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Basic Measures to Ensure the Development of Open Data Infrastructure

Abstract. Introduction. This article is devoted to the analysis of trends in the development of open data infrastructure, the identification of shortcomings and advantages of the implementation of open data policy. The article examines the current state of public access to public information through the prism of the analysis of the existing legislative framework of Ukraine and the implementation of the open data policy.

Purpose. The purpose of the article is to identify the most pressing problems of the modern stage of open data implementation and ways to solve them.

The subject of research is open data infrastructure. Analysis of the situation with project incubators based on open and big data is necessary to popularize the data and encourage others to research it. The main tasks and the action plan for ensuring the development of open data are outlined, which allows to structure and systematize the work of the executive power body, local self-government. The main functions of the public authority and the advantages of publishing public information in the form of open data for free use are determined. Quantitative composition of managers of information in the format of open data by organizational and legal form is highlighted.

Results. The article examines the composition and problems of national participants of the open data system and defines the prospects and priorities of their development and interaction. The authors come to the conclusion that the solution of the problem of regulation by the public administrations of relations between managers of open data and their consumers involves the implementation by public administrations at the regional level of a policy of full openness. The work examines managers involved in the publication of information on competitions. Characteristic features of the introduction of open data in Ukraine were determined and approaches to improve the efficiency of this process were formed.

Conclusions. The obtained results can be used for further prospective studies of the mechanisms of public authority regulation of relations between managers of open data and their consumers.

Keywords: open data; big data; public information; managers of information

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Основні заходи для забезпечення розвитку інфраструктури відкритих даних

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Дана стаття присвячена аналізу тенденцій розвитку інфраструктури відкритих даних, визначенню недоліків та переваг реалізації політики відкритих даних. У статті розглянуто сучасний стан доступу населення до публічної інформації через призму аналізу чинної законодавчої бази України та впровадження політики відкритих даних.

Метою статті є висвітлення найбільш актуальних проблем сучасного етапу впровадження відкритих даних та шляхи їх вирішення.

Предметом дослідження є інфраструктура відкритих даних. Аналіз ситуації з інкубаторами проектів на основі відкритих і великих даних необхідний для популяризації даних та заохочення інших до їх дослідження. Окреслено основні завдання та план дій задля забезпечення розвитку відкритих даних, що дає змогу структурувати й систематизувати роботу органу виконавчої влади, місцевого самоврядування. Визначено основні функції органу публічної влади та переваги оприлюднення публічної інформації у формі відкритих даних для вільного використання. Висвітлюється кількісний склад розпорядників інформації у форматі відкритих даних за організаційно-правовою формою.

У статті досліджено склад і проблематику національних учасників системи відкритих даних та визначено перспективи й пріоритети їх розвитку та взаємодії. Автори приходять до висновку, що розв'язання проблеми урегулювання публічною владою відносин між розпорядниками відкритих даних та їх споживачами передбачає реалізацію органами публічної влади на регіональному рівні політики повної відкритості. У роботі розглянуто розпорядників, що займаються публікацією інформації про конкурси. Визначено характерні риси впровадження відкритих даних в Україні та сформовано підходи до покращення ефективності цього процесу.

Отримані результати можуть бути використані для подальших перспективних досліджень механізмів урегулювання публічною владою відносин між розпорядниками відкритих даних та їх споживачами.

Ключові слова: відкриті дані; великі дані; публічна інформація; розпорядники інформації.

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Formulation of the problem. Representatives of most state institutions, commercial enterprises and public associations tend to present the results of their work and emphasize the social significance of everything they do. A few years ago, this feature took shape in the currently very common mechanism of providing Open Data based on the use of information technologies. In democratically developed countries, thanks to this mechanism, representatives of all forms of ownership receive significant investments not only due to the effective presentation of their activities, but also due to the high demand of the general public for the open data they publish. The whole appeal of open data is that it can bring unexpected benefits not only to those who publish or request it on their own initiative, but also to those who do so in response to public response.

Analysis of recent research and publications. Many works of foreign and domestic scientists are devoted to the study of open data accompanying the activities of the state, such as the openness of the authorities regarding access to public information and the use of modern information technologies in public administration. Among them, for example, M. Fedorov [1], who noted the main principles of using open data during the war; A. Gazin [2] revealed the current state of implementation of open data in Ukraine and made recommendations for its improvement; T.V. Dzhiga, I.V. Tkach, O.S. Solid bread [3; 4; 5] studied the effectiveness of public administration on the basis of open data [6]. Important for use are the works of L. James [7], which studied the theoretical foundations of open data. However, the process of creating an open data system remains insufficiently studied.

Formulation of research goals. The purpose of this article is to study the current problems of the modern stage of open data implementation and to find optimal ways to solve them.

Outline of the main research material. Scientific and technological progress, along with natural and labor resources, is considered to be the main factor of production in the development of society. In foreign and domestic literature, it is associated with the concept of an innovative process that combines science, technology, economics, entrepreneurship and management [8]. It covers the whole complex of relations: production, exchange and consumption. Taking into account the constant acceleration of scientific and technological progress, strengthening of globalization processes and internationalization of markets, innovation and creativity become the main success factors not only of individual enterprises, but also of all national economic systems, and the strategic management of innovations is the most important task of anti-crisis policy of regional development.

Research has shown that open data is an integral part of Big Data (Fig. 1).

The data in Fig. 1. show that information presented in the form of open data is an integral part of innovative Big Data technologies.

Innovative development is a decisive factor in increasing the efficiency of the enterprise, economic growth, improvement of product quality, economical use of resources, prevention of environmental consequences of industrialization. It is the application of innovative technologies that promotes dynamic self-development and ensures competitiveness at all hierarchical levels of the economy. The scope of big data applications of open data is extremely wide due to the volume of information collected and processed by public administrations.

Every citizen is a potential user of open data (or services based on it). Information made public in the form of open data can influence decisions in everything from buying real estate (e.g. mortgage information) to commuting (e.g. public transportation information).

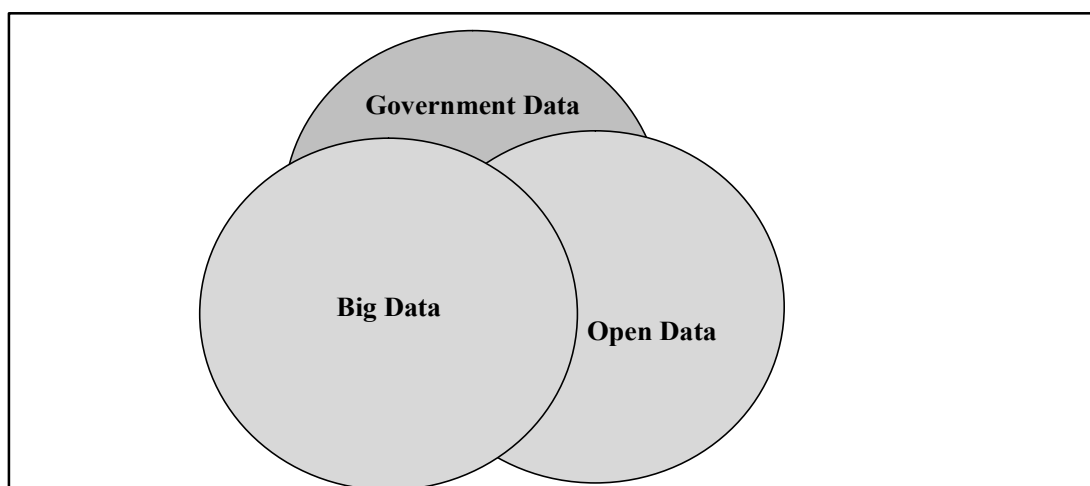


Figure 1 – The relationship between Big Data and Open Data

Source: compiled by the authors according to [8]

In the countries of the European Union, on June 20, 2019, Directive 2019/1024/EU was adopted, introducing new regulatory rules in the field of secondary use of information and open data. The member states of the European Union are obliged to implement the new rules by July 17, 2021. According to the results of the study "On the compliance of Ukrainian legislation with European legislation in the field of open data", the legislation of Ukraine in the field of open data complies with Directive 2003/98/EC and Directive 2019/1024/EC, except for some (non-essential) aspects. In general, the Ukrainian legislation provides more favorable regulation of access to open data. The main advantages of the Ukrainian legislation relate to:

- provision of all public information in the form of open data by default (open by default);
- a wider volume of information to which access is provided;
- a wider range of entities subject to open data requirements;
- free access to open data; shorter timelines for considering requests;
- providing access to information with limited access where the public interest in obtaining the information outweighs the harm of disclosure.

