

## ASSESSING THE STATE OF THE CORPORATE INFORMATION AREA IN UKRAINE

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**Abstract.** The article defines the methodological tool to assess the state of the corporate information area in the country. The authors have proposed the integrated indicator and its key components as a simplified alternative to existing approach to evaluation of the state of the corporate information area. The efficiency of the proposed indicator in terms of information lack is underlined. The state of the corporate information area of Ukraine using an integrated indicator in 2010–2020 is assessed in the article. The authors determine that the integrated indicator of the state of the corporate information area of Ukraine has more significant fluctuations than its individual components during the study period. The article analyzes the correlation between the integrated indicator of the state of the corporate information area and gross value added at actual prices of the national economy of Ukraine in 2010–2020. As a result of the study, the authors revealed that changes in the state of the corporate information area can be considered a driver of changes in the general state of the national economy.

*Keywords:* corporate information area, integrated indicator, information and communication technologies, gross value added, Internet users, capital investment

## 1 Introduction

Prospects for the world economy in the XXI century are determined by the nature of countries' transition to a new stage of productive forces development — from the industrial to post-industrial stage determined by services, science, education, highly skilled labor, new knowledge, technologies and management methods. Based on the latest technologies (means of communication,

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information processing), a new economy has developed. It requires a new vision, new approaches and new action plans, provides the conditions that would encourage individuals and businesses to create the next generation of knowledge, technologies, business models and dynamic management systems.

The post-industrial nature of the economy is a new stage of civilization with restructured and transformed all the elements of the society, all systems of interaction between them, drivers of social processes, their economic and social mechanisms, indicators and methods of measuring efficiency. In the context of building a society united by means of global communication, the information and communication revolution is reflected in the business processes changes. In such a case, corporations have to adopt their activity to information and communication transformations in order to save and increase their competitiveness especially in terms of Covid-19 influence. Therefore, investigation of the state of corporate information area is important in modern conditions of business processes transition particularly.

Recent researches and publications show a great attention to the question of building a corporate information area. They are mainly concentrated on the two directions of investigation: the information environment (single information area) and corporate information system (infrastructure).

Some of the authors are concentrated on the concept of the single information area. The single information area is considered from the standpoint of public administration, the formation of a single information policy, the strategy of formation and development of a single information area in Ukraine. The single information area is a set of databases and data banks, technologies for their maintenance and use, information and telecommunications systems and networks that operate based on common principles and general rules, ensuring information interaction of organizations and citizens and meeting their information needs. The single information space consists of the following main components: information resources—databases and data banks, all types of archives, depository systems, libraries, museum repositories; information and telecommunication infrastructure [1, 6, 11].

The corporate information area in this case is an element of the single information area which takes into account the corporate level only instead of the country level as a whole.

There are also researches that concentrate attention on the corporate information systems while studying the corporate information area. Corporate information system (CIS) is identified by the representatives of this view as an information system that supports the automation of management functions and provides information to improve knowledge and make management decisions. It implements a modern management ideology that combines the business strategy of the enterprise and advanced information technology [4, 8, 9].

The corporate information area in this case is an external information environment instead of the internal information and communication infrastructure of the enterprise.

As for assessing the corporate information area, there are some models that evaluate internal corporate information infrastructure and do not take into account the external information and communication environment [11, 12].

**The aim and objectives of the study.** As a result of the literature review, it is identified the concentration of scientists on the definition of the information environment instead of corporate information area and the absence

of methodological tools to evaluate its dynamics and efficiency. Therefore, it is necessary to investigate the state of the corporate information area in Ukraine, to propose the methodological tool for its assessment, to study the influence of changes in corporate information area on the national economy and to identify prospects for the further research in this field.

## 2 Methodological tool to assess the state of the corporate information area in the country

The research encountered two significant problems related to methodology and data such as:

- lack of investigations the concept “state of corporate information area” and methodological approaches to its evaluation;
- lack of open sourced data for the study.

