INTRODUCTION
At this stage of the world economy, a large number of countries directed for the industry development, as well as its innovative component introduce a cluster approach, which is based on obtaining positive benefits and using the effects of extensive concentration of enterprises and their industries, namely: economies of scale, synergies, knowledge exchange, use of common resources, etc. The classical cluster structure is considered as a certain formation, which is organized according to a number of principles, and therefore connected with a certain territory. This location and proximity lead to these results. However, with the digital economy development and the growing share of information consumption of operational processes, goods and services, the effectiveness and efficiency of the economic entities’ interaction is less correlated with their location.

In such realities, the domestic economy development is characterized by the transition to a qualitatively new level of introduction and use of information and telecommunications technologies in all spheres of economic and social activity of the country. Under these conditions, effective interaction of enterprises is impossible without the creation of both production and clusters of digital economy. In a general sense, a cluster means the integration of business entities and cooperating institutions of cooperation, which are territorial or joint activities are aimed at improving the efficiency of their operation, competitiveness and optimization of the regional development.

LITERATURE REVIEW
Many scientific works of domestic and foreign scientists are devoted to the study of digitalization, innovation and information development, among them: Adam (2018); Afonasova, Panfilova, Galichkina, Ślusarczyk (2019); Alraja, Hussein, Ahmed, (2020); Billestrup, Stage (2014); Budzinski, Stöhr (2019); Butko, Pishinen (2019); Chudnovskiy, Tsabolova, Zhukova (2021); Dannikov, Sichkarenko (2018); De Silva (2019); Eichstädt (2020); Gopane (2020); Heat (2019); Ključnikov, Civelek, Krajčík V, Ondrejmišková (2020); Kornieieva (2018); Kychko I., Tulchynska S., Zhgygalkevych Z., Treitiak O. (2021); Lazarenko I.; Saloid S.; Tulchynska, Kryuchenko, Tulchinsky (2020); Lin Chia (2018); Myovella, Karacuka, Haucap (2020); Revko (2020); Shkarlet, Ivanova (2020); Sudolska, Łapińska (2020); Szopik-Depczynska, Cheba, WiŚniewska (2020); Tulchynska, Vovk, Saloid (2021); Yunfu Xu, Aiya (2020); Zajkowska (2017) et al.

World experience proves that clustering is an effective tool of regional and (or) national competition, according to studies by such foreign scientists: Arnold E., Deuten, Van Giessel (2004); Charles, Wessner, Wolff (2012); Enright (1992); Fontagne, Koenig, Mayneris, Poncet (2012); Porter, (2002, 2010); Ketelhohn, Artiganave, Kelly, Krasniqi, Zhang (2010); Santisteban M. (2006); Solveill, Lindqvist, Ketels (2003) et al.
METHODS

Within this paper, such scientific research methods are used as: the method of analysis and synthesis to identify global models of cluster structures and outline their main characteristics; the identification of features and characteristics of Ukrainian clusters; the statistical - for the formation of indicators that allow to describe the state of digitalization of the regions in Ukraine; the graphic method - to visualize the impact of the digital economy on the development of socio-economic relations and the transformation of the clustering process in digital economy.

RESULTS AND DISCUSSION

The application of the cluster approach to the development of national and regional economies should be considered today as one of the effective and efficient tools for the development of both individual territories and areas of economic and social activity, primarily the emergence of a synergy effect. It is proved that the economy clustering has a number of advantages:

- formation of systems (clusters) for the production of a particular product or product, which are created on the basis of the association of economic entities on a territorial, sectorial or legal basis;
- reduction of transaction costs by establishing close cooperation and accounting and control of costs and profitability of all cluster members to achieve a common goal;
- simplification and optimization of cluster management activities by creating a single object of cluster structure management, which is more effective than regulating the functioning of each individual business entity, which while retaining their property rights.

The use of the cluster approach by the economy development of a country or its regions is demonstrated today by most countries of the world. Cluster formations exist and function successfully in Europe, Asia, North and South America, Australia and Africa, a large number of them are concentrated in countries such as India, USA, UK, France, Spain, etc. (Fig. 1).

Fig. 1. Distribution of countries in the world by the largest number of clusters

![Distribution of countries](image)

Source: Search data.

Countries that are territorially close have a large number of common features in the implementation of the cluster approach, mostly at the initial stage. With further development, each country begins to acquire its own characteristics of clustering, but a number of similarities
remain due to the institutional environment and so on. Activities and development of clusters have recently been concentrated not only within regions and countries, but also spread more widely, which leads to the formation of a number of territories in the region which should eventually be considered as international competitive market players. The study of the cluster approach implementation in different countries of the world allowed to identify the leading features of the global cluster models (Table 1).