At the same time, Directive 2019/1024/EU has developed new approaches in the field of open data. A number of approaches proposed in the EU are more progressive than the current conditions of the open data sphere in Ukraine, and their implementation can positively affect the development of the domestic open data sphere.

The purpose of publishing information in open data format is to enable its rapid processing by automated means. Having data in a structured and machine-readable format creates an opportunity to create a visualized presentation of analyses, to present research on changes in politics, economy or society, to develop recommendations for the implementation of reforms and

control over the performance of public authorities' duties, to optimize operational activities for business, to create useful services and applications.

The development of open data includes a list of tasks, deadlines and identification of persons responsible for their implementation. Adoption of the action plan will allow to structure and systematize the work of the executive body of local self-government.

The action plan can be developed on the basis of the principles of the International Open Data Charter and the Roadmap for the Development of Open Data in Ukraine. It is worth focusing on the following main tasks:

- normative support - harmonization of the normative and legal framework with the norms of the current legislation, approval of administrative documents necessary for the establishment of the process;
- organizational and personnel support - creation of a working group, definition/creation of a responsible body, position or responsible persons in structural subdivisions;
- financial support - providing funds for the development of one's own open data portal, application programming interfaces to databases, database development, training, hackathons, development of services, products based on open data;
- data audits - organizing and conducting audits, implementing recommendations;
- data quality and availability control (monitoring of published datasets);
- publication of quality data - determining the list of datasets to be published, priorities;
- popularization of data and cooperation with users - organizing and conducting meetings with interested parties, hackathons;
- training – organizing and conducting of training events, consulting.

A prerequisite for the effective implementation of the action plan is a clear formulation and realistic tasks, deadlines and monitoring of the implementation. The structural unit responsible for the implementation of the

open data policy may be the IT department (or another department, division, unit, sector responsible for information and communication technologies, computer and technical support). For this, it is necessary to make changes in the department's regulations, in the job descriptions of employees, or to appoint/create a new position of the person responsible for open data. In addition, it is worth considering the possibility of creating a separate body responsible for open data; during the development of the regulation on the public authority, it is necessary to define and establish its main functions:

- 1) implementation, coordination and control of open data, communication with users, organization and holding of events; development of amendments to normative legal documents on open data, if necessary;
- 2) development and monitoring of the implementation of the action plan for the development of open data; optimization of work with data, data exchange between structural units, state and municipal organizations, non-subordinate bodies of executive power, commercial and public organizations;
- 3) ensuring that the issue of open data is included in the technical solutions that are planned to be developed in the bodies of executive power, local self-government;
- 4) providing the possibility to download data from databases in the open data format;
- 5) ensuring the filling of the single state portal of open data of Ukraine and, if available, also its own portal of open data or the corresponding section of its own website;
- 6) ensuring communication with users of open data and administrators of public information managers, to provide them with consultations;

7) ensuring regular updating of datasets in open data format;

8) timely informing the management about deviations from the conditions of work performance in case of objective reasons;

9) adjustment, coordination and control of the work of departments on publication of data in the open data format on the unified state portal of open data and, if available, also on its own open data portal, on the corresponding section of the website of subordinate units and enterprises, institutions, organizations;

10) regular (at least once a quarter) review of the work of managers in publishing data on the unified state portal of open data and, if available, also on its own portal of open data or the corresponding section of the site; checking the quality of published data;

11) ensuring communication with activists, public organizations, scientific, IT and business environment regarding development.

The advantages of publishing public information in the form of open data for free use have been identified, including:

- the possibility of creating additional mechanisms for implementing the right of access to information held by public administrations;
- increasing the transparency of the activities of state bodies;
- ensuring the free circulation of information and the possibility of its further use for the realization of personal rights and freedoms of an individual and a citizen, development of innovations and stimulation of economic activity, as well as prevention and detection of corruption.

The main measures to ensure the development of open data infrastructure are presented in Fig. 2.

