

THE IMPACT OF DIGITIZATION IN ENSURING SUSTAINABLE ECONOMIC GROWTH AT THE NATIONAL LEVEL

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Abstract:

Considering today's technical and technological progress, digitization represents a clear solution in ensuring an appropriate development that responds to new trends and that ensures the successful achievement of strategic national development objectives. Thus, this paper aims to analyze the contribution of digitization to the growth of the national economy in a sustainable way and our goal in finding new solutions for overall development of our country to match the other countries in European Union. In the study, we sought to highlight the most relevant factors of the digitization process with direct involvement in the sustainable development of the economy. To carry out this research, we used the factor analysis method with the help of the IBM-SPSS software to select the representative variables. The purpose of using this analysis method is to identify the factors with the strongest impact/role on the development of digital infrastructure at the level of the national economy in order to support a sustainable development, having as a reference base the evolution of some representative indicators that marked this process during 2017 – 2022. The evolution and dynamics of the influencing factors resulting from the research determine the detailed analysis and the identification of potential discrepancies between the digital transformation process and the proposed objectives.

Keywords: Factor Analysis, Digitization, Economic Development, Sustainability

JEL classification: C15, C87, F10, F20, O33, O44, O52

1. Introduction

In the current political and social context, digitization has emerged as a global necessity to restructure and reorganize so that the economy progresses in a sustainable manner. The concern of the European Commission on the development of favorable, sustainable solutions that enable the digital revolution of the EU member states was included in three objectives of major importance:

- Operation of new technologies in accordance with citizens' needs;
- Encouraging the development of a valid and competitive economy;
- Development of a constant, open and democratic society.

The digitization process aims to focus its attention on achieving economic excellence in the aspect of a developