The implications of smart public governance for sustainable development in the EU

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Smart public governance (SPG) has considerable potential for modernizing public administration, improving public service delivery, dealing with increasingly more complex development imperatives, and promoting well-being. Together with an appropriate smart environment, SPG may contribute to achieving the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) set by the United Nations. Based on the comprehensive conceptual framework, the paper aims to present the performance of the EU countries in SPG, SDGs and smart environment, examine the efficiency of the EU countries in exploiting SPG practices to achieve SDGs and determine the relationship between these concepts. The data for the EU countries were obtained from several EU, OECD and other secondary data sources for the period before the crisis, i.e. 2020. The data were analysed with several different methodological approaches, namely measurement of composite indexes, comparative analysis of composite indexes and correlation analysis. The empirical results reveal the following. As regards the performance of the EU countries in SPG, SDGs and smart environment dimension, the results reveal that the overall performance of main dimensions varies greatly across EU countries. According to the SPG dimension results, Denmark and the United Kingdom are the top-performing countries, while Greece and Romania are the lowest-performing countries. Moreover, Sweden, Denmark, and the United Kingdom are the top-performing countries in the smart environment dimension, while Romania, Greece, and Bulgaria have the lowest performance. Finally, in the SDGs dimension, Austria and Denmark are the top-performing countries, while Croatia performs poorly. A further in-depth comparison of best and worst-performing EU countries reveals that Luxembourg, Ireland, and the United Kingdom, are facing efficiency shortages, while Portugal, Romania, Slovakia, Malta and Croatia were identified as countries with relatively low levels of SPG and sustainable development. As concerned the implications of SPG and smart environment for SDGs, the results of correlation analysis indicate that SPG is strongly associated with SDGs, especially with social and environmental dimensions, with a smart environment also having an important role. The findings will be beneficial for policymakers by providing evidence-based guidelines for developing national policies that should support smart public governance and its beneficial implications for sustainable development.

Keywords: smart public governance, sustainable development goals, smart environment, conceptual framework, EU countries

Introduction

The scientific literature has been debating digitalisation for the past 20 years. Many social scientists believe digitalisation is the main force behind human socio-cultural development. It affects societal change by boosting connectivity, transforming analogue processes and information into digital, and enhancing interactions and communication among individuals, groups, and objects (Pereira, 2021; Scholz et al., 2018; Linkov et al., 2018; Loebbecke & Picot, 2015). Digitalisation also came up in discussions in the public sector simultaneously. To define digitalisation activities, terms like e-government, e-services, and e-democracy have been used in the public sector for a while now (Velsberg et al., 2020; Meijer & Bolívar, 2016; Nam & Pardo, 2011; Yildiz, 2007; Van de Donk & Snellen, 1998).

However, it is still difficult to locate studies on the smart state in the literature on digital governance (Gil-Garcia et al., 2016; Scholl & Scholl, 2014; Jimenez et al., 2014; Gil-Garcia, 2012). An examination of the scientific literature reveals that smart public governance (later SPG), a recently proposed term in the social sciences, is piquing the curiosity of scientists. Some academics use SPG to emphasise the value of information and communication technology (also abbreviated as ICT) and e-government in the public sector. Other researchers have conceptualised and constructed the concept of a smart city using the phrase SPG, which they claim is one of the most crucial components of a smart city. But some academics view SPG as a synonym for good governance or assess it in light of good governance,

highlighting the significance of incorporating good governance concepts within the public governance process. As a result, even if the concept of SPG has not yet been precisely described in the scientific literature, there are numerous methods to interpret and further grasp it. The confusion is whether SPG can be recognised as a distinct idea of public administration with a particular level of smartness in the public governance process or whether it is still used in a disconnected manner (Bernardo, 2017; Buškevičiūtė, 2014). The following question is what SPG should look like within the framework of a smart state (on a national level).

It is vital to note that the concept of SPG also encompasses another relatively established but understudied social science concept recently appearing in the literature due to digitalisation. Of course, we're talking about smartness. The technical sciences are where this concept primarily originates from. Even while scientific definitions of smartness have recently gained more and more weight, various academics still have differing views on what it means. Numerous sources with multiple interpretations of the term frequently arise. There is no accepted definition of smartness among researchers, which is one of the causes of this variance. The language used by academics is the second factor. For instance, in the Anglo-Saxon region, the term "smart" is used to define the traits of an object's smartness in terms of technology and society. In many other languages, however, there are numerous ways to describe smartness. What does smartness stand for. The answer to that question is crucial in understanding what smartness is about. In any social system, such as a state or a city, people are the main stakeholders (Jucevicius & Juceviciene, 2018; Buškevičiūtė, 2014; Juceviciene & Jucevicius, 2014; Rosen, 2003). Because smartness involves a good understanding of communities and constituencies (i.e., being receptive) and accurate assessment of a particular situation or people (i.e., being smart), people have a keen ability to judge (i.e., be prudent) and make decisions and to respond quickly or effectively to change (i.e., being fast), which is considered in the literature of the present time as a desirable aspect of governments, cities, communities, infrastructure, and organisations (Gil-Garcia et al., 2016). Technology and data are heavily emphasised in specific definitions, but sustainability, openness, creativity, and resilience are also highlighted. The concept of smartness, therefore, includes hopes for the public sector to become more robust and adaptable through emerging technologies and optimistic assumptions like interconnection, efficiency, sustainability, effectiveness, transparency, and collaboration. Being smart is not a goal in and of itself but rather a means to other desirable social, economic, or environmental outcomes (Gil-Garcia et al., 2014; Nam & Pardo, 2014).

Since the beginning of the twenty-first century, governments and cities, in particular, have been actively creating strategies to become "smart" through the widespread use of ICT as a strategy to address a variety of environmental concerns. No field has ever had as much of an impact on developing countries and societies as ICT today. It is vital to remark at this point. To create a community where knowledge is shared, the latter is expected to significantly accelerate human progress and enable the closing of digital divides. At this time, it is crucial to discuss the Sustainable Development Agenda by 2030, which the United Nations formally endorsed as a strategy for the prosperity and well-being of people and the planet. It is believed that implementing the goals of the agenda, which cannot be accomplished without the collaboration of countries and stakeholders, will best help to resolve the problems about the sustained well-being of people, the economy, and environmental protection, as well as seeking ways to increase freedom and strengthen global peace (Wu et al., 2018; Tjao & Tjao, 2016). Globally, governments will work toward a set of 17 global Sustainable Development Goals (from now on: SDGs) by 2030 as part of the United Nations Agenda for Sustainable Development. They are based on the Millennium Development Goals (also abbreviated as MSGs), which emphasise reducing poverty and promoting global sustainability regarding health, education, and the environment. In other words, the SDGs aim to complete those components of the MDGs that were not realised. The first ten SDGs, which include reducing or eliminating greenhouse gas emissions and improving access to water and sanitation, must be accomplished by 2030. The final seven SDGs, which include protecting the oceans and increasing gender equality, will be fulfilled using more restrained strategies. It is imperative to remember that each of the 17 SDGs will contribute to creating a more sustainable planet and higher quality of life for people (United Nations, 2015). SDG stands for social inclusion, environmental sustainability, and economic development as part of a global plan. Global collaboration and aid from

governmental and non-governmental entities are required to accomplish the proposed SDGs (Allen et al., 2017).