Table 1. World models of cluster structures

| World model  | Brief description and features                                                                 | Advantage                                                                                                                                 |
|--------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| European     | Achieving close cooperation between the state and business structures for the effective functioning of the cluster formation | Recognition of the authority of the state in the European business environment, its performance as a defender of market conditions and industry |
| North American | Low level of the state intervention and influence on the processes of the creation and development of clusters, achieving a high level of the participants’ competition in cluster structures in market economy | Effective interaction of government agencies, industry and educational institutions, resulting in the creation of innovations and technological advances; low level of the formalization in the cluster approach implementation by public authorities. |
| Asian        | State intervention for the formation of competitive clusters, which are the integration of small and medium-sized businesses with large enterprises based on subcontracting conditions for production. Achieving within this model the effect of specialization at a low level of efficiency of the state innovation system in the cluster approach implementation | Protection provision by state bodies of their own producers from foreign ones, assistance with their promotion on world markers |
| South American | Clustering is carried out mainly with the participation and at the expense of international organizations with the involvement of foreign direct investment to carry out innovations. The cluster structure has a core, which consists of leading companies | Direction of clusters for export |
| Australian   | The cluster structure consists of representatives of private business and public authorities who participate in financing the creation of the cluster on an equal basis through a specially created organization | This model is attractive to all participants in the cluster structure due to mixed funding |
| African      | This model is the youngest of the others, which is characterized by a change in several concepts of the cluster development in a short period of time | Financial and organizational support of international organizations for the processes of origin, formation and development of cluster initiatives and structures |
| Post-Soviet  | Cluster structures have a core, which is mainly large enterprises and operate at a low level of competition, market relations and small business development | Accelerating economic development by creating cluster structures |

Source: Search data.

Based on the above, we can formulate the following generalizing features of the global clustering:

- formation, functioning and development of cluster structures is an effective tool for the development of countries and its regions and serves as a catalyst for the transition of socio-economic systems to a higher level;
- a strategic advantage and a distinctive feature of cluster formation is to obtain a synergistic effect, which leads to the increased efficiency of both the cluster and the region in which it operates;
- a characteristic feature of the cluster is its innovative orientation;

The cluster policy is implemented on the basis of cooperation and networking between business entities, authorities, research institutions and educational institutions in order to
achieve a synergy effect and the formation of locomotives of innovative development of the regions. The experience of clustering in Ukraine is more than 20 years, during which all regions of the country worked to study and identify areas of clusters, assess their potential, develop and approve strategies, projects, programs, etc., but real action is aimed at practical steps of clustering little, which is reflected in the small number of actually functioning cluster associations in Ukraine. There is no single official data on their number, so the authors collected and systematized data on the number and specialization of cluster structures, which were identified and described by domestic scientists and experts (Fig. 2).

**Fig. 2. Cluster’s specialization in Ukraine in 2020**

| Cluster Specialization                                | Count |
|-------------------------------------------------------|-------|
| Information Technology                                 | 20    |
| Agriculture and fisheries                             | 18    |
| Food production                                       | 16    |
| Tourism and recreation                                 | 14    |
| Production of wooden products                          | 12    |
| Mechanical engineering and equipment production        | 10    |
| Construction                                          | 8     |
| Transport and logistics                               | 6     |
| Education                                             | 4     |
| Education                                             | 2     |
| Production of electronic equipment                     | 2     |
| Shipbuilding                                           | 2     |
| Flax production                                       | 2     |
| Production of souvenirs                                | 2     |
| Apiculture                                            | 2     |
| Stone processing                                      | 2     |
| Forest industry                                       | 2     |
| Metallurgy                                            | 2     |
| Light industry                                        | 2     |
| Production of electronic equipment                     | 2     |
| Production of souvenirs                                | 2     |
| Production of wooden products                          | 2     |
| Mechanical engineering and equipment production        | 2     |
| Food production                                       | 2     |
| Agriculture and fisheries                             | 2     |
| Tourism and recreation                                 | 2     |
| Information Technology                                 | 2     |