The state of the corporate information area is a complex concept and there is no single universal indicator for its assessment. It can be argued that in any method of assessing this situation researchers are forced to rely on abstract models that do not fully describe the complex reality of economic relations between institutional units of the national economy in the information area, as well as all factors influencing processes of using information and communication technologies (ICT). The issue of this assessment is illustrated by the history of the ICT Development Index (IDI). It was calculated and published from 2009 to 2017 and accumulated 11 indicators into the aggregate score. Therefore, it was too complicated and had to be abandoned due to methodological problems [3].

Consequently, for the purpose of analyzing the state of corporate information area in this study it was decided to use a simplified model of integrated indicator based on publicly available statistics - quantitative key indicators calculated by generally accepted methods and available in open sources. The proposed integrated indicator summarizes 3 indicators. They characterize a separate aspect of the state of the corporate information area in Ukraine. Some of the indicators are used in the same form as they are presented in the original source, as well as there are indicators preliminary converted into a coefficient based on the initial absolute values or calculated in the process of pre-integration of individual indicators. In particular:

1) Individuals using the Internet (% share of total population) is presented unchanged according to the World Bank (an indicator that expresses the extent of ICT in the country);

2) the share of capital investment in software and database of total capital investment in the economy is calculated based on data from the State Statistics Service of Ukraine of capital investment in software and databases and total capital investment (million UAH) (an indicator of the economic potential of information and communication technologies in the country);

3) level of market exchange of computer and communication services in the national economy ( $L_{MES}$ ) is the result of integrating the two indicators by calculating the geometric mean:

$$L_{MES} = \sqrt{L_{EX} \times L_{IM}} \quad (1)$$

where  $L_{EX}$  and  $L_{IM}$  — indicators of the ICT services share in total export and

import of commercial services, respectively (computer, communications and other services in percent of commercial service exports and computer, communications and other services in percent of commercial service imports) according to the World Bank data.

The importance of the indicators is proposed to be the same in the process of calculating the integrated indicator of the state of corporate information area, which will avoid distortions of the result associated with subjective judgments in the process of assigning ranks to each indicator.

The proposed integrated indicator is aimed primarily to be used at the level of institutional units belonging to corporations in justifying strategic decisions related to ICT. It is quite suitable for rapid diagnosis of ICT development in the country and can replace the IDI indicator.

The peculiarity of the proposed integrated indicator is in the necessity of its dynamics calculation. It is not useful to calculate it for one year only without comparing with the established base (or reference) values of individual key indicators. In the research, the baseline values for each of the three indicators of 2015 for comparison were used. The choice of the baseline values was due to the well-known events of 2014 in Ukraine.

The integrated indicator of the state of the corporate information area for a particular year is calculated based on the triangle area. The vertices of it are plotted in a coordinate system with 3 axes. Each of the axes corresponds to one of the above key indicators. At the same time, each axis lays has a relative value and shows the share of the indicator's value by in its base value for a given year.

The resulting value of the triangle's area is correlated with the base area (calculated for a triangle of a base size where all vertices have coordinate 1) and is expressed as a decimal fraction (fraction of one). Formula for calculating the integrated indicator of the state of corporate information area in the country is as follows:

$$\begin{aligned} II &= \frac{1}{2} \times [(I_1 \times I_2) + (I_2 \times I_3) + (I_3 \times I_1)] \times \sin 120^\circ / \left( \frac{1}{2} \times 3 \times \sin 120^\circ \right) \\ &= [(I_1 \times I_2) + (I_2 \times I_3) + (I_3 \times I_1)] / 3, \end{aligned} \quad (2)$$

where

$II$  — an integrated indicator of the state of the corporate information area;

$I_1, I_2, I_3$  — indices (relative values) of key indicators used in the model of the integrated indicator:

- 1) the share of Internet users in the total population;
- 2) the share of capital investment in software and databases of total capital investment in the economy;
- 3) an indicator of the importance of market exchange of ICT services for the national economy according ( $L_{MES}$ ) to the formula (1).