The paper aims to present the performance of the EU countries in SPG, SDGs and smart environment, determine the relationship between these concepts and examine the efficiency of the EU countries in exploiting SPG practices to achieve SDGs. Empirical insights can thus strengthen our theoretical conceptualisation and adapt it to the point where they can be used to build a conceptual framework (Bolivar & Meijer, 2015). The paper argues that the connection between SPG, SDGs, and the context of a smart environment is very important and addresses the following research questions: (RQ1) *What is the performance of the EU countries in SPG, SDGs and smart environment dimension?*; (RQ2) *How efficient are the EU countries in exploiting SPG practices to achieve SDGs in given smart environment conditions?*; and RQ(3) *What are the implications of SPG and smart environment for SDGs?* The answers to these questions will lay the groundwork for a fresh understanding of the distinctive advantages and difficulties that governments experience in achieving the SDGs.

The topic discussed in the paper is a typical scientific novelty with a little investigation because the concept of SPG has not yet been thoroughly investigated in the scientific literature by academics. It is imperative to begin by outlining the conference paper's key concept, SPG. For this paper, we propose to define SPG as a *modern approach to public governance that uses sophisticated information technologies to transform processes (interventions) between public administration and citizens with the aim of increasing collaboration, interaction, co-production, improving decision-making and to achieve results that meet the needs of citizens (that is generating public value)* (Criado & Gil- Garcia, 2019; Webster & Leleux, 2018; Pereira et al., 2018; Gil-Garcia, 2012). The definition we suggest offers a comprehensive viewpoint that considers the significance of ICTs and citizen-state collaboration and the outcomes of producing public value. This conference paper has five sections in total, including the introduction. In the second section, there is a more thorough discussion of the literature review. The methodological explanation and the innovative conceptual framework are presented in the third section. Section four presents the main results. Finally, the fifth section provides a short discussion and concluding remarks.

Literature Review

In the social scientific literature, the concept of SPG as a novel and promising path motivates and guides the development of innovative activities, such as establishing a conceptual framework that enables conceptual understanding and future research. It increases awareness of the necessity for new governance models, policy initiatives, and regulatory frameworks (Estavez et al., 2021). To describe the characteristics of SPG in a smart and open government setting, Scholl and Scholl (2014) released the first well-known study in the social science field. The study examined both Johnston and Hansen's findings on the SPG element and Wilke's concept of SPG, emphasising the strength of government takeover operations. They empirically identify eight crucial areas of public administration in their study, which results in a plan for prudent SPG research and practice. The authors distinguished between type A and type B problematic outcomes, asking peers and social science practitioners to identify and look into complex outcomes for a better understanding and command of the subject. The authors contend that the evolution of SPG was the key to enabling smart infrastructure, public-sphere interactions, public administration, and societal security and safety, all of which would lead to a more smart and transparent state of government than the traditional democratic government (Estavez et al., 2021).

A review and an empirical study published in 2016 (Bolivar & Meijer, 2015) were the first of their kind to address the conceptual gap in SPG. The authors developed a study model of SPG at the local government level based on a thorough literature review. The latter suggests three primary building elements that could be applied to many other future study types: strategies for establishing, arrangements, and outcomes. Another study that year (that is Lin et al., 2015) considered the concept of SPG at the local level. While the study adds little, if any, novelty to the topic of pioneering activities, such as the development of a conceptual framework, the authors claim that SPG is inextricably linked to the issue of social sustainability. The author views the enormous and quick influx of peasants into

cities as a severe urban sustainability and planning problem, necessitating participatory and inclusive SPG aided by current information technologies (Estavez et al., 2015).

In 2017, a study by Lithuanian academics (i.e., Šiugždinienė et al., 2017) looked into the characteristics and criteria of SPG. Further, it recommended a tool for its evaluation at the national government level. The authors' contribution to realising the potential of the suggested framework depends on participatory methods and collaboration amongst various parties. They contend that in this way, SPG can encompass a variety of elements, including participation in decision-making and utilising internal and external resources. These processes of democratisation and empowerment allow citizens to express their opinions on policies, participate in boards and public hearings, and influence collaborative dynamics and actions. In the study, the latter thus proposed four critical components of a framework that would enable this. Its fundamental components are strategic dynamics, cross-sectoral collaboration, inter-institutional collaboration, and citizen empowerment. In his most recent evaluation of the conceptual framework of SPG, Lin (2018) adds context and ICT as two more components to Bolivar and Meijer's study model of SPG. According to the author, facilitating collaboration and participation in the technological background is one of the crucial factors affecting the success of using digital tools in developing such a model.

There has been a lot of discussion concerning sustainability concerning the SDGs among scholars, so it makes sense to inquire about what sustainability entails. The term sustainability has taken on a variety of interpretations during the past 20 years, and as a result, practitioners and academics have come to understand it in various ways. The term sustainability is now thought of as having a variety of meanings and not having an accurate definition. Most often, we can see that the term in the literature refers to the three interconnected pillars – economic, environmental, and social (Rajnbari et al., 2019; Purvis et al., 2018). Therefore, it makes sense to discuss each of them briefly (Diaz-Sarachaga et al., 2018; Swain, 2018; Moldan et al., 2012):

- **Economic pillar** – since economic development has been the most important political objective for world leaders for the past 50 years, previous global economic crises have demonstrated that maintaining it is a fundamental and broadly supported goal of the general people. That is why it is even more crucial to modify how economic growth is approached to expand the economy to promote sustainable development. The environment and natural resources are the ultimate foundation on which all future economic operations must be based. As a result, it is anticipated that the sustainability of resources and the environment will become increasingly important for economic growth in the future. According to several authors, sustainable development might be understood economically to mean growing "consumption" over an extended period.
- **Environmental pillar** – the Environmental Strategy for the First Decade of the 21st Century of the OECD made a significant contribution to environmental sustainability, and the Millennium Ecosystem Assessment Project helped to develop the idea further. The management of land, fresh water, oceans, forests, air, natural resources, and animals are only a few examples of environmental facts and challenges. Laws and regulations address them and other measures to enhance human welfare by safeguarding the raw material resources utilised to meet human needs.
- **Social pillar** – includes initiatives, laws, plans, and policies that promote social issues. Compared to the environmental and economic pillars of sustainability, this one is the least well-defined and understood. Still, it is also the most crucial to the long-term survival of human civilisations. Social cohesiveness and the capacity for cooperation are essential for social sustainability. Considering this, providing for each person's specific requirements, including those related to their health and well-being, nutrition, housing, education, and cultural expression, is important.

Increasingly, in recent contributions to SDGs, it is possible to perceive a greater emphasis, which tends to change the primary approach to the goals. Indeed, the latest strategy separates the economic, environmental, and social pillars and aims for the economy to serve society by growing in a safe working environment for the planet (EAT, 2016).

During the research, we created a conceptual framework (see Figure 1) that illustrates the connection between SPG and SDG while considering the smart environment's particulars. Several study contributions from the social science literature addressed a related issue and helped us build our conceptual framework. Thus, the focus of this chapter has been on previous attempts to develop a conceptual framework for the relevant dimensions. The conceptual framework we created based on our theoretical research and verified with empirical data from the EU countries is presented in the next chapter.

Methodology and Conceptual Framework

The comprehensive conceptual framework is developed by considering the main theoretically founded dimensions, namely SPG, SDGs, and smart environment (see Figure 1). The corresponding elements for each dimension are determined based on further theoretical considerations. Finally, for each element, we identified measurable indicators obtained from the Eurostat, OECD and other data sources. Critical criteria for data selection include 1) coverage of all EU-28 member states, including the United Kingdom, as at the time before 2020, it was still a member state; 2) the latest available data for the period before the outbreak of the Covid-19 pandemic in 2020, and 3) reliability and validation of data sources. Detailed information about measurable indicators, including their conceptual structure, is available in the Appendix (see Figure 1).