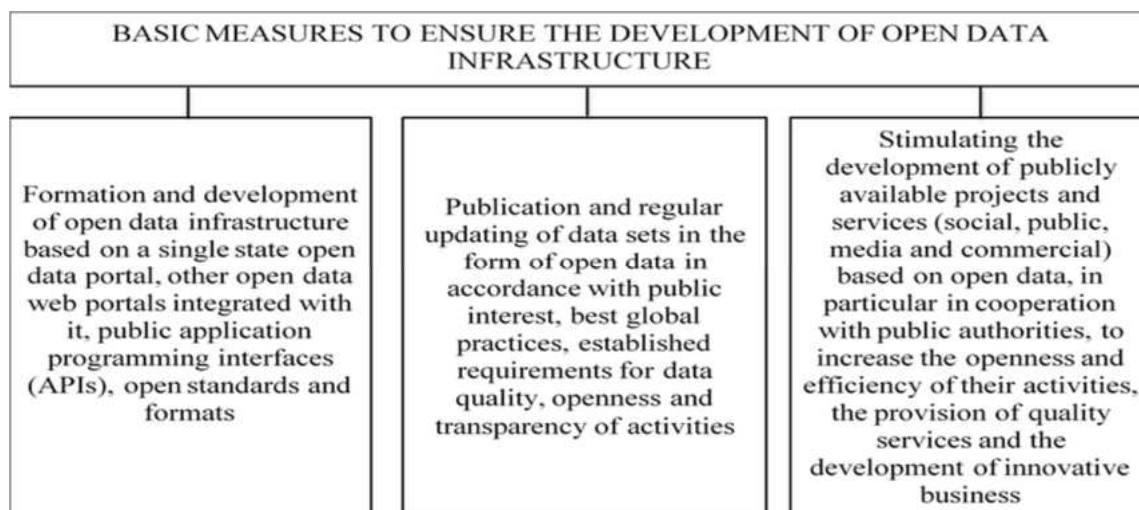


Figure 2 – Basic measures to ensure the development of open data infrastructure

Source: compiled by the author

Three interrelated components are necessary for a sustainable, well-established and systematic implementation of open data at the state and local levels:

- regulatory - implementation of the legal framework, procedures governing open data, the list of datasets to be published, the work of administrators, responsibilities, conditions of data use;

- organizational - a set of steps that must be taken by a public authority in order to fulfill the tasks specified in the normative legal acts;

- technical - implies that data must be published in clearly defined formats, in accordance with standards, in a certain place (portal, repository, website) and with appropriate frequency of updating.

The publication of open data for local self-government bodies may include the following tasks:

1) identification of structural divisions (sectors, divisions, departments) and/or persons responsible for open data;

2) approval of the procedure for publishing datasets on the single governmental portal of open data of Ukraine and, if available, on its own portal or website;

3) conducting and implementing the results of data audits;

4) if necessary, the creation of a working group for the implementation and development of open data in industry with the participation of interested parties.

The responsibilities of the department responsible for open data in public administrations at the regional level include:

- organizing and carrying out regular (at least once a year) audits (inventory) of the data of public information managers;

- establishing of the register of data managers of public information;

- maintaining and updating the register of data managers of public information;

- control over the performance of public information managers of regulatory documents on open data;

- organizing and conducting training on open data issues for those responsible for preparing and publishing data;

- work with administrators and developers regarding the use of data for management, decision making, and service creation;

- preparation of reports on the publication of public information by public information managers on the unified state open data portal, and, if available, also on their own open data portal or the corresponding section of the website.

The draft list of datasets for publication is prepared by the open data authority on the basis of the results of a data audit; an online survey (with a list of data to be prioritized or with an open question); meetings, discussions with interested parties, the public; analysis of information requested by citizens and legal entities in the order of access to public information, appeals for disclosure of information; analysis of visits, downloads, views on the official website.

User demand for data must be identified prior to release. To identify demand for data, you can conduct an online survey, organize a meeting or roundtable with interested individuals or organizations, or hold an ideathon - an event where potential users and representatives of the data manager discuss ideas for

data-based projects or problems that can be solved with data. This allows the data manager to focus their efforts on the most valuable datasets that are guaranteed to be used in the process of analytical research or the creation of a socially useful service. In this way, the administrator will be able to prepare these datasets for publication in the form and format required by the users, as well as determine the optimal update frequency for them.