Such an approach to the evaluation of an integrated indicator has been tested and demonstrated its adequacy in research of the financial system development [7] and business environment security assessment [2]. In addition to the analysis of the state dynamics of the corporate information area for an individual country, the proposed model of the integrated indicator allows

a comparative analysis for several countries. It is possible to compare the time series of calculated integrated indicators of individual countries for identifying trends in the level of development of corporate information area, as well as to compare with the time series of other indicators. It should be noted that in addition to simplicity and accessibility, one of the significant advantages of the proposed model is its clarity, which is provided by the drawing a geometric figure (triangle) in the form of a petal diagram.

The choice of a simplified model of the integrated indicator is related to the problem of lack, fragmentation or doubtful information about a number of indicators on the research topic. This problem is relevant not only for the Ukraine. In Ukraine, an additional complication was that since 2014 information about the occupied territory of the Autonomous Republic of Crimea, Sevastopol and part of the temporarily occupied territories in Donetsk and Luhansk regions has become unavailable. As a result, the formation of the full necessary information base for the period from 2010 to 2020 was impossible. Using available fragmentary data for different periods negatively affected the obtained results but did not make it impossible to study in general.

### 3 Integrated indicator of the state of the corporate information area in Ukraine in 2010–2020

The corporate information area of the country is identified in the current research as a set of socio-economic conditions for using ICT by non-financial and financial corporations in the national economy. This concept was introduced to distinguish the corporate information area from the information environment, which is broader and covers a number of other aspects of ICT development, including technical, organizational, legal, as well as information security (cybersecurity). Cybersecurity index (Global Cybersecurity Index) assesses the level of information security in global practice recent years.

The integrated indicator of the state of the corporate information area in Ukraine has increased significantly in 2010–2020 (Fig. 1).

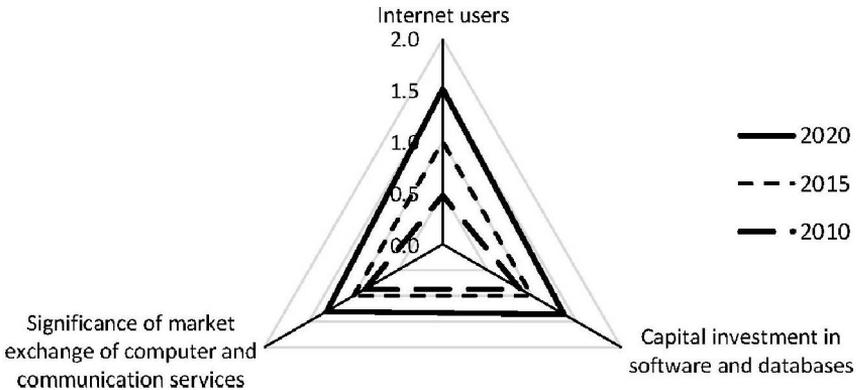


Fig. 1: The state of the corporate information area of Ukraine assessed using an integrated indicator in 2010, 2015 and 2020. Source: Own elaboration based on data of the World Bank [13] and SSSU [10].

The most significant increase in the integrated indicator of the state of the corporate information area in Ukraine is associated with an increase in the share of the population using the Internet. This growth is faster than growth in the world as a whole and individual groups of countries (Fig. 2). It can be stated that the share of the population using the Internet in Ukraine has significantly exceeded the average of developing countries and is closer to the developed world over the last decade.

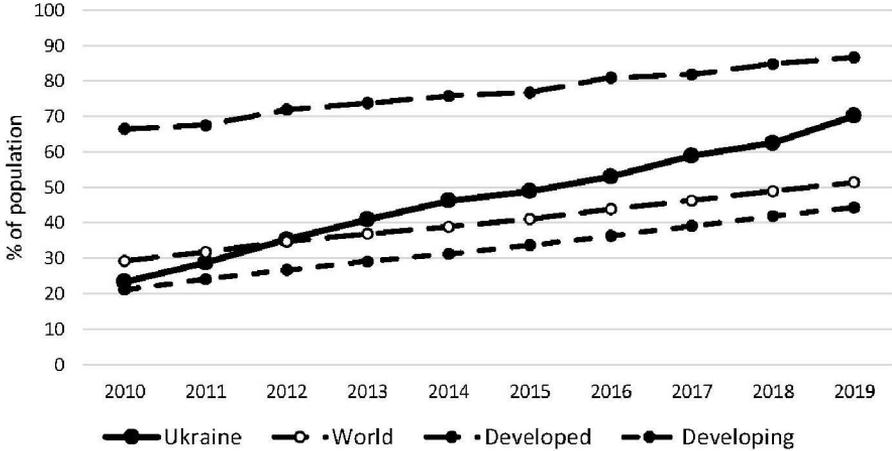


Fig. 2: The share of population using the Internet in Ukraine and the whole world in 2010–2019. Source: Own elaboration based on the data of the World Bank [13], ITU [3].