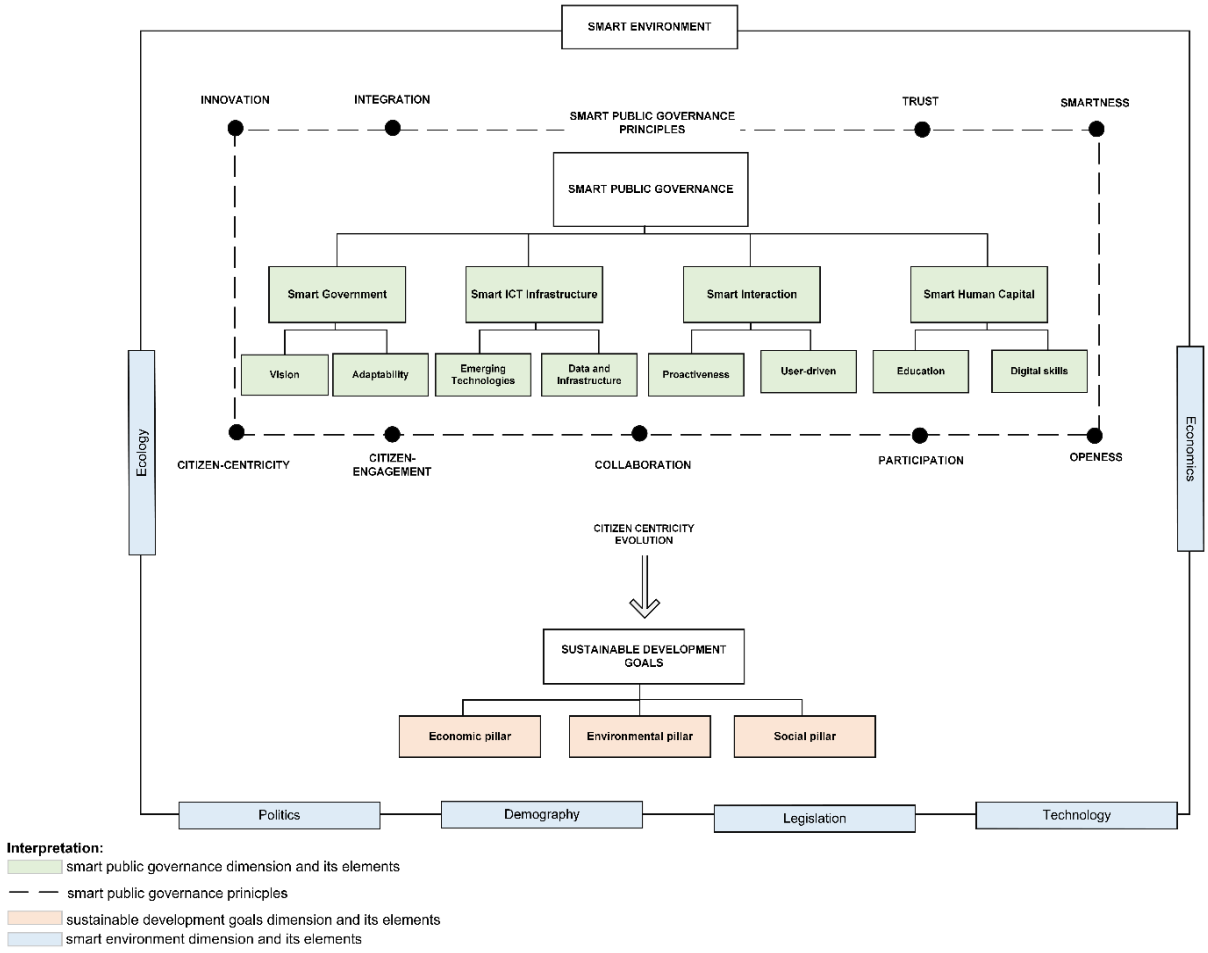
The data were processed by considering the following three steps. *First*, we removed quantitative indicators with a high proportion of missing values (more than 60%). Based on this, two quantitative indicators have been removed from the conceptual framework (namely open government data and adult literacy rate). *Second*, we replaced the missing values using the expectation-maximisation (EM) algorithm. *Third*, we followed the structure (Figure 1 in the Appendix) to calculate the new variables. We started with the original variables at level 5 and normalised them with the relative rank method (the normalised value of the country corresponded to its relative rank (ranging from 0 to 1)). The composite variables at level 4 were constructed as arithmetic means of the corresponding normalised variables (see the tree structure in Figure 1 in the Appendix) from level 5. The same procedure was used to construct variables at levels 3 and 2 (without normalising the relative rank). The final variable at level 1 was constructed as a geometric mean of variables at level 2 (OECD or other international organisations also use a similar approach). Since the geometric mean is always less (or equal) than the arithmetic mean, lower values of individual indicators have a stronger impact on the final result.

Smart Public Governance: The importance of the context of SPG is becoming increasingly apparent in publications addressing smart cities. This is not the case in publications on smart states. Regardless of whether the concept of SPG is applied to the state or the city, systematic examination of its role is scarce (Meijer et al., 2016). After reviewing the relevant literature, we note that some scholars (Lin, 2018; Šiugždiniene et al., 2017; Bolivar & Meijer, 2015; Scholl & Scholl, 2014) have already tried to classify the concept into (sub)elements when developing pioneering conceptual frameworks. Nevertheless, there is no consensus among the scholars in the scientific literature regarding which characteristics define SPG and how significantly they influence it. A review of the literature on SPG has led us to the conclusion that if we want to achieve SPG, we must consider four elements, namely ***(1) smart government, (2) smart ICT infrastructure, (3) smart interaction, and (4) smart human capital.*** All mentioned elements are equally important in our conceptual framework, and their synergy leads to the successful establishment of SPG.

Smart Public Governance Principles: After analysing the scientific literature, we discovered that scientists have yet to identify the principles of SPG. Nevertheless, Gil-Garcia et al. (2016) came the closest to identifying such principles in their research. They proposed a framework for understanding and measuring government smartness and proposals for smart government development. On the other hand, ideas of good public governance are better documented in the present literature. International organisations worldwide were actively applying the concept of good public governance by the end of the twentieth century, both in specific policy areas such as global environmental legislation and in a

broader policy context. The need for good public governance is thus much larger today than twenty years ago. Its implementation can be seen at national, regional, and global levels, where good governance principles have been further developed. In light of the diverse roles of national authorities, the implementation of good public governance in the EU Member States has also been addressed through interpretation and application (Addink, 2019a; 2019b). By analysing the literature on the principles of good public governance and by attempting to understand smartness, we were, for our conceptual framework, able to emphasise the principles that, in our opinion, impact the development of smart public governance at the national level. We suggest nine principles of SPG based on what has been stated, namely ***(1) innovation, (2) integration, (3) trust, (4) smartness, (5) openness, (6) collaboration, (7) participation, (8) citizen engagement, and (9) citizen centricity.***

Figure 1: A conceptual framework with the SPG, the Smart Environment, and the SDGs as its three core components.



Source: Authors' elaboration.