When publishing a valuable dataset, it is worth spreading information about it to all interested parties: on the official page of the manager and/or in social networks, profile communities. A large part of datasets remain unused because potential users are unaware of their existence. The administrator should make an effort to disseminate information about the published dataset to facilitate the involvement of journalists, analysts, and developers in its use.

Once a dataset is published, you should maintain contact with users, respond to their comments and requests about the published data, identify projects, research, or studies based on the data, and publicly encourage their authors.

Some managers publish information about projects based on their data on their websites or social media pages. This serves as recognition for the authors of the projects, while popularizing the data and encouraging others to explore it. Contests for projects based on open data are an effective way to attract users.

Among the managers engaged in publishing information about competitions, the following can be distinguished

Open Data Incubator - an incubator of projects based on open and big data, created by the NGO SocialBoost. It unites the startup community and the public sector, in particular through the national investment program "Ukrainian Startup Fund", to solve national problems through the creation of innovative projects and electronic services. Incubator participants receive financial support, mentoring, etc.

The Ukrainian Startup Fund (UFS) is a nationwide investment program that provides financing to Ukrainian entrepreneurs. Within the framework of the program, on the initiative of the Cabinet of Ministers of Ukraine, a state fund was created whose activity is aimed at supporting innovative projects and helping Ukrainian entrepreneurs to establish successful global companies.

Transparency and Accountability in Public Administration and Services (TAPAS) - a USAID/UK aid project aimed at reducing corruption and increasing trust in government, including through the use of open data tools. TAPAS is a co-organizer of numerous events on open data, and project experts are authors of studies, methodological recommendations and regulatory documents. Open Data Challenge - national competition of IT projects based on open data with a prize fund of UAH 2.5 million. The competition has been held since 2017, and a large part of the available open data products are winners or participants of the competition.

OpenUp - according to the definition on the website - "a community of activists, developers, researchers who share the values of openness in Ukraine: data, code, research and formats". The organization, among other things, is engaged in legal practice in the field of open data.

Data from cities - a project of TechSoup and the civic network "Opora" aimed at the development of technological services for cities. The project includes incubation, training and technical support for local administrations (data audits, creation of local open data portals, etc.).

Some market participants do not create and use services based on open data, but facilitate the

development of the market and provide participants with necessary resources (financial, informational, etc.).

According to the information of the State Statistics Service, as of January 1, 2020 in Ukraine there are 86,381 persons who can be administrators (Table 1).

The persons (administrators) who are obliged to publish information in the format of open data include local public administrations, local self-government, legal entities financed from the budget (with regard to the use of budget funds), persons to whom authority has been delegated (with regard to the performance of duties), business entities occupying a dominant position in the market (with regard to the terms of supply of goods and services).

Table1 Quantitative composition of managers of information in the format of open data by organizational and legal form

Legal form	Number
State Enterprise	3750
Public enterprise	32
Municipal Enterprise	13883
State organization (institution, institution)	9613
Communal organization (institution, institution)	59103
In total	86381

Source: compiled and supplemented by authors based on reference materials [9]

The actual number of managers may differ due to the creation and termination of organizations, a more conservative estimate based on the number of offices of the single web portal of public funds is 47,525 managers.

The Antimonopoly Committee of Ukraine does not publish a list of business entities with a significant market advantage, but provides a list of 139 natural monopolies. In addition, other (including private) business entities that possess information on the state of the environment, the quality of food products, possible accidents and disasters,

and other information of public interest are considered to be managers.

As of February 7, 2020, 9,721 managers are registered on the open data portal, 3,222 have published at least one data set - about one third of the registered and about 5% of the total number of managers (Figure 3). This indicates a low level of awareness of the legal requirements, a lack of the necessary skills and motivational factors. Those who partially disclosed the identified records disclosed, on average, half of the datasets.

