BIG DATA IN SUSTAINABLE REGIONAL DEVELOPMENT: THE DIGITAL FUTURE OF SMART REGIONS

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ABSTRACT

Purpose – The idea of sustainable regional development is a well-known concept in the EU, enshrined in official documents, forms the basis of local policies and is widely used in practice. At the same time, decentralization processes are taking place in Ukraine, which enhances not only local authorities' ability to define development priorities but also increases the responsibility for achieving results. Therefore, the purpose of this paper is to investigate the strategic role of Big Data in supporting sustainable regional development.
Methodology – The authors conduct an analysis of the academic literature about sustainable regional development highlighting the strategic role of Big Data. The authors also use a comparative analysis of regions by the completeness of providing information on official sites of regional state administrations.
Conclusions – This research paper has important value by analyzing the strengths and weaknesses of the local authorities, providing useful information for ensuring sustainable regional development.

Keywords: Sustainable Development. Big Data. Local Authorities. Smart Region. Strategic Priorities.

1. INTRODUCTION

The modern world is developing dynamically, which leads to the fact that the volume of data is increasing exponentially. According to UN experts, 90% of the data has been created in the last two years, and it is projected to increase by 40% annually [1]. On the one hand, this greatly complicates the decision-making processes at all levels: global, national and regional. After all, the assessment of a significant volume of information requires more and more time, the highest qualifications of staff, the best information and computer technologies, and ever the greatest financial resources. On the other hand, the potential of using Big Data can increase the efficiency of managerial decisions, since large arrays of information will increase the accuracy of analysis and forecasts.

As a result, using Big Data will contribute to sustainable development and increase the transparency of decision-making. Big-open data is important for the success of the United Nations 2030 Sustainable Development Goals (SDG). Huge data sets, supported by technical and analytical services, are required to address SDGs-17 goals, 169 target and 230 indicators. So, Big Data applications may offer the ability to collect and analyze real-time information [2], relating to public procurement or the formation of local budgets. It is will be able to facilitate policy-making in the region.

This paper aims at illustrating the role of Big Data in supporting sustainable regional development. This paper aims to overcome the knowledge gap by achieving the following objectives: 1) to clarify the definition of Big Data; 2) to propose a conceptual framework that demonstrates the relationship between Big Data and sustainable regional development, and 3) to demonstrate regional development trends using open Big Data.

2. MATERIAL AND METHOD
The authors conduct an analysis of the academic literature about sustainable regional development highlighting the strategic role of Big Data. The authors also use a comparative analysis of regions by the completeness of providing information on official sites of regional state administrations.

3. LITERATURE REVIEW
The concept of Big Data is becoming increasingly popular among academics and practitioners. Definition includes 3V's [3] or 4V's [4] of data management: volume (steady growth of amount of data), velocity (constant growth of pace of data generation and distribution), variety (constant changes to data formats and structures), and veracity (different level of the quality of data). The systematization of the perception of this definition is given in Table 1.

Table 1. The systematization of the perception of Big Data

Author	Features
Erevelles, Fukawa and Swayne [5], Power [6], Laney [3], Mukred [4]	Big Data through the prism of different Vs: Volume, Variety, Velocity, Validity, Veracity, Value and Visibility
Wamba, Akter, Edwards, Chopin and Gnanzou [7], Petrova, Sushchenko, Trunina and Dekhtyar [8], Gandomi and Haider [9]	Big Data through the prism of infrastructures, such as technologies, analytics and methods
Davenport, Barth and Bean [10], Mayer-Schönberger and Cukier [11]	Big Data as a symbiosis of technological and organizational issues (big data must be integrated into all business processes)
Xu, Frankwick and Ramirez [12]	Big Data as an instrument for achieving strategic goals, such as marketing and new product development
Irani [13], Erevelles, Fukawa and Swayne [5]	Big Data as a component of organizational culture, which allows for more evidence-based management decisions
Sivarajah, Kamal, Irani and Weerakkody [14]	Big Data as a potential to ascertain valued insights for an enhanced decision-making process
Jukić, Sharma and Nestorov [15]	Big Data as a source to generate new knowledge thus proposing innovative and actionable insights for businesses
Dumbill [16], Chen and Zhang [17]	Big Data as business intelligence for better informed business decisions
Günther, Mehrizi, Huysman and Feldberg [18]	Big Data as an instrument for business model improvement and innovation

So, the main feature of Big Data is the ability to enhance decision-making. In the management process, it is accepted to classify the four types of development evaluation and big data analytics (Figure 1).
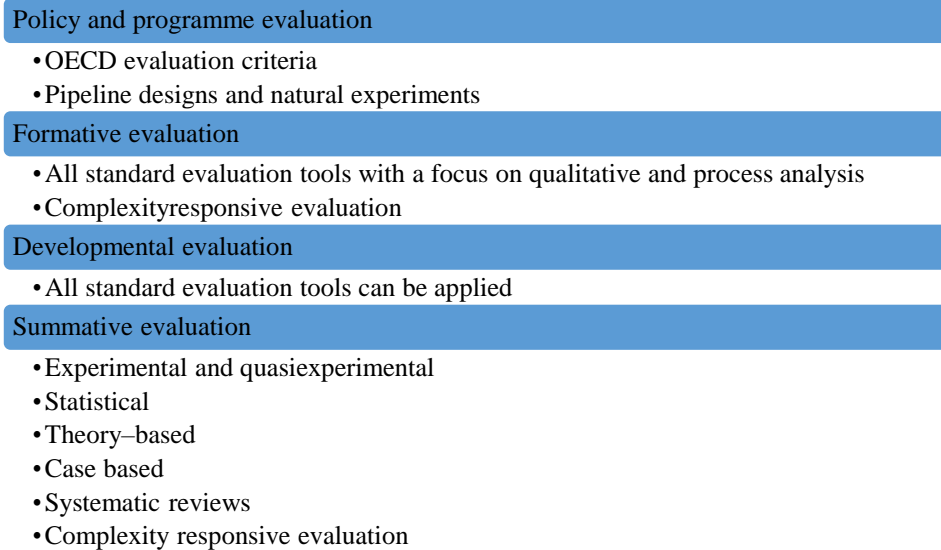
Policy and programme evaluation
• OECD evaluation criteria
• Pipeline designs and natural experiments

Formative evaluation
• All standard evaluation tools with a focus on qualitative and process analysis
• Complexityresponsive evaluation

Developmental evaluation
• All standard evaluation tools can be applied

Summative evaluation
• Experimental and quasiexperimental
• Statistical
• Theory–based
• Case based
• Systematic reviews
• Complexity responsive evaluation

Figure 1. The main methods of development monitoring and evaluation [19].

The purpose of the policy and broad-based programme evaluation is the assessment of the achievement objectives of country programmes and multi-donor collaborative programmes. The formative evaluation used in the case to provide regular feedback to management and other stakeholders to help strengthen the implementation of programmes and projects. Developmental evaluation should be used to help managers and other stakeholders to improve programme performance and to learn lessons for the selection and design of future programmes. The purpose of a summative evaluation is to assess the extent to which observed changes in outcome variables can be attributed to the effects of the project intervention [19].

As a result of using Big Data, the potential for sustainable regional development is created. So, McKinsey Global Institute's research [20] confirms cost reductions for administrative activities up to 20 per cent as a result of using Big Data.

4. EXPERIMENTAL RESULTS

Big Data generated in the regional environment can potentially lead to more transparent and effective management decisions, quality services and innovations that can lead to changes in regional development priorities. However, significant amounts of disparate information about the state of the region are often generated by different techniques and using different technologies. According to the report A World that Counts [21], in the modern world, the amount of information and the speed of its dissemination increase at an incredible speed. Data comes from different sources, namely data from new technologies, qualitative data, citizen-generated data and perceptions data. This is why the UN World Data Forum's achievements are important in moving the official statistics community towards a more inclusive process of partnership and consultation, as well as taking into account the value of non-traditional data. The Forum adopted the Cape Town Plan [22], which aims to:

- Modernize governance and institutional frameworks for improvement big data ecosystem;
- Unification of statistical standards that will allow data integration and comparison between different states;
- Active use of new technologies and data sources into mainstream statistical activities.