***Smart Environment*:** We live in an age of rapidly evolving smart technologies that are changing our environment and making it more interactive and informative (Gubbi et al., 2013). The development of smart technologies has been primarily strongly influenced by digitalisation. The convergence of these technologies and improved availability has further sparked interest in creating smart environments (Rashidi & Holder, 2011). The identification of general (sub)elements that lead in the direction of the development of a smart environment has thus become a relatively evolving topic in the existing literature. The consideration of a smart environment is most frequently seen in the literature on smart cities (Zhuang et al., 2017; Caragliu et al., 2009; Giffinger et al., 2007). As a result, smart environments are frequently mentioned in these contributions as a potential for users to collaborate and interact with their immediate surroundings seamlessly. Technological advancements and the advent of smart

technologies, as well as services, have made this possible. In our conceptual framework, the development of a smart environment at the national level consists of five elements, namely ***(1) economics, (2) technology, (3) legislation, (4) demography, (5) politics, and (6) ecology***. These are categories that Rainey (2014) already recognised as important in his work. Taking the elements into account, the state can create a smart environment that impacts not only SPG but also creates a citizen-centric orientation.

Sustainable Development Goals: After analysing the scientific literature, we discovered that the authors point out that a Venn diagram is the most common way SDGs are presented in the literature. It is a design with comprehensive sustainability at its centre, symbolised by three intersecting circles (economic, environmental, and social). Such a design has drawn considerable criticism because, according to sustainability academics, it sadly possesses no logical qualities. Considering this, the literature started to express the goals for sustainable development somewhat differently, specifically as a three-pillar design. While the authors caution that even in this case, the meaning frequently remains ambiguous, making it difficult to operationalise it coherently, it is true that the latter, because it is more straightforward, has recently taken the lead in interpreting the goal of sustainable development (Purvis et al., 2018). The most recent graphic of the SDGs splits the ***(1) economic, (2) environmental, and (3) social pillars*** and aims to make the economy serve society by increasing a safe working environment for the planet (EAT, 2016) – see Figure 2 in Appendix. At this point, it is crucial to note that the economic, environmental, and social pillars are interconnected components in the first and second delineations. In contrast, the writers consider the components as separate pieces in the most current delineation.

For the next 15 years, the UN has set seventeen SDGs, each of which must be accomplished by both developing and developed countries (Spaiser et al., 2016). In this paper, we concentrated on the EU countries for our analysis. Under each SDG, we chose indicators that we believe are crucial for establishing the relationship between the SPG and the SDGs while considering the particulars of the smart environment. A more thorough description of the observed indicators is shown in Figure 3 in Appendix. To empirically examine the role of SPG in achieving SDGs, three methodological approaches were applied. First, to determine the performance of the EU countries in SPG, SDGs and smart environment dimension, the composite indexes across all dimensions were examined and compared between the countries. Second, to investigate how efficient are the EU countries in exploiting SPG practices to achieve SDGs in given smart environment conditions a comparative analysis of composite indexes was performed. Finally, to examine the implications of SPG and smart environment for SDGs, the composite indexes were investigated by correlation analysis.

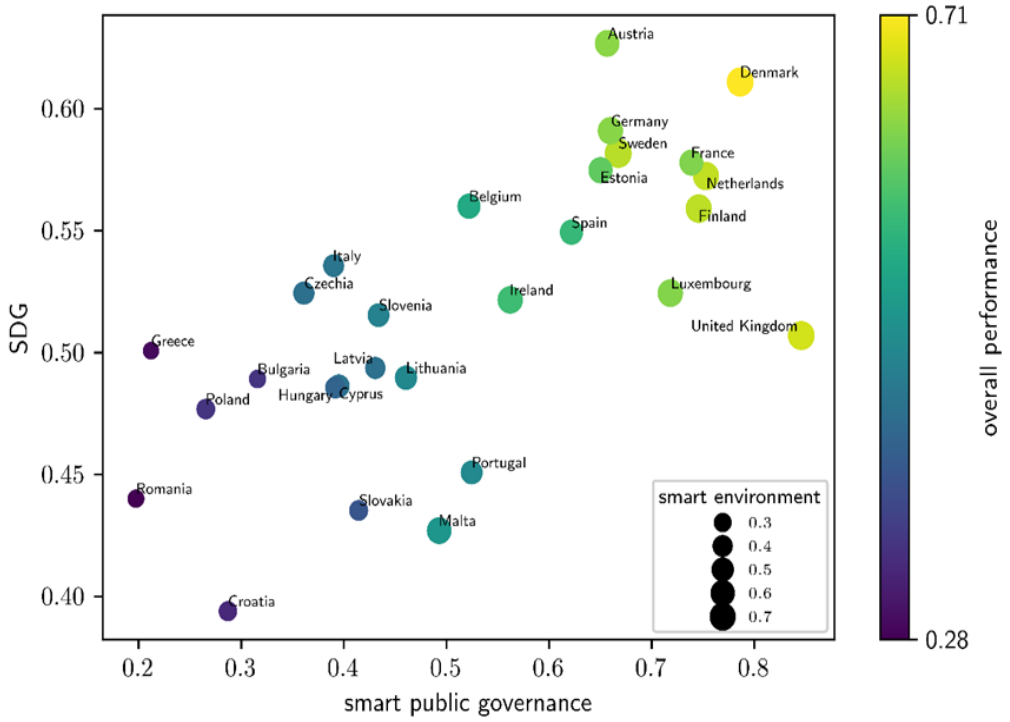
Results

The overall performance of each dimension of the EU countries is presented in Figure 2. The circle's colour reflects how well the individual country performed. Moreover, the horizontal and vertical axis represents the SPG and SDGs dimensions, respectively, while the size of the circle reflects the performance of the smart environment dimension. The results show that based on the **overall performance** Denmark, the United Kingdom, Netherlands, Finland (especially due to SPG and smart environment), and Sweden (especially due to smart environment) are top-performing countries. Contrary, Romania and Greece are identified as low-performing countries.

Further results reveal detailed country performance in each dimension. The results for the **SPG dimension** showed that the United Kingdom (especially due to smart ICT infrastructure and smart human capital) and Denmark (especially due to smart interaction) are the top-performing countries. On the other hand, we can observe that Greece (especially due to smart ICT infrastructure and smart government) and Romania (especially due to smart interaction and smart human capital) are the low-performing countries. According to the analysis, Sweden (especially due to ecological conditions), Denmark, and the United Kingdom (especially due to technological and ecological conditions) are the top-performing countries in the **smart environment dimension.** On the other hand, we can observe Romania (especially due to economic conditions and technological conditions), Greece (especially due

to political conditions), and Bulgaria (especially because of ecological conditions) are the low-performing countries. As reported by the analysis, Austria (especially due to its environmental pillar) and Denmark are the top-performing countries in the **SDGs dimension**. In contrast, Croatia (especially due to its social pillar) is a low-performing country.

Figure 2: EU countries based on SPG, SDG, Smart Environment, and their overall performance.



Source: Eurostat, 2019; OECD, 2019; authors' elaboration.

Based on the overall performance it is possible to identify the best and worst-performing EU countries (Table 1). The group of best performers consists of 13 while the group of worst performers consists of 15 EU countries. Given the level of inputs (i.e., the level of SPG), some best-performing countries achieved insufficient results (i.e., the level of SDG), while some worst-performing countries achieved satisfactory results, despite the smaller level of inputs.

In the group of best-performing countries, Austria and Denmark were identified as countries, which pay a lot of attention to SPG and also achieve the highest levels of sustainable development. Contrary, Luxembourg, Ireland, and the United Kingdom, despite their high levels of SPG, achieve relatively low levels of sustainable development, implying that these countries are facing efficiency shortages, especially when it comes to achieving economic (the United Kingdom and Luxembourg) and environmental (Ireland) pillar of sustainable development. Moreover, despite significantly lower levels of SPG than best-performing countries, Italy, Czechia and Slovenia were identified as countries with relatively high levels of sustainable development in the group of worst-performing countries. Contrary, Portugal, Romania, Slovakia, Malta and Croatia were identified as countries with relatively low levels of sustainable development. Further insights revealed the potential of Portugal to improve the economic pillar, Romania and Malta to improve the environmental pillar and Slovakia and Croatia to improve the social pillar of sustainable development. These results are also supported by the previous research, emphasizing that Southeastern European countries still have room for improvement in the path to achieve sustainable development (Glass & Newig, 2019).