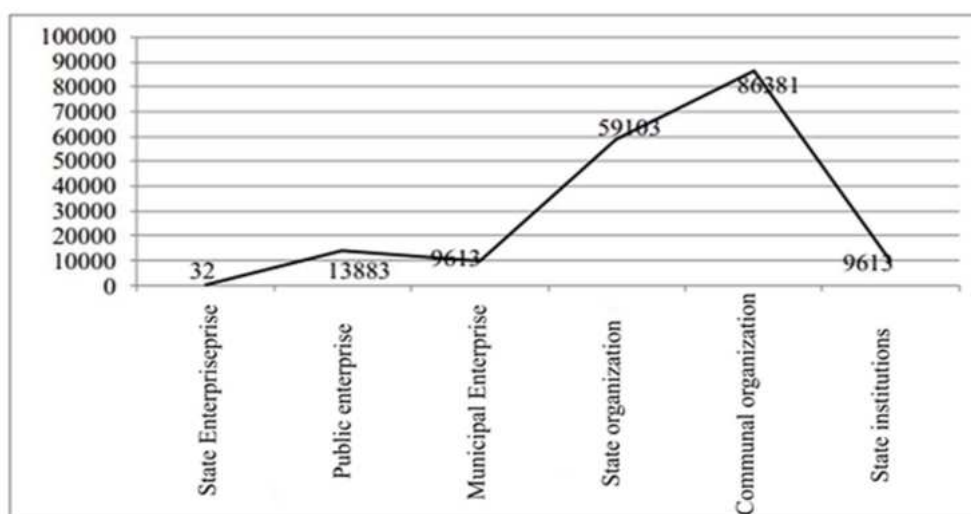


Figure 3 – Distribution of managers on the portal

Source: compiled by the authors according to [9]

Thus, it can be said that Resolution 835 has only been implemented to 53% in terms of publication of priority datasets [10]. At the same time, it is possible to publish information in the form of open data not only on the portal, but also on the websites of public administrations. About half of the public administrations at the regional level do not have a corresponding section on the website, more than 27% publish in the "open data" section ordinary public information (without metadata, in unsuitable formats, etc.). Among those who publish

information in the form of open data, most provide links to their pages on the portal or to the pages of individual collections.

Successful reuse of open data depends on its quality. The main quality indicators measured are: compliance of the file format with the recommendations; correctness of the registration; update time. In addition, the completeness of the information, the ability to link to other data sets, the absence of errors in the content, and the timely response to feedback are of great importance.

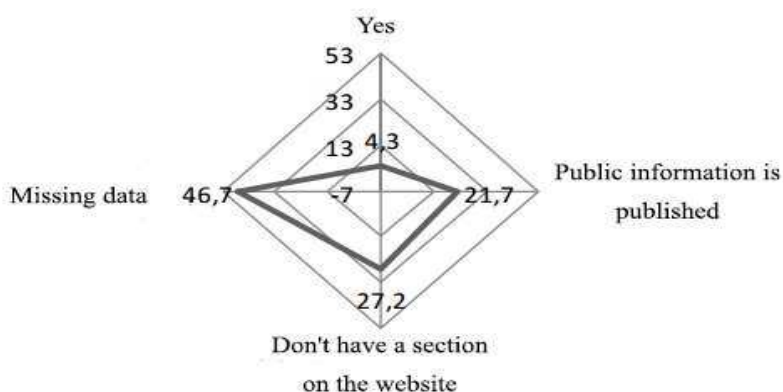


Figure 4 – The structure of information disclosure on the administrators' websites

Source: compiled by the authors according to [9]

The creation of information by the administrator is an organic result of the activity of the subject and is not regulated by a separate instrument, therefore separate instruments for obtaining information affecting the policy in the field of open data are not provided. Among the shortcomings of the regulation, the following can be distinguished

1) information created by third parties on a contractual basis may not be available to the customer (e.g. public authorities conclude contracts for the dispatching of public transport, but do not oblige the contractors to transmit or publish traffic information in real time);

2) the information is created or received in a form that is not suitable for machine processing (open data includes the provision of information in a machine-readable format: if the administrator receives information in paper form / scanned images / in the form of text documents with tables, then the disclosure of such information in the form of open data will require a great deal of time and effort to convert it into open machine-readable formats);

3) the method of information processing (information is processed by various agents (Microsoft Office, various electronic processing systems, as well as in paper form).

As a result, the same information can be published using different approaches (formats, structure, attributes, etc.). As a result, the data sets of different managers are not interoperable, which makes them difficult to use. In practice, the open data business process differs from the legal business process described above. The main

difference is the lack of preliminary assessment of the entire volume of public information and its proactive disclosure in the format of open data. That is, there is a problem with the implementation of the "openness by default" principle.