The three dimensions of the Big Data framework for sustainable regional development are shown in Figure 2.
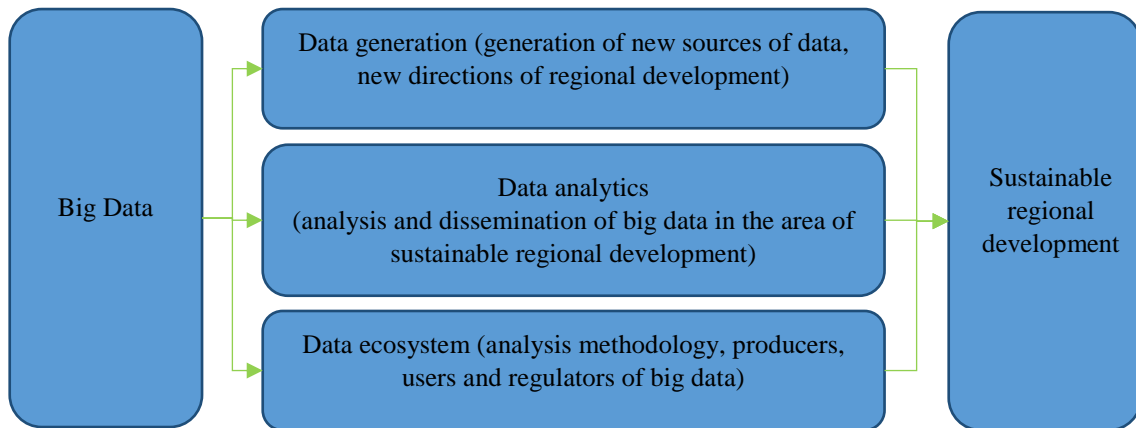
Figure 2. The three dimensions of the Big Data framework for sustainable regional development

The driver of sustainable development of the country is smart regions, which by means of effective use of Big Data will build a recognizable brand of the region and increase its competitiveness in the conditions of digitalization of the world economic space. The concept of «smart regions» within the boundaries of a digital transition connected to environmental transition and tackling the issues of regional durability, sustainable way of living, as well as questions of mobility, energy consumption and waste management [23].

The achievement of sustainable regional development requires the availability of high-quality, timely and reliable data. That's why the results of the comparative analysis of the regions on the completeness of providing information on the official sites of regional state administrations are given in Table 2.

Table 2. A comparative analysis of regions by the completeness of providing information on official sites of regional state administrations

Regions	Insignificant amount of systematized data	Sufficient amount of systematized data	Significant amount of systematized data
Chernihiv, Chernivtsi, Donetsk, Ivano-Frankivsk, Kharkiv, Khmelnytsky, Lugansk, Zakarpattia, Zhytomyr	+		
Cherkasy, Kherson, Lviv, Nikolaev, Poltava, Rivne, Ternopil, Vinnytsia, Volyn, Zaporizhia		+	
Dnipropetrovsk, Kiev, Kirovograd, Odessa, Sumy			+

The analysis shows that not all regions are able to fully utilize the potential of Big Data because they are not able to manage change effectively [24]. So, experts believe that regions can benefit from the use of big data if they focus on five main areas [25]:

- Leadership (leadership teams that set clear goals and vision, define what success looks like, and ask the right questions);
- Talent management (search for professionals who have skills not only in working with large amounts of information but also able to apply modern visualization tools and techniques);
- Technology (continuous improvement of internal and external sources of data processing technologies);
- Decision making (the leader must be flexible and able to quickly make decisions in a changing environment);
- Organizational culture (the presence of a clear understanding of what kind of data and in what format are needed for the development of the region).

Big-Open Data aims to prevent discrimination and promote transparency in regional policy-making and accountability (Figure 3). Roles of Stakeholders in the Data Ecosystem are given in Table 3. In this case, all stakeholders should use a set of data related rights when using information [21]: right to be counted, right to an identity, right to privacy and to ownership of personal data, right to due process (for example

when data is used as evidence in proceedings, or in administrative decisions), freedom of expression, right to participation, right to non-discrimination and equality, and principles of consent. For the development of the Data Ecosystem, not only the existence of different stakeholders is important, but also the existence of mechanisms to create the data value chain (Table 4).
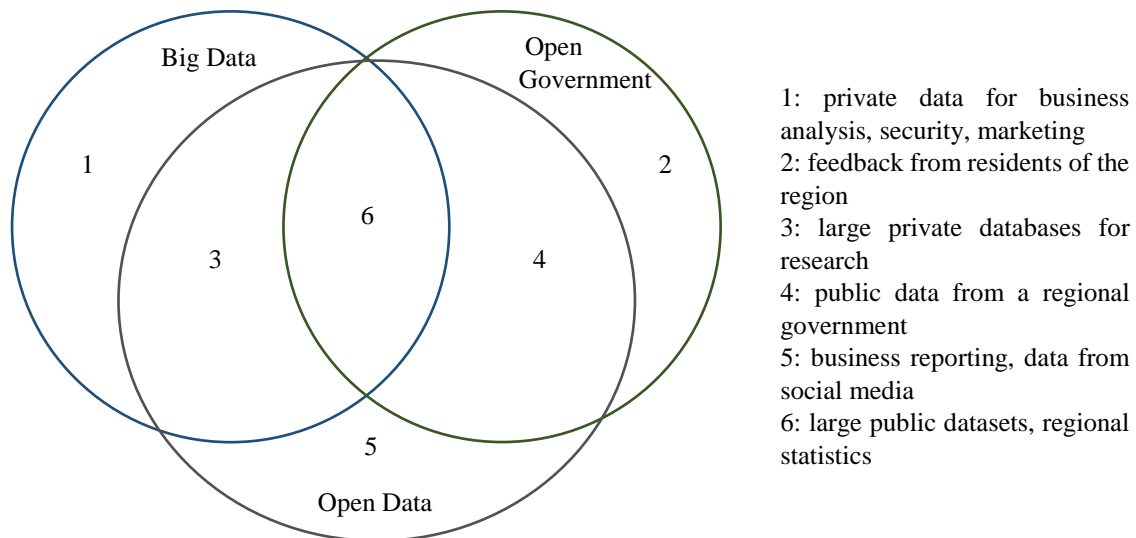

1: private data for business analysis, security, marketing
2: feedback from residents of the region
3: large private databases for research
4: public data from a regional government
5: business reporting, data from social media
6: large public datasets, regional statistics

Figure 3. Using Big Data Open Data in the private and public sectors [26]

Table 3. Roles of Stakeholders in the Data Ecosystem [2].

Stakeholders	Roles
Government and regional authorities	The main purpose is the policy-making process, for example, security, traffic and road safety, critical infrastructure, waste management, and public health
Statistical offices	The task is to store and process big data; including improving the accuracy, timeliness and relevance of their statistics and reducing costs
Science community	The main purpose of this search for the most useful and useful channels can be very useful for society.
Data brokers	The main task is to collect information from a wide range of sources in order to further sell such information.
Civil society organizations and individuals	The main purpose is to keep governments and companies accountable, using evidence of their impact, providing feedback to data producers, developing data literacy, and helping communities and individuals create and use data, provide accountability and make better decisions for themselves.
All society	The main purpose of the representatives of public, private and civil society is the production and consumption of processed data.

Table 4. Components of a Data Ecosystem to create the data value chain [27].

Components	Types of components
Stakeholders	Data producers, Data users, Data funders, Infomediaries
Capacities	Statistical capacity, Analytical capacity, Data literacy, Leadership
Processes	Monitoring, Accountability, Transparency, Development planning, Policy-making, Knowledge sharing
Policies	Laws, Enabling regulations, E-commerce, Copyrights, International obligations
Infrastructure	Telecoms, Data centres, Data analytics and visualization, Data standards, Inter-operability

Big Data can be grouped into three main categories, based on the data life cycle: data, process and management challenges [14]:
- Data challenges problems associated with the characteristics of the data).
- Process challenges (problems associated with methods of capture, integration, data transformation, the right model of analysis and interpretation of data).

- Management challenges (problems associated with privacy, security, governance and ethical issues).

That is why the regional authorities should pay attention to the quality of information, establish processes and assign effective guidance for data analysis. In general, when building a regional development strategy based on the use of Big Data, there are potential qualitative changes in all areas of the region's livelihoods. Thus, E-Government technology allows to improve the quality of administrative services, provides equal access to these services, increases citizens' interest in regional policy issues and activates their participation in the development of the region. This leads to empowering citizens, improving transparency, participation, and equality. The use of large data in the business environment has led to the emergence of E-Commerce and Market Intelligence. In the long run, this will increase sales and customer satisfaction as a result of using targeted and personalized advice. If the region's infrastructure is based on the potential of Big Data, then residents receive high-quality roads, new solutions in the right places, traffic safety, etc. All of the above is able to turn the regions into smart regions in the era of digitalization.

5. CONCLUSION

Regions are perhaps the most important arena for sustainable development. The need for timely, credible and complete data is the basis for effective management decisions. Big Data helps not only provide sustainable regional development but also tracking progress towards the achievement of the SDGs. Another important use of big data in the regional administration is in a reduction of regional problems and risks with its real-time insights. New approaches should be experimented to evaluate the datasets, overcoming those challenges and addressing the regional sustainability issue.

As the study showed, the regions are different in relation to Big Data: each region had differing data-related capacities, processes, priorities and approaches in addition to unique, and region-specific data challenges. Lack of expertise, along with the other challenges, also prevents same regions to adopt big data applications. However, an effective mechanism for using big data has been created in the country to enhance the transparency of regional governance, namely the system of public procurement. Using open Big Data can become a powerful tool for local authorities, the private sector and NGOs to become accountable and committed towards society. Big Data can provide relevant information to monitor sustainable regional development in an open, participatory and transparent way, as well as promote public debate and to improve regional policy.

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