European cities use BSI, i.e., (British Standards Institution, Section 1.4.2.). A comparison of common and different elements of the US and European implementation models can be found in Table 5.

Table 5. Common and different elements of American and European implementation models.

Elements	North America	Europe
Technological core	Yes	Yes
Best practices cases	Yes	No
Key performance indicators ratings	Yes	Yes
Local requirements	Yes	No
Goals	Yes	Yes

Problems	Yes	No
Implementation processes	Yes	No
Sustainability Model	Yes	No
Cooperation with stakeholders	Yes	Yes
People orientation	Yes	Yes
Vision	Yes	Yes
Education	Yes	Yes
Bottom-up	Yes	No

Source: [29–31].

European models (Table 5), on the other hand, do not contain American elements such as best practices, the possibility of adaptation to local requirements, problem determination, the description of implementation processes, and the creation of sustainability models and, in addition, are not bottom-up oriented.

When comparing the implementation standards of a Smart City in North America (National Institute of Standards) and Europe (British Standards Institution), certain fundamental differences, advantages and limitations in the understanding of the given structures were revealed (Tables 6 and 7).

Table 6. Advantages of implementation standards in North America and Europe.

Benefits	North America NIST	Europe BSI
Small range	Yes	No
Complexity	Yes	No
Simplicity	Yes	No
Specification	Yes	No
Focus on education and regional cooperation	Yes	No
Sustainability support	Yes	No
Constant modification of the model	Yes	No
Possibility to add any part to the model	Yes	No
Include legislative requirements	Yes	No
Bottom-up orientation	Yes	No
Openness	No	Yes
Feedback	No	Yes

Source: [27–31].

American standards lack the openness and feedback achieved by European standards by BSI, but BSI does not have the other elements (Table 7).

Table 7. Restrictions of implementation standards in North America and Europe.

Restrictions	North America NIST	Europe BSI
Unavailability of materials	Yes	No
Data confidentiality	Yes	No
Regional boundary	Yes	No
Top-down orientation	No	Yes
Inconsistency	No	Yes
Absence of best practices	No	Yes

Source: [27–31].

The main limitations of the National Institute of Standards (NIST) in North America include low availability of materials on the Internet, high data confidentiality and only local focus. The British Standards Institution (BSI), on the other hand, is not uniform, there is no best practice and a top-down orientation is preferred (Table 8).

Table 8. Summary of the key elements of implementation standards and models.

	North America	Europe
Elements	Bottom-up orientation	Openness
	Education	Feedback
	Best practices	Technological core
	Technological core	Evaluation of key performance indicators
	Simplicity	Education
	Complexity	Cooperation with stakeholders
	Local requirements	Achieving goals
	Cooperation with stakeholders	Reporting
	Achieving goals	
	Modification, reporting	

Source: [27–31].

4. Discussion

The results of the secondary analysis of the literature and results from Section 3 provided data for answers to the two stated research questions, to which the authors took personal positions in the discussion.

4.1. What Are the Key Elements of North American and European Smart City Standards, Implementation and Cluster Models for the Recommended Strategic Management of European Smart Cities?

The authors are of the opinion that a critical factor in the success of American standards and models is primarily the orientation to the needs and interests of the population in the form of the so-called bottom-up principle. Simplicity, complexity and specificity contribute to the effective use of local specifics of the selected area. The theoretical framework is supported by education, and the practical phase is implemented through best practice. In a dynamically changing environment, it is therefore appropriate to incorporate into European models elements of flexibility and the continuous modification of models and relevant standards. In the 21st century, it is essential to build Smart City concepts in a way to reflect global trends and challenges, promote sustainability and become a Smart Sustainable City, i.e., acted globally, but thought locally. In the given issue, it is essential not only to collect data from the field, but also to transform them into the form of information and knowledge and to share them at all levels of management, i.e., operational, tactical and strategic.

The basis should be a technological core with a properly functioning infrastructure and Wi-Fi connection. The best practice of cluster models of balanced innovators from America and Europe highlights the need for education that simplifies the acceptance of change, and managing diversity with the primary goal of improving the quality of life. The Smart City concept can generally be deployed for six areas (mobility, housing, health, people, government and the environment). Monitoring legislation and applying best practices such as cities in North America will help manage cities in a smart way based on sustainability and cluster collaboration. It is then appropriate to measure the resulting effect in practice by monitoring critical success factors, the results of which are compared with the plan in the reporting. A summary of the key elements that the authors consider appropriate to implement in the general governance model of European Smart Cities can be found in Table 8.

4.2. How Is it Appropriate to Strategically Manage European Smart Cities in General?

Currently, the Smart City theme represents a trend that is evolving on different continents. Their differences are conditioned by cultural aspects and local specifications. Each city is unique and requires an individual approach to strategic management. It is necessary to manage these agglomerations through centrist models oriented to people, taking technology as a cornerstone of building smart infrastructure.

According to the world experts in Section 1.2., it is even more desirable than the status of being a Smart City to reach the level of Smart Sustainable City, which brings long-term benefits. According to the American standards and implementation models (Section 1.4.1.), the key element is education and the continuous modification of models in a dynamically changing world. According to the European standards and implementation models, the essential element is feedback (Section 1.4.2. and Table 8).

Cultural differentiations and attitudes towards private sector support and the search for opportunities have also been reflected in concepts and Smart City standards. Individualism, proactivity, innovation and specification are elements of the success of American cities, which provide an insight into European cities on how to build a Smart City more efficiently (Tables 6–8).

The article recommends a general implementation model for the field of the smart management of European Smart Cities (Figure 1) based on the principle of selecting key elements from the comparison of standards, implementation and cluster models in Section 3 (summarized in Table 8). The model (Figure 1) is perceived as bottom-up, together with feedback, a technology core, stakeholders and top-level strategic management, taking into account applicable legislation and principles (absent from current European models and frameworks). At the primary level, there are key needs that matter to the people of Europe. According to the authors, most people prefer affordable prices for goods and services, a high quality of life and education, and culture promoting the multiculturalism of Europe's Smart Cities, and this has a big impact on needs.

According to the authors, these needs modify Maslow's hierarchy of needs. The same values are recognized and prioritized by the inhabitants of balanced innovators, which form the cluster pattern that is closest to cities in Europe in terms of the nature of archetypes. Within the technological core, there is a Wi-Fi network, applications and sensors. The third part of the model in Figure 1 is the planning and organizational level, i.e., principles, frameworks, recommended standards and models to be implemented by Rivas for the six areas of Smart Cities, such as mobility, environment, housing, health, people and government [19]. This part is influenced by external factors such as current legislation and world best practices (for example, balanced innovators in Section 3, Table 4). The next level of the model is the implementation part, which includes the implementation model adjusted to the local conditions of the country and the selected city. Management is provided by managerial functions such as planning, organizing and governance (level 5). Governance has an impact on monitoring. The cycle is represented by feedback (shown by the dashed line in Figure 1) from monitoring to planning. With this step, the whole process of governance can be improved.

The last part of the general implementation model for the Smart Cities Area in Europe is the processes of monitoring, KPI (key performance indicator) measurement and reporting, which is also recommended by the European Commission [16]. Based on the data obtained, it is possible to continuously improve all activities, processes, the comprehensive model and the satisfaction of all stakeholders (feedback is shown by the dashed line in Figure 1). The benefits of the created model are its simplicity, bottom-up orientation, centrist orientation to people, their needs and expectations, the application of a technological, social, project and managerial core, or a form of continuous improvement based on the obtained data and a higher reputation of the city. A limitation is the need to specify a model for local conditions in selected European countries and cities, taking into account cultural, technological, social and behavioral differences.

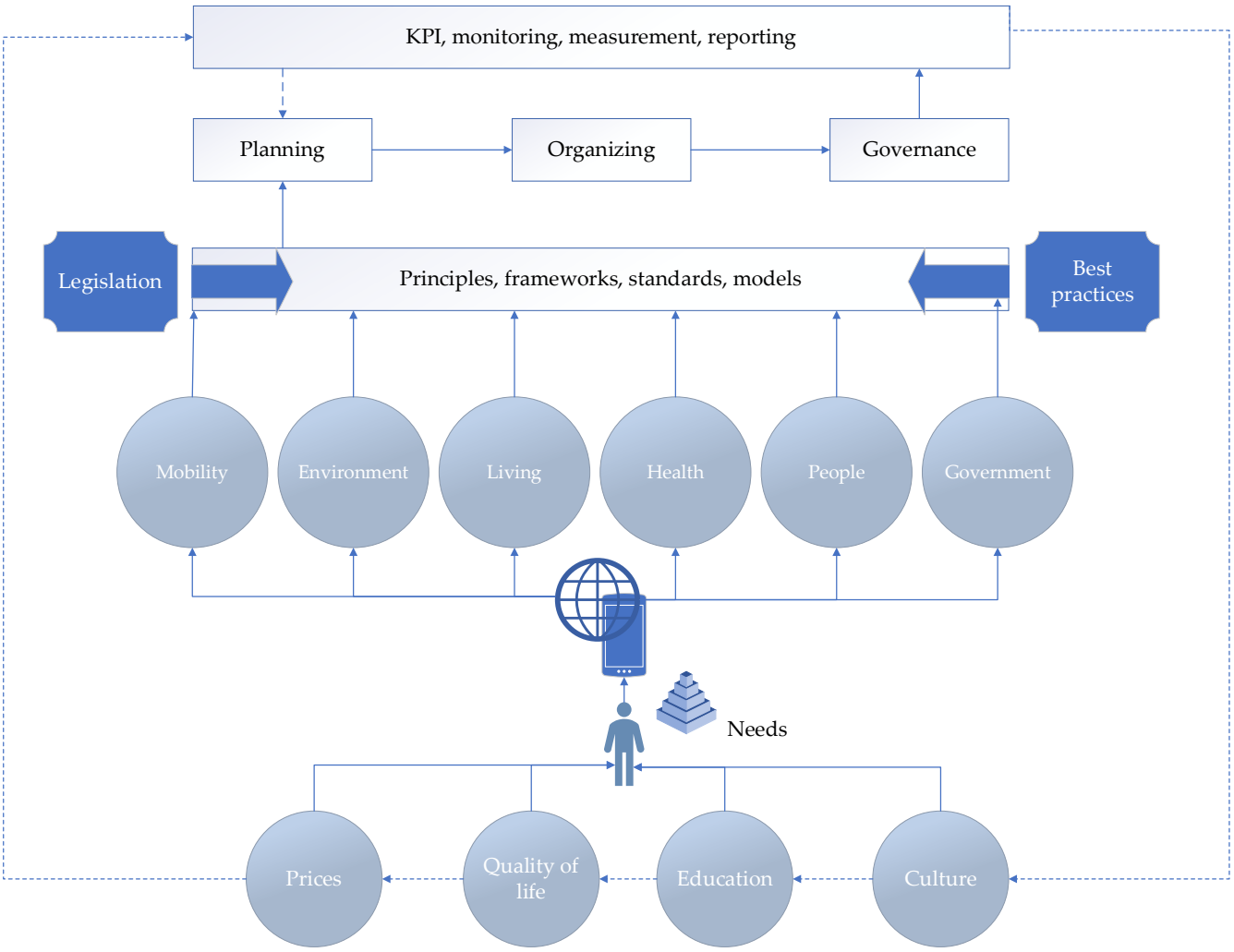

Figure 1. General implementation model for the field of intelligent governance of European Smart Cities (own processing by authors according to the results of literature review and Section 3).

5. Conclusions

All world cities have specific differences, which significantly affect the form of implementation models, cluster groups or accepted standards for the Smart City area. The purpose of this article was fulfilled by creating a general implementation model for the governance of European Smart Cities based on a comparison of Smart City standards, implementation and cluster models of cities in North America and Europe. Currently, there is a different approach not only in understanding the concept of a Smart City, but also in the elements and models of its governance. The choice of the correct model determines the classification into the cluster type, on which the selection of the correct archetypes of a particular Smart City depends. This article presents the following main findings:

- European models are more graphically sophisticated but not very complex, aspects of feedback are missing at all levels, and frameworks and standards are not uniform, which creates the conditions for misinformation.
- North American city models meet the criteria for effective governance, achieving a positive reputation not only locally but also globally, but are not very open as an example of best practice for other world cities due to low data availability and specific features considered only for local conditions in America.
- Based on the findings from the article, the authors recommend the following for the effective management of Smart Cities in Europe:
    - Establish a technological core,

- Involve stakeholders,
- Connect all management levels (strategic, tactical and operational) with feedback,
- Examine current legislation in the field of standards for Smart Cities,
- Continuously modify the model,
- Favor a bottom-up approach.

This article points to the need to perceive each city individually, and to realize the interdependence between variables such as systems, elements, archetypes, models and standards that affect social, behavioral, and cultural aspects and the acceptance of change. The general recommended model of Smart City implementation for the European area is a guide for strategic city management, how to effectively establish, manage and continuously improve it to achieve the set goals and benefits of implementation (sustainability and quality of life), together with its adjustment according to applicable legislation and specific conditions, city or region. The implementation and verification of the model in practice is a prerequisite for research activities in the future.

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