**Source:** search data.

It should be noted that the number of the above clusters in the country is not constant, because, first, a large number of cluster structures formed during the period from the 90s to 2010 ceased to exist, and second recent years are characterized by the formation of new clusters. connections. Thus, based on the study of the functioning of domestic cluster structures, it is possible to outline special features and give a description of domestic clusters (Table 2).
Table 2. Features and characteristics of Ukrainian clusters

| Characteristic            | Content                                                                                                                  |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Location of members of    | A large number of cluster participants in their location is limited to the territory of                                  |
| cluster formations on a   | one region or the district of the country                                                                               |
| common territorial basis  |                                                                                                                          |
| Connection of cluster     | The following specialization prevails among domestic clusters: agriculture and                                           |
| members with a common     | agro-industrial sector, food production, tourism and recreation                                                          |
| sphere of activity        |                                                                                                                          |
| Structure and number of   | In recent years, there has been an increase in the number of clusters of information                                       |
| cluster members           | technology and cluster structures of innovation (innovation clusters) in the regions of the country                      |
| Development and support   | Ukrainian cluster structures mostly combine from 20 to 50 members, among which enterprises, firms, companies, educational |
| of domestic cluster       | institutions, banking institutions, public organizations, etc. should be singled out.                                     |
| initiatives by           |                                                                                                                          |
| international            |                                                                                                                          |
| organizations            |                                                                                                                          |
| The initial stage of      | The implementation of the clustering process in Ukraine was initiated and is carried out on the basis of cooperation with |
| functioning of the        | foreign organizations and specialists of the USA and the EU, the implementation of joint programs and projects            |
| vast majority of domain   |                                                                                                                          |
| clusters                 |                                                                                                                          |
| Methodological, institutional, financial, etc. complexities of clusters | The process of origin and further functioning of clusters began with the regions with the lowest indicators of the socio-economic development; a large number of clusters are still at the stage of emergence or formation, has a small number of real participants with weak interaction, territorially located within the region, and sometimes the district. There is no methodology for identifying, forming and evaluating the effectiveness of clusters. |

Source: Search data.

The development of Ukraine has recently been increasingly influenced by the intensification of the processes of the world digitalization (Table 3). Digital economy in Ukraine is already a reality, which has a number of preconditions, which are reflected in the following data of the country:

- development of infrastructure for Internet access, as well as growth in the number of Internet users;
- development of IT infrastructure at domestic enterprises;
- development of e-commerce;
- development of the IT sphere;
- development of e-government.

Table 3. Indicators of the digital economy development in Ukraine

|                        | Proportion of households that have access to Internet services at home, % | Share of Internet subscribers to the whole population | Share of the population employed in the IT sector, including IT clusters per 1000 population |
|------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Ukraine                | 65.8                                                                     | 68.5                                                 | 183.00                                                                                     |
| The Crimea             |                                                                         |                                                      |                                                                                            |
| Vinnytsia              | 63.9                                                                     | 64.2                                                 | 5.13                                                                                       |
| Volyn                  | 53.3                                                                     | 57.3                                                 | 1.92                                                                                       |
| Dnipropetrovsk         | 79.3                                                                     | 77.8                                                 | 15.25                                                                                     |
| Donetsk                | 68.0                                                                     | 76.8                                                 | 3.52                                                                                       |
| Zhytomyr               | 54.6                                                                     | 65.                                                   | 3.28                                                                                       |
| Transcarpathian        | 75.9                                                                     | 77.9                                                 | 1.54                                                                                       |
| Zaporizhzhia           | 68.5                                                                     | 71.3                                                 | 5.97                                                                                       |
| Ivano-Frankivsk        | 65.3                                                                     | 76.4                                                 | 3.14                                                                                       |
| Kiev                   | 60.8                                                                     | 60.6                                                 | 17.65                                                                                      |
| Kirovohrad             | 54.1                                                                     | 56.0                                                 | 1.85                                                                                       |
| Luhansk                | 63.3                                                                     | 67.4                                                 | 1.46                                                                                       |
| Lviv                   | 68.9                                                                     | 70.2                                                 | 18.99                                                                                      |
| Mykolayiv              | 66.8                                                                     | 70.5                                                 | 4.90                                                                                       |
| Odessa                 | 69.8                                                                     | 76.3                                                 | 8.65                                                                                       |
| Poltava                | 52.2                                                                     | 60.8                                                 | 3.55                                                                                       |
| Rivne                  | 49.3                                                                     | 69.1                                                 | 2.32                                                                                       |
| Sumy                   | 67.2                                                                     | 71.6                                                 | 2.50                                                                                       |
| Ternopil               | 64.9                                                                     | 67.9                                                 | 2.04                                                                                       |
| Kharkiv                | 65.0                                                                     | 70.4                                                 | 25.77                                                                                      |
| Kherson                | 50.6                                                                     | 65.5                                                 | 2.20                                                                                       |
| Khmelnytsky             | 55.3                                                                     | 61.1                                                 | 2.70                                                                                       |
| Cherkassy              | 59.5                                                                     | 66.2                                                 | 4.3                                                                                       |
| Chernivtsi             | 69.3                                                                     | 72.2                                                 | 1.78                                                                                       |
| Chernihiv              | 55.3                                                                     | 62.3                                                 | 2.99                                                                                       |
| Kyiv city              | 83.7                                                                     | 81.4                                                 | 37.89                                                                                      |
| Sevastopol city        | -                                                                        | -                                                    | -                                                                                          |