The value of individual components and the integrated indicator of the state of the corporate information area in Ukraine is illustrated in Table 1.

The integrated indicator of the state of the corporate information area of Ukraine has more significant fluctuations than its individual components during the study period as evidenced by the variance index and average annual growth rate (table 1). However, these figures would be significantly lower if the pandemic 2020 is not taken into account. The variance index of the integrated indicator would be 27.9%, which is 11.1 percentage points less than the value calculated taking into account the pandemic situation.

The dynamics demonstrated by the integrated indicator of the state of corporate information area is fully consistent with the dynamics of the ICT Development Index (IDI) of Ukraine until the end of its calculation and publication (until 2017) and is illustrated by Fig. 3.

Fig. 3 does not show the equation for the trend line. The linear regression coefficients are not statistically significant because of the insufficient amount of time series data and the lack of open sources IDI values in 2014. However, the statistically significant correlation coefficient 0.912 shows a linear statistical relationship and the proposed simplified integrated indicator allows us to assess the conditions of ICT in the country with the same level of efficiency as methodologically complex and time consuming an IDI. Therefore, the integrated indicator of the state of the corporate information area may replace the IDI after the termination of its publication.

Table 1: Integrated indicator of the state of corporate information area of Ukraine, 2010–2020

Year	Internet users, % of population	Capital investment in software and databases, % of total capital investment	Significance of market exchange of computer and communication services, %	Integrated indicator of the state of the corporate area
2010	23,30	1,55	28,35	0,527
2011	28,71	1,35	30,08	0,559
2012	35,27	1,25	30,78	0,614
2013	40,95	1,39	32,62	0,755
2014	46,24	1,46	33,94	0,868
2015	48,88	1,80	32,52	1,000
2016	53,00	1,76	31,51	1,020
2017	58,89	1,83	30,86	1,111
2018	62,55	1,64	33,81	1,148
2019	70,12	1,64	33,85	1,249
2020	73,97	2,44	42,30	1,931
Standard deviation	15,67	0,31	3,44	0,196
Variance index, %	31,8	18,8	10,5	39,0
Average annual growth rate, %	12,2	4,6	4,1	13,9

Source: Own elaboration based on the data of the World Bank [13] and SSSU [10]

As a result, the state of the corporate information area in Ukraine has improved in 2010–2020.

In our opinion, the time series of the integrated indicator quite adequately illustrates the impact of the Covid-19 pandemic on the state of Ukrainian corporate information area. The integrated indicator showed a growth trend in 2010–2019, which is well described by the linear regression model<sup>1</sup> (Fig. 4), but the integrated indicator had a significant growth in 2020 due to the pandemic.

It can be assumed that the destruction of the integrated indicator growing trend in 2020 is due to expanding remote communication through the information and communication technologies during the pandemic. This increase led to a rapid growth of at least two key indicators, which are used to calculate the integrated indicator of the state of corporate information area by formula (2):

<sup>1</sup>All regression coefficients in the models are statistically significant ( $p$ -value does not exceed 0.01); adequacy models confirms the absence of autocorrelation residues, homoscedasticity condition is not violated.