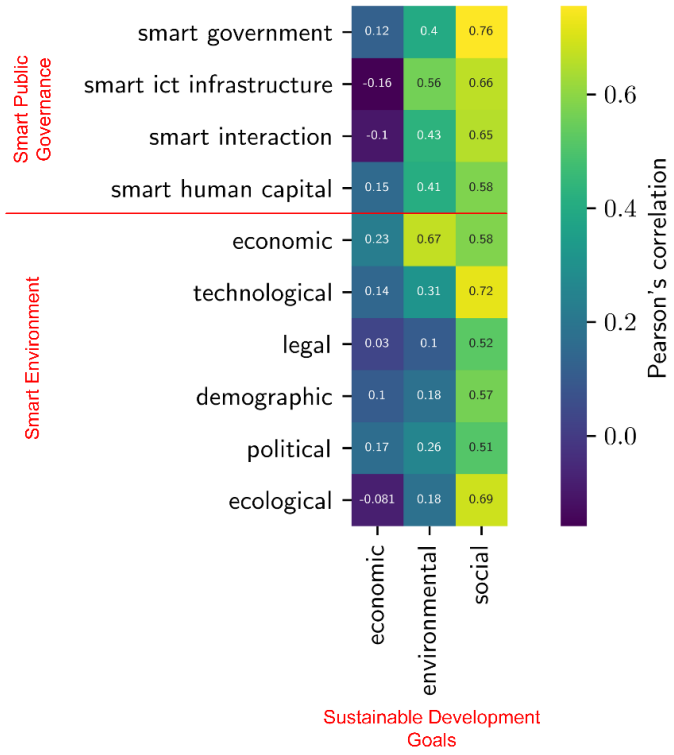
Table 1: Best and worst-performing EU countries.

Country	SPG	Smart environment	SDG	Final index	Results
Best-performing countries					
Austria	0.66	0.62	0.63	0.64	relatively high
Denmark	0.79	0.74	0.61	0.71	relatively high
Germany	0.66	0.65	0.59	0.63	mediocre
Sweden	0.67	0.75	0.58	0.66	mediocre
France	0.74	0.58	0.58	0.63	mediocre
Estonia	0.65	0.59	0.57	0.61	mediocre
Netherlands	0.75	0.70	0.57	0.67	mediocre
Belgium	0.52	0.54	0.56	0.54	mediocre
Finland	0.75	0.71	0.56	0.67	mediocre
Spain	0.62	0.54	0.55	0.57	mediocre
Luxembourg	0.72	0.66	0.52	0.63	relatively low
Ireland	0.56	0.66	0.52	0.58	relatively low
United Kingdom	0.85	0.74	0.51	0.68	relatively low
Worst-performing countries					
Italy	0.39	0.43	0.54	0.45	relatively high
Czechia	0.36	0.45	0.52	0.44	relatively high
Slovenia	0.43	0.47	0.52	0.47	relatively high
Greece	0.21	0.24	0.50	0.29	mediocre
Latvia	0.43	0.40	0.49	0.44	mediocre
Lithuania	0.46	0.50	0.49	0.48	mediocre
Bulgaria	0.32	0.28	0.49	0.35	mediocre
Cyprus	0.40	0.46	0.49	0.45	mediocre
Hungary	0.39	0.39	0.49	0.42	mediocre
Poland	0.27	0.34	0.48	0.35	mediocre
Portugal	0.52	0.48	0.45	0.48	relatively low
Romania	0.20	0.26	0.44	0.28	relatively low
Slovakia	0.41	0.35	0.44	0.40	relatively low
Malta	0.49	0.62	0.43	0.51	relatively low
Croatia	0.29	0.33	0.39	0.33	relatively low

Source: Eurostat, 2019; OECD, 2019; authors' elaboration.

Moreover, the correlation analysis presented in Figure 3 reveals that SPG has important implications for SDGs. More specifically, the strongest correlations can be observed between 3 SPG elements (smart government, smart ICT infrastructure and smart interaction) and 2 pillars of sustainable development (social and environmental), whereby the social pillar has the strongest correlation with smart government, while environmental pillar with smart ICT infrastructure. Although the correlation analysis does not allow for identifying a clear causal relationship between SPG and SDGs, some patterns can be established. In the context of smart government, it seems that a well-established vision and adaptability may facilitate the decision-making process, implementation and acceptance of policies directed towards the achievement of the social pillar (Glass & Newig, 2019), while smart technologies can provide efficient solutions for green service processes, which lead to minimizing natural resource consumption (Li et al., 2020). To some extent, smart interaction, characterised by proactiveness and a user-driven approach seems to be positively associated with the social pillar, presumably due to the participation and knowledge-sharing practices (Glass & Newig, 2019). As regards the smart environment, its elements are generally well correlated with the social pillar of sustainable development (especially from the technological and ecological aspect), while the economic aspect of the smart environment is highly correlated with the environmental pillar of sustainable development. This implies that a favourable (external) smart environment has also some relevant implications for achieving sustainable development (Rashidi & Holder, 2011). Another finding is that both SPG and smart environment are not highly correlated with the economic pillar of sustainable development.

Figure 3: Pearson's correlation between corresponding elements of SPG and Smart Environment relating to SDGs.



Source: Eurostat, 2019; OECD, 2019; authors' elaboration.

Discussion and Conclusion

The paper highlighted the role of SPG in achieving sustainable development through a conceptual framework and its empirical application on the sample of EU countries. The comprehensive conceptual framework was developed by considering the main theoretically founded dimensions, namely SPG, SDGs, and smart environment, whereby further theoretical considerations facilitated the identification of the corresponding elements for each of these dimensions. Further, each element is supported by several measurable indicators allowing several empirical considerations. First, to determine the performance of the EU countries in SPG, SDGs and smart environment dimension, the composite indexes across all dimensions were examined and compared between the countries. Second, to investigate how efficient are the EU countries in exploiting SPG practices to achieve SDGs in given smart environment conditions a comparative analysis of composite indexes was performed. Finally, to examine the implications of SPG and smart environment for SDGs, the composite indexes were investigated by correlation analysis.

Accordingly, the paper provides the answers to the main research questions. As regards the performance of the EU countries in SPG, SDGs and smart environment dimension (RQ1), the results reveal that the overall performance of main dimensions varies greatly across EU countries. According to the SPG dimension results, Denmark and the United Kingdom are the top-performing countries, while Greece and Romania are the lowest-performing countries. Moreover, Sweden, Denmark, and the United Kingdom are the top-performing countries in the smart environment dimension, while Romania, Greece, and Bulgaria have the lowest performance. Finally, in the SDGs dimension, Austria and Denmark are the top-performing countries, while Croatia performs poorly. As regards the efficiency of the EU countries in exploiting SPG practices to achieve SDGs in given smart environment conditions (RQ2), the comparison between the best and worst-performing EU countries reveals that Luxembourg, Ireland, and the United Kingdom, are facing efficiency shortages, while Portugal, Romania, Slovakia, Malta and Croatia were identified as countries with relatively low levels of SPG and sustainable

development. This is in line with previous research highlighting that Southeastern European countries still have room for improvement in the path to achieve sustainable development (Glass & Newig, 2019). As concerned the implications of SPG and smart environment for SDGs (RQ3), the results of correlation analysis indicate that SPG is strongly associated with SDGs, especially with social and environmental dimensions (Glass & Newig, 2019), with a smart environment also having an important role (Rashidi & Holder, 2011).