Source: search data.
Today, transformations that take place in the spatial distribution of production and the competitive environment are associated with the economy digitalization. The introduction and development of digital information technologies in all components of production systems leads to increased efficiency by reducing costs in terms of promoting segregated employment, reducing information and management costs, as well as the interaction between environmental factors of direct action and more. Against this background, new forms of economic ties and interaction appear (Fig. 3).

**Fig. 3.** The impact of digitalization on the development of socio-economic relations

Digitization of the modern economy affects the formation and functioning of cluster structures, which is primarily manifested in reducing the importance of the spatial location of the components of cluster formation, as currently the exchange and transmission of information does not depend on the proximity of participants. Development of modern communications, which are provided by digital technologies, allows the exchange of implicit knowledge without personal interaction and transmission of information, remotely in online format. In addition, the creation of a single digital information space of the cluster allows all its members to gain new knowledge and transform it into innovation, which contributes to the benefits. Against the background of these processes is the separation of information and management processes from material production, which is becoming increasingly automated and robotic, and is located where there is a large number of cheap resources. While people engaged in the information and digital process seek to live where there is a high standard of living. Thus, based on modern transformations, a cluster is a certain association of economic entities that are not united by territorial proximity.

The changes brought about by digital economy have certain consequences for clustering. First, the basis of the cluster is the intellectual component, for the effective functioning of which does not require material resources or close proximity of production systems, but the ability to best implement the human potential. Second, clustering is increasingly ceasing to be associated with a particular region of the country or neighboring territories due to resource constraints and reduced competitiveness. Third, the central element of the cluster is the implementation of digital information management and financial transactions, which are weakly dependent on the geographical location of participants and affect its competitiveness. Thus, traditionally, industrial production clusters are transformed into entities that are
adaptable to the new requirements of digitalization (digital clusters). Thus, the development of the domestic economy based on the digital platform not only does not eliminate the benefits of classical clustering, but also adds new ones (Fig. 4).

**Fig. 4.** Clusters in the context of the economy digitalization

| DIGITIZATION OF THE ECONOMY (influence and manifestations) |
|-----------------------------------------------------------|
| Reducing the significance of the geographical factor for the work of cluster |
| Removing the exchange of implicit knowledge |
| Improving the availability of information |
| Separation of information processes from material production |

| CLUSTERING (process changes) |
|------------------------------|
| Changing the place of concentration of capital |
| Reducing the effectiveness of traditional cluster policy, built on the territorial principle by increasing the information intensity of goods |
| Dissemination of the digital environment for information, management and financial intra-cluster transactions |

| INFORMATION TECHNOLOGIES OF DIGITALIZATION IN THE FIELD OF INDUSTRIAL SYSTEMS |
|-------------------------------------------------------------------------------|
| Simulation and creation of digital duplicates |
| Machine learning |
| Robotization and informatization of production |
| Industrial Internet |
| ERP, CRM, BPM systems |
| Cloud technologies |

| DIGITAL ECONOMY CLUSTERS |
|--------------------------|
| Implementation of basic transactions in the digital |
| Reduction of intra-cluster transaction costs relative to external ones |
| Achieving effective interaction of cluster members regardless of their location |

| GAINING BENEFITS AND OVERCOMING PROBLEMS |
|------------------------------------------|
| Reduce maintenance infrastructure costs |
| Overcoming the negative impact on the environment |
| Reduce barriers to entry for new members |
| Increasing cluster competition |
| Ensuring greater access to resources |

**Source:** Search data.

The issue of the concept and essence of the cluster of digital economy, which appears in the context of digitalization of socio-economic relations, is interesting. We believe that this cluster structure implements such a basic function as reducing the transaction costs of cooperation and interaction of its participants and is not limited to manufacturers in the field of information technology. The core of a cluster is an association of enterprises and the basis of their interaction is located in the digital space and is not tied to a specific location, and production systems themselves can be material. Thus, a digital economy cluster should be understood as a set of economic entities that cooperate and interact with the help of digital information and communication technologies are sustainable and aimed at reducing transaction costs.