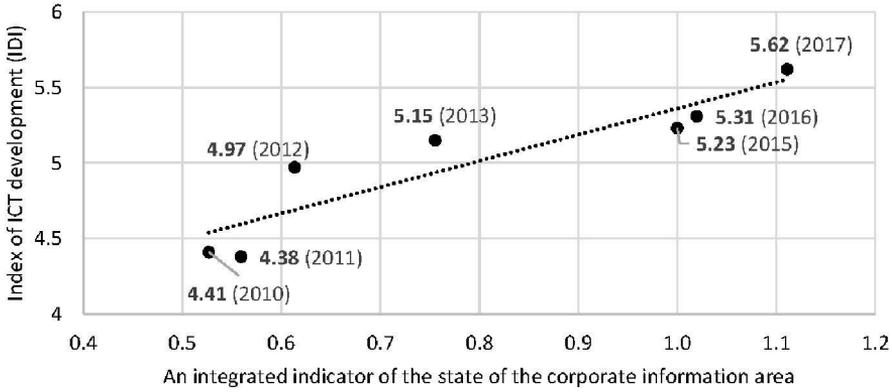


Fig. 3: Comparison of the integrated indicator dynamics of the state of corporate information area and the index of development of information and communication technologies (IDI) of Ukraine in 2010–2017 (data signatures are IDI values for the respective years). Source: Own elaboration based on the data of the World Bank [13], ITU [3], SSSU [10].

the share of capital investment in software and databases of total capital investment in the economy and an indicator of the importance of a computer and communication services exchange in the national economy. It is likely that if the share of Internet users in the total population of Ukraine is clarified in 2020, the estimation of the above-mentioned significant increase will be revised upwards.

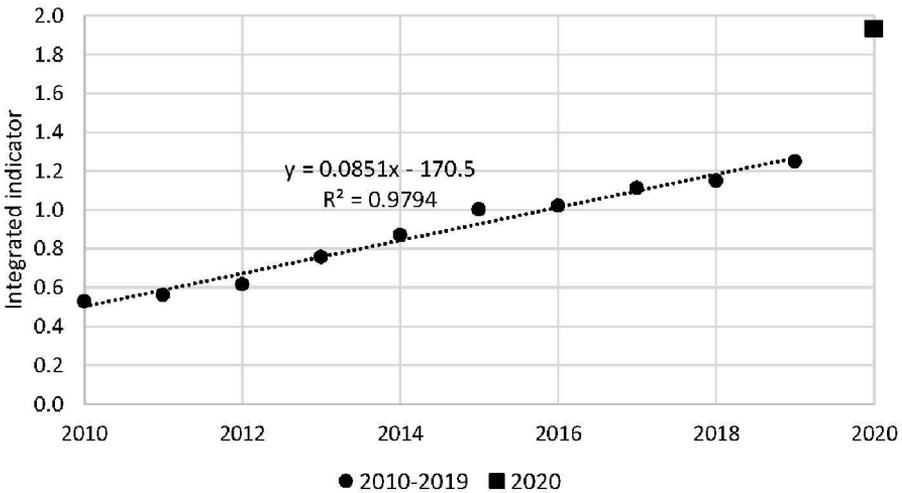


Fig. 4: The integrated indicator dynamics of the state of the corporate information area of Ukraine in 2010–2020. Source: Own elaboration based on the data of the World Bank [13] and SSSU [10].

#### 4 Relation between the integrated indicator of the state of the corporate information area and gross value added

The improvement in the state of the corporate information area in Ukraine during the researched period was accompanied by a nominal increase in the vast majority of monetary economic indicators in the national economy as a whole and its individual sectors. Growth is nominal due to the fact that it was observed only while measuring indicators in the Ukrainian currency without taking into account inflation. Instead, taking into account inflation in the time series of domestic economic indicators, we can observe 2 different intervals—before and after 2014. Therefore, to prevent error conclusions in the relationship between the state of the corporate information area and the economic state (in particular, such a false conclusion can be made based on exponential regression model illustrated in Figure 5a), it is essential to take into account inflation. The simplest and most correct way to take into account inflation is to convert the monetary value of economic indicators from Ukrainian hryvnia to US dollars (observing the functioning of a sufficiently developed foreign exchange market in Ukraine).

The statistical relationship between the state of the corporate information area and gross value added in Ukraine is illustrated in Fig. 5.