Several limitations of the paper should be noted. First, the research neglects other factors that are not directly related to SPG, SDGs, and smart environments, which presents an opportunity for further research. Namely, including/examining the selected socio-economic factors can be relevant for supplementing the presented conceptual framework. Nevertheless, it is believed that the conceptual framework can be helpful for researchers as a common language and analytical lens in (1) understanding the interpretation of the concept of SPG at the national level in the social science literature, (2) identifying key (sub)elements of SPG, smart environment and sustainable development, and (3) examining the interplay between them. Since the identified potential of SPG to help achieve SDGs in a given (external) smart environment, the findings will be beneficial for policymakers by providing evidence-based guidelines for developing national policies that should support smart public governance and its beneficial implications for sustainable development.

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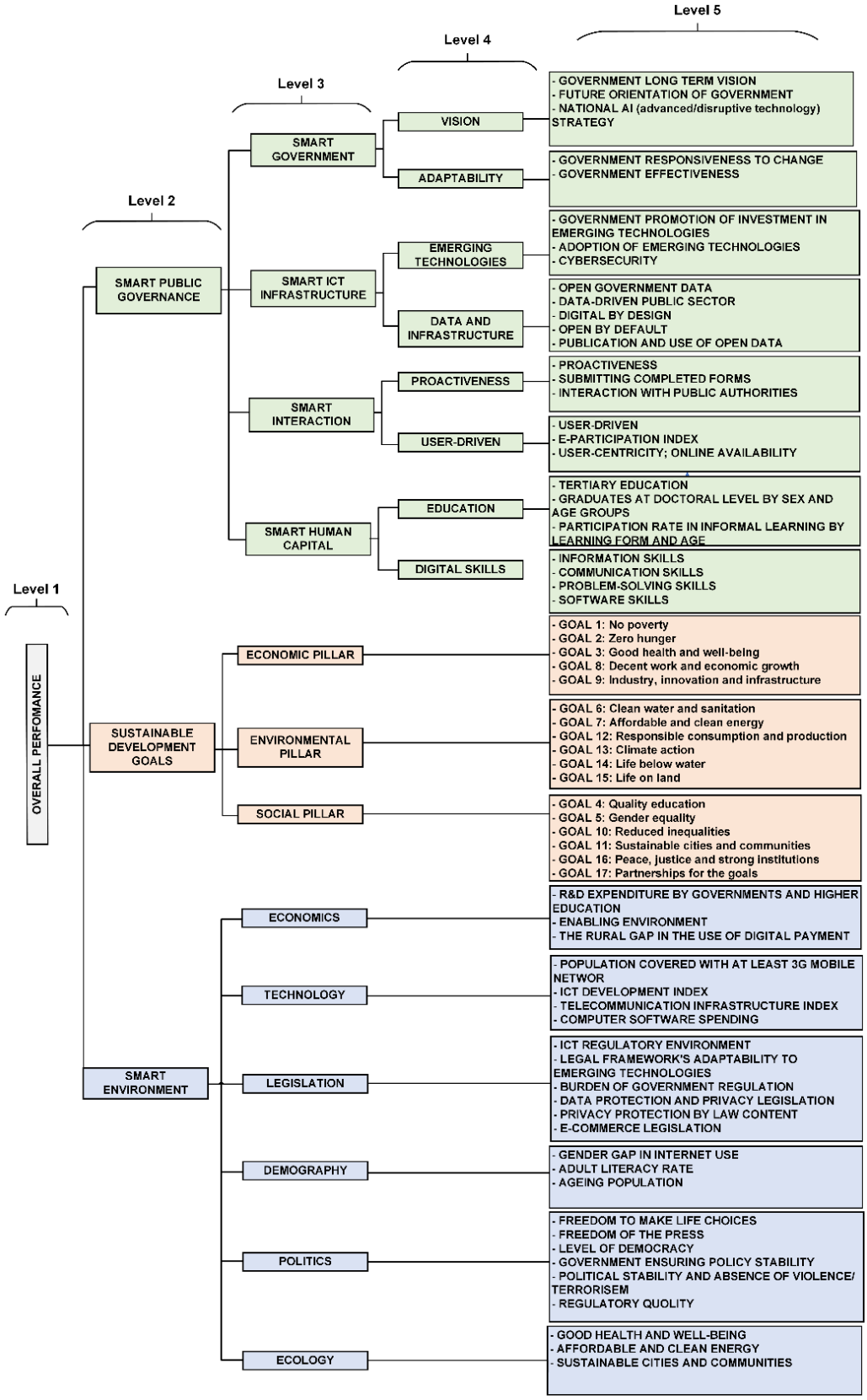
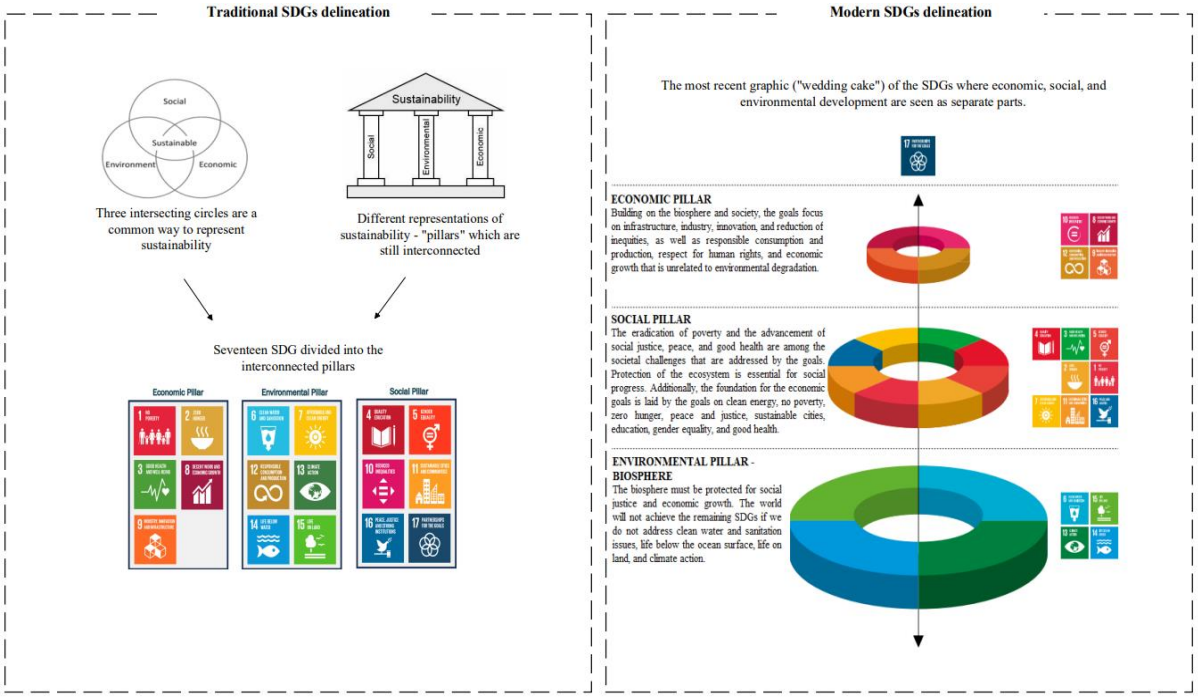
Appendix

Figure 1: Tree structure of the conceptual framework.