In the practical activity of public authorities at the regional level, the main point of reference for the publication of open data is the list of sets determined by Resolution No. 835 of October 21, 2015 "On approval of the Regulation on sets of data subject to publication in the form of open data". Other available sets are processed last; the determination of the available amount of information, the determination of whether it is open or closed, as well as the performance of a triple test are informally carried out by managers.

Decisions on these issues are not made or published. Administrators without appropriate IT solutions publish ordinary work files under the guise of open data; data published on administrative websites often lack metadata and are published in the form of a web page with information or scanned copies of documents.

Individual open data portals often do not have a customized API for harvesting data into the portal; if a request for access to information that has not yet been made public is received, the set is prepared only after receiving the request itself (processing of formats, personal data, etc.). The options for the implementation of the open data policy include the continuation of the current policy, the policy of effective or complete

openness. The proposed options have both advantages and disadvantages (Table 2).

Table 2 **Advantages and disadvantages of implementing an open data policy**

Policy implementation option	Advantages	Disadvantages
Valid open data policy	the policy already provides positive dynamics	non-compliance with policy requirements by a significant number of managers low quality of published data slowness of changes
	does not require additional financial resources for implementation requires minimal political resources for continued implementation	reduction of the total volume of public information possible drop of Ukraine in data openness ratings
	competent authorities are able to concentrate on the most valuable datasets of a limited number of administrators	
Policy of effective openness	will reduce the use of financial and organizational resources at managers	requires significant financial and organizational resources as in
	The CMU can flexibly respond to society's request for a certain type of information	managers, as well as competent authorities needs institutional (reorganization of public administrations) and regulatory changes
Full disclosure policy	increasing the volume of public information in the form of open data	requires significant political efforts to implement the policy
	improving the quality of the most valuable datasets	
		non-compliance with policy requirements by a significant number of managers

Source: compiled by the author

Conclusions. Thus, today, theoreticians and practitioners of public administration face the task of systematizing the work done and developing proposals for improving the existing mechanisms. It is a matter of regulating the relations between the managers of open data and their consumers by public authorities, namely:

- requirements to publish datasets extend to tens of thousands of datasets;
- requirements of managers for open data and separate datasets are unclear;
- monitoring and controlling compliance is complicated by the combination of a large number of managers with low institutional capacity;
- managers publish datasets according to the list approved by the CMU, and other available datasets are in fact published on a voluntary basis;
- managers provide information in the form of open data upon request, their responsibility for violations is insignificant.

The policy of effective openness provides for:

- changing the list of datasets to be published in the form of open data to an exhaustive one;
- reduction of the number of managers of information in the form of open data and their clear definition (CSOV, NBU, GPU, courts, large cities, large state enterprises, etc.);

- a detailed description of the main requirements for open data;

- control of the implementation of the legislation is carried out by the Commissioner for Human Rights and the Ministry of Digital Policy without organizational changes, but with respect to a smaller number of administrators and data sets. The control is carried out on the facts of non-disclosure, non-compliance with disclosure requirements, failure to respond to a request;
- increased responsibility for open data violations in relation to the datasets included in the list.

In the case of the implementation of an effective data policy, other controllers provide information in the form of open data upon request or publish it at their own discretion. It seems most appropriate to implement a policy of full openness by public authorities at the regional level, determined by a series of principles, namely:

- clear definition and consolidation at the legislative level of the principle of openness and the obligation of managers to disclose all public information in the form of open data;
- The CMU defines the list of the most valuable datasets, for each of which the Ministry of Digital Policy defines the requirements (API availability, formats, content, update conditions, etc.);

- existing datasets not included in the list are subject to mandatory disclosure by managers in any form that meets open data requirements;

- a detailed description in the law of the main requirements for open data (machine readability, open format, interoperability, etc.);

- control over the implementation of the law is carried out by a body that has sufficient organizational and financial capacity (sufficient staff, IT solutions for automation);

- the control is carried out regarding facts of non-disclosure, non-compliance with requirements, non-response to requests;

- determination of different degrees of responsibility for various violations depending on the consequences; identifying an administration or a manager as the subject of the violation and strengthen the responsibility for violations in the field of open data.

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