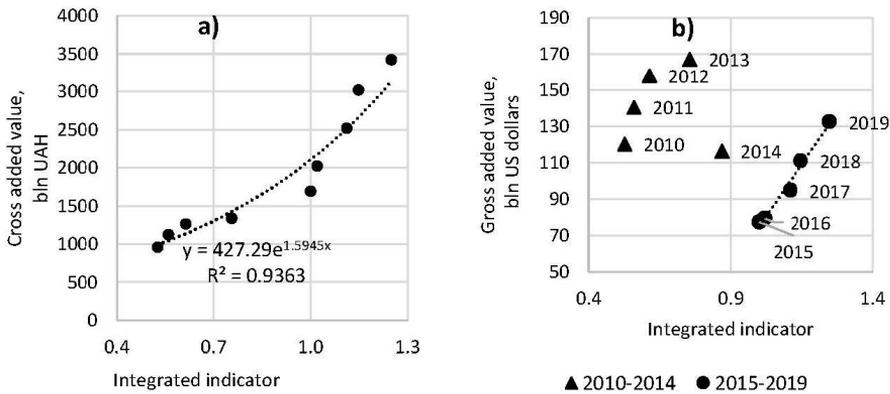


Fig. 5: Integrated indicator of the state of corporate information area and gross value added in actual prices in Ukraine in 2010–2019<sup>1</sup>: a) in hryvnia<sup>2</sup>; b) in US dollars at the average official National Bank of Ukraine exchange rate. Source: Own elaboration based on the data of the World Bank [13], SSSU [10] and NBU [5].

A new directly proportional linear dependence in the ratio of integrated indicator and gross value added has begun since (Fig. 5b). It allows a preliminary assessment of the indicators importance and influence. The changes in the general economic situation (characterized by changes in added value) cause changes in the state of the corporate information area and not vice versa. But the statistical verification with the correlation coefficient calculated based on time series with a lag does not confirm this assumption (Table 2).

The detected excess of the correlation coefficient for data with a bias of the integrated indicator of the state of the corporate information area over the value with a bias of gross value added (table 2) proves the statement about

Table 2: Correlation between the integrated indicator of the state of the corporate information area (II) and gross value added at actual prices of the national economy of Ukraine, 2010–2020

Year	Data with Gross value added bias		Data with integrated indicator bias	
	II	Gross value added	II (lag 1)	Gross value added
2015	1,000	116,3*	0,868*	77,3
2016	1,020	77,3	1,000	79,2
2017	1,111	79,2	1,020	94,6
2018	1,148	94,6	1,111	111,0
2019	1,249	111,0	1,148	132,4
2020	1,931	132,4	1,249	– **
Correlation coefficient for the biased data:				
GVA	1	<b>0,6998</b>	×	×
II	×	×	<b>0,8965</b>	1

\* 2014      \*\* data absence

Source: Own elaboration based on the data of the World Bank [13], SSSU [10] and NBU [5].

the priority of changes in the state of the corporate information area compared to changes in the general state of the economy. Of course, this statement is a subject of in-depth further verification.

Similar relationships were found between the integrated indicator of the state of the corporate information area and the output at basic prices as well as gross value added at actual prices of the non-financial corporations sector of Ukraine.

## 5 Conclusions

Using a simplified integrated indicator to evaluate a state of the corporate information area allows institutional units to assess the conditions of ICT in the national economy with the same level of adequacy as calculating the ICT Development Index (IDI), which was methodologically complex and time-consuming.

The state of the corporate information area, which summarizes the set of socio-economic conditions for the using ICT by institutional units of the national economy, has improved during 2010–2020 in Ukraine. The integrated indicator of a corporate information area state demonstrates a statistically significant growth trend from 2010 to 2019, which is described by the linear regression model. The growth was not disturbed even by the well-known events of 2014 in Ukraine. The rapid growth of the integrated indicator interrupted this trend in 2020 as a result of the Covid-19 pandemic.

The assumption that changes in the general state of the national economy (characterized by changes in key indicators of output and value added) cause changes in the state of the corporate information area and not vice versa, was

not confirmed in the study of the situation in Ukraine. Instead, the analysis provides a preliminary argument for the conclusion that changes in the state of the corporate information area can be considered a driver of changes in the general state of the national economy. Taking into account the limited information base and the preliminary nature of the obtained results this topic requires further research.

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