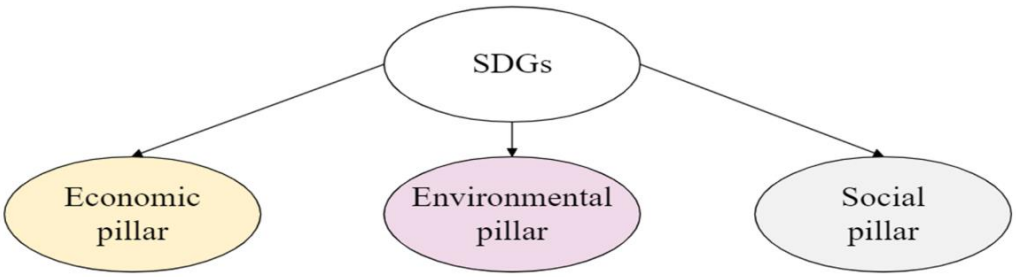
Source: Authors' elaboration.

Figure 2: The pillars of sustainability – traditional vs modern delineation.



Source: Adopted and summarised from Stockholm Resilience Centre (2016), Purvis et al. (2018), and Pretlove & Blasiak (2018).

Figure 3: SDG Goals divided by an economic, environmental, and social pillar, with indicators we included in the analysis.



SDGs	Indicators
Goal 1: No poverty	People at risk of poverty or social exclusion
	Severe material and social deprivation rate by age group and sex
	Severe housing deprivation rate by poverty status
Goal 2: Zero hunger	Obesity rate by body mass index (BMI)
	Government support for agricultural research and development
	Area under organic farming
	Ammonia emissions from agriculture
Goal 3: Good health and well-being	Healthy life years at birth by sex
	Share of people with good or very good perceived health by sex
	Smoking prevalence by sex
	Standardised preventable and treatable mortality
	Self-reported unmet need for medical examination and care by sex
Goal 4: Quality education	Early leavers from education and training by sex
	Tertiary educational attainment by sex
	Adult participation in learning by sex
Goal 5: Gender equality	Gender pays gap in unadjusted form
	Gender employment gap, by type of employment
	Positions held by women in senior management positions
Goal 6: Clean water and sanitation	Population having neither a bath, nor a shower, nor indoor flushing toilet in their household by poverty status
	Population connected to at least secondary wastewater treatment
	Phosphate in rivers
Goal 7: Affordable and clean energy	Primary energy consumption
	Energy productivity
	Share of renewable energy in gross final energy consumption by sector
Goal 8: Decent work and economic growth	Real GDP per capita
	Investment share of GDP by institutional sectors
	Employment rate by sex
Goal 9: Industry, innovation, and infrastructure	Gross domestic expenditure on R&D by sector
	R&D personnel by sector
	Share of buses and trains in inland passenger transport
Goal 10: Reduced inequalities	Purchasing power adjusted GDP per capita
	Income distribution
Goal 11: Sustainable cities and communities	Population living in households considering that they suffer from noise, by poverty status
	Settlement area per capita
	Recycling rate of municipal waste
Goal 12: Responsible consumption and production	Average CO2 emissions per km from new passenger cars
	Circular material use rate
	Generation of waste excluding major mineral wastes by hazardousness
	Gross value added in the environmental goods and services sector
Goal 13: Climate action	Net greenhouse gas emissions
	Contribution to the international 100bn USD commitment on climate-related expending
	Population covered by the Covenant of Mayors for Climate & Energy signatories
Goal 14: Life below water	Surface of the marine protected areas
	Marine waters affected by eutrophication
Goal 15: Life on land	Surface of the terrestrial protected areas
	Soil sealing index
Goal 16: Peace, justice, and strong institutions	Population reporting occurrence of crime, violence, or vandalism in their area by poverty status
	Corruption Perceptions Index
Goal 17: Partnerships for the goals	EU financing to developing countries by financing source
	General government gross debt
	Share of environmental taxes in total tax revenues

Source: Authors' elaboration.

References

Addink, H. (2019a). Principles of Good Governance. In H. Addink (eds.), *Good Governance: Concept and Context*, (part I). Oxford: Oxford University Press.

Addink, H. (2019b). Implementation of the Good Governance Principles on the International Level. In H. Addink (eds.), *Good Governance: Concept and Context*, (Part III). Oxford: Oxford University Press.

Allen, C., Metternicht, G., & Wiedmann, T. (2017). An Iterative framework for national scenario modelling for the sustainable development goals (SDGs). *Sustainability*, 25(0), 372–385.

Bernardo, M.R.M. (2017). Smart City Governance: From E-Government to Smart Governance. In L.C.Carvalho (eds.), *Handbook of Research on Entrepreneurial Development and Innovation Within Smart Cities* (pp. 290-326). IGI Global.

Bolívar, M. P. R. & Meijer, A. (2015). Smart Governance: Using a Literature Review and Empirical Analysis to Build a Research Model. *Social Science Computer Review*, 34(6), 673–692. doi: 10.1177/0894439315611088

Buskeviciute, J. (2014). Sumaniojo viešojo valdymo koncepcijos paieškos: skirting teorinių prieigų kritinė analizė, *Public Policy and Administration*, 13(3), 359-371.

Caragliu, A., Del Bo, C., & Nijkamp, P. (2009). Smart cities in Europe. In *Proceedings of the 3rd Central European Conference in Regional Science*.

Criado, J.I. & Gil-Garcia, J.R. (2019). Creating public value through smart technologies and strategies: From digital services to artificial intelligence and beyond. International *Journal of Public Sector Management*, 32(5), 438-450. doi: 10.1108/IJPSM-07-2019-0178

Diaz-Sarachaga, J. M., Jato-Espino, D., & Castro-Fresno, D. (2018). Is the Sustainable Development Goals (SDG) index an adequate framework to measure the progress of the 2030 Agenda? *Sustainable Development*, 1-9. doi. 10.1002/sd.1735

EAT (2016) *How food connects all the SDGs by Stockholm Resilience Centre*. Available on: The SDGs wedding cake - Stockholm Resilience Centre

Estavez, E., Pardo, A.T., & Scholl, J.H. (2021). *Smart cities and smart governance: toward the 22nd century sustainable city*. Cham: Springer.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Milanović, N., & Meijers, E. (2007). *Smart cities - Ranking of European medium-sized cities*. Vienna: Centre of Regional Science.

Gil-Garcia, J. R., Zhang, J., & Puron-Cid, G. (2016). Conceptualising smartness in government: An integrative and multi-dimensional view. *Government Information Quarterly*, 33(3), 524–534. doi: 10.1016/j.giq.2016.03.002

Gil-Garcia, J. R. (2012). Towards a smart State? Inter-agency collaboration, information integration, and beyond. *Information Polity*, 17(2012), 269–280. doi: 10.3233/IP-2012-000287

Glass, L. M., & Newig, J. (2019). Governance for achieving the Sustainable Development Goals: How important are participation, policy coherence, reflexivity, adaptation and democratic institutions?. *Earth System Governance*, *2*, 100031. doi: 10.1016/j.esg.2019.100031

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. *Future Generation Computer Systems*, 29(7), 1645–1660. doi:10.1016/j.future.2013.01.010

Jimenez, C. E., Solanas, A., & Falcone, F. (2014). E-government interoperability: Linking open and smart government. *Computer*, 47(10), 22–24. doi: 10.1109/MC.2014.281

Jucevičienė P & Jucevičius R. (2014). What Does It Mean to Be Smart? In The 8th International Scientific Conference Proceedings. 911–918.