The following features of the digital economy cluster can be distinguished:
• the main transaction processes take place in the digital space;
• transaction costs of interaction are lower in the cluster structure than outside it;
• effectiveness of interaction and cooperation of cluster members does not depend on their physical location.

Thus, it can be noted that the development and dissemination of digitalization has a positive effect on the quality of the information component and accelerates the process of its exchange, resulting in the following transformations in the management process:

• there is a decrease in the influence of the territorial feature of economic entities on the effectiveness of their cooperation and interaction;
• improving the quality of transmission and exchange of both explicit and implicit knowledge;
• separation of information production from material;
• ending the dependence of access to knowledge and technology on the territorial proximity to their source.

Thus, the above transformations change the approaches, principles and patterns of the cluster formation, namely: expand the geography of enterprises in the cluster, change the location and concentration of major production processes, transfer of various intra-cluster transactions (information, management, financial) in the digital space, which becomes the main condition for the integration of enterprises in modern conditions.

Therefore, the digital economy development is occurring today around the world, including Ukraine. To speed up this process and increase its efficiency, it is necessary to use all available tools, one of which is clustering. It allows to unite the efforts of all participants of the cluster: enterprises, authorities, research institutions and educational institutions to achieve a synergistic effect and positively affect the development of the region, the country and the living standards of their population.

CONCLUSION
In the article, based on the thorough analysis and systematization of data, the leading world models of cluster structures are singled out, their characteristic is given and advantages of each are defined, on which base, generalizing features of clustering are systematized and formulated. The implementation of the cluster approach in Ukraine is studied, the specialization of Ukrainian clusters, their features and main features are given. The analysis of digitalization of Ukraine by regions is carried out based on a number of indicators; they are grouped by the level of the digital economy development. The influence of digital economy on socio-economic systems in general, and separately on the clustering process, the consequences of such influence are determined. Digitization has been shown to transform clustering and lead to the emergence of new clusters - digital economy clusters, which are a set of economic entities based on sustainable interaction, digital communications, which leads to lower transaction costs. Thus, the transformations that occur with clustering in digital economy are the emergence of these cluster structures, which today can unite companies not only close to the territory, reduce transaction costs and transfer them to the digital sphere, almost independent of access to resources.

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Transformational processes of clustering in digital economy

Abstract
Within the article, information on the current state of clustering is systematized, for which the data on the cluster formations functioning in the world are analyzed, on the basis of which seven world models of clusters are singled out, their main and characteristic features are outlined. The orientation of Ukrainian clusters is clarified, special features are revealed and their characteristics are given. It is proved that modern manifestations of digital economy significantly influence the process of clustering and cluster formation. The analysis of digitalization of Ukraine in the regional section is carried out, grouping of regions on digital development of regions is conducted. The influence of digitalization on the development of socio-economic relations is revealed and outlined. The main transformational changes of modern clustering in the conditions of digitalization are formulated, it is proved that its change led to the appearance of such cluster formations as clusters of digital economy, their concepts, essence, features and advantages are clarified.

Keywords: Transformation processes. Clustering. Digital economy. Information economy. Regional economy.

Resumen
El artículo sistematiza la información sobre el estado actual de la agrupación para la cual se analizan los datos de las formaciones de agrupaciones en funcionamiento en el mundo, a partir de la cual se destacan siete modelos mundiales de agrupaciones, se esbozan sus principales rasgos y rasgos característicos. Se aclara la orientación de los grupos ucranianos, se revelan características especiales y se dan sus características. Está comprobado que las manifestaciones modernas de la economía digital influyen significativamente en el proceso de agrupación y formación de agrupaciones. Se lleva a cabo el análisis de la digitalización de Ucrania en la sección regional, se lleva a cabo la agrupación de regiones sobre el desarrollo digital de las regiones. Se revela y describe la influencia de la digitalización en el desarrollo de las relaciones socioeconómicas. Se formulan los principales cambios transformacionales del clustering moderno en las condiciones de la digitalización, se demuestra que su cambio llevó a la aparición de formaciones de clúster tales como clusters de economía digital, se aclaran sus conceptos, esencia, características y ventajas.

Keywords: Procesos de transformación. Agrupamiento. Economía digital. Economía de la información. Economía regional.