Jucevicius, R. & Juceviciene, P. (2018). Knowledge dimension in smart development. In *European Conference on Knowledge Management*. 369-376.

Li, Y., Dai, J., & Cui, L. (2020). The impact of digital technologies on economic and environmental performance in the context of industry 4.0: A moderated mediation model. *International Journal of Production Economics*, *229*, 107777.

Linkov, I., Trump, B., Poinsatte-Jones, K., & Florin, M. V. (2018). Governance strategies for a sustainable digital world. *Sustainability*, 10(2), 440. doi: 10.3390/su10020440

Lin, Y. (2018). A comparison of selected Western and Chinese smart governance: The application of ICT in governmental management, participation, and collaboration. *Telecommunications Policy*, 42(10), 800–809. doi:10.1016/j.telpol.2018.07.003

Lin, Y., Zhang, X., & Geertman, S. (2015). Toward smart governance and social sustainability for Chinese migrant communities. *Journal of Cleaner Production*, 107, 389–399. doi:10.1016/j.jclepro.2014.12.074

Loebbecke, C., & Picot, A. (2015). Reflections on societal and business model transformation arising from digitisation and big data analytics: A research agenda. *The Journal of Strategic Information Systems*, 24(3), 149-157. doi: 10.1016/j.jsis.2015.08.002

Meijer, A., & Bolívar, M. P. R. (2016). Governing the smart city: A review of the literature on smart urban governance. *International Review of Administrative Sciences*, 82(2), 392–408. doi: 10.1177/0020852314564308

Meijer, A. J., Gil-Garcia, J. R., & Bolívar, M. P. R. (2016). Smart City Research. *Social Science Computer Review*, 34(6), 647–656. doi:10.1177/0894439315618890

Moldan, B., Janoušková, S., & Hák, T. (2012). How to understand and measure environmental sustainability: Indicators and targets. *Ecological Indicators*, 17, 4–13. doi. 10.1016/j.ecolind.2011.04.033

Nam, T., & Pardo, T. A. (2014). The changing face of a city government: A case of Philly311. *Government Information Quarterly*, 31(1), S1-S9. doi: 10.1016/j.giq.2014.01.002

Nam, T., & Pardo, T. A. (2011). Conceptualising smart city with dimensions of technology, people, and institutions. In J. Bertot, K. Nahon, S. A. Chun, L. Luna-Reyes, & V. Atluri (eds.), *Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation In Challenging Times* (pp. 282–291).

Pereira, G.V. (2021). *Introduction to Digital Transformation of Government* (Scientific foundations training and entrepreneurship activities in the domain of ICT-enabled Governance). Danube: University Krems

Pereira, G. V., Parycek, P., Falco, E., & Kleinhans, R. (2018). Smart governance in the context of smart cities: A literature review. *Information Polity*, 23(2), 143–162. doi:10.3233/ip-170067

Pretlove, B. & Blasiak, R. (2018). *Mapping Ocean Governance and Regulation*. Available on: https://www.researchgate.net/publication/327884976_Mapping_Ocean_Governance_and_Regulation

Purvis, B., Mao, Y., & Robinson, D. (2018). Three pillars of sustainability: in search of conceptual origins. Sustainability Science. doi:10.1007/s11625-018-0627-5

Rashidi, P., Cook, D. J., Holder, L. B., & Schmitter-Edgecombe, M. (2011). Discovering Activities to Recognise and Track in a Smart Environment. *IEEE Transactions on Knowledge and Data Engineering*, 23(4), 527–539. doi:10.1109/tkde.2010.148

Rainey, G. H. (2014). *Understanding and managing public organisations*. San Francisco (USA): John Wiley & Sons, Inc.

Ranjbari, M., Morales, G., Shams, E., Zahra & Carrasco-Gallego, R. (2019). Sustainability and the Sharing Economy: Modelling the Interconnections. *Direccion y Organizacion*, 68(33-40). doi. 10.37610/dyo.v0i68.549.

Rosen, F. (2003). *Classical utilitarianism from Hume to Mill*. London: Routledge.

Scholl., H. & Scholl, M. (2014). Smart Governance: A Roadmap for Research and Practice. In *iConference 2014 Proceeding*. 163–176. doi: 10.9776/14060

Scholz, R., Bartelsman, E., Diefenbach, S., Franke, L., Grunwald, A., Helbing, D., ... & Montag, C. (2018). Unintended side effects of the digital transition: european scientists' messages from a proposition-based expert round table. *Sustainability*, 10(6), 2001. doi: 10.3390/su10062001

Sinha, A., Sengupta, T., & Alvarado, R. (2019). Interplay between technological innovation and environmental quality: Formulating the SDG policies for next 11 economies. *Journal of Cleaner Production*, 118549. doi:10.1016/j.jclepro.2019.118549

Spaiser, V., Ranganathan, S., Swain, R. B., & Sumpter, D. J. T. (2016). The sustainable development oxymoron: quantifying and modelling the incompatibility of sustainable development goals. International *Journal of Sustainable Development & World Ecology*, 24(6), 457–470. doi:10.1080/13504509.2016.123562

Stockholm Resilience Centre (2016). *The SDG wedding cake*. Available on: The SDGs wedding cake - Stockholm Resilience Centre

Swain, R.B. (2018). A Critical Analysis of the Sustainable Development Goals. In: Leal Filho, W. (eds.) *Handbook of Sustainability Science and Research*: *World Sustainability Series* (341-355). Springer: Cham.

Šiugždinienė, J. Gaule, E., & Rauleckas, R. (2017). In search of smart public governance: the case of Lithuania. *International Review of Administrative Sciences*, 85(1), 1–20. doi: 10.1177/002085231770781

Tjoa, A.M., Tjoa, S. (2016). The Role of ICT to Achieve the UN Sustainable Development Goals (SDG). In: Mata, F., Pont, A. (eds.) *ICT for Promoting Human Development and Protecting the Environment* (3-13). Springer: Cham.

United Nations (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. Available on 21252030 Agenda for Sustainable Development web.pdf (un.org)

Van de Donk, W., & Snellen, I. (1998). *Towards a theory of public administration in an information age*. Amsterdam: IOS Press.

Velsberg, O., Westergren H. U., & Jonsson K. (2020) Exploring smartness in public sector innovation - creating smart public services with the Internet of Things. *European Journal of Information Systems*, 29(4), 350-368. doi: 10.1080/0960085X.2020.1761272

Zhuang, R., Fang, H., Zhang, Y., Lu, A., & Huang, R. (2017). Smart learning environments for a smart city: from the perspective of lifelong and lifewide learning. *Smart Learning Environments*, 4(1). doi:10.1186/s40561-017-0044-8

Webster, C. W. R., & Leleux, C. (2018). Smart governance: Opportunities for technologically-mediated citizen co-production. *Information Polity*, 23(1), 95–110. doi:10.3233/ip-170065

World Bank (2020). *The Global Risks Report 2020*. Available on The Global Risks Report 2020 | World Economic Forum (weforum.org)

Wu, J., Guo, S., Huang, H., Liu, W., & Xiang, Y. (2018). Information and Comunications Technologies for Sustainable Development Goals: State-of-the-Art, Needs and Perspectives. *IEEE Communications Surveys & Tutorials*, 20(3), 2389-2406. doi: 10.1109/COMST.2018.2812301.

Yildiz, M. (2007). E-government research: Reviewing the literature, limitations, and ways forward. *Government Information Quarterly*, 24(3), 646–665. doi: 10.1016/j.giq.2007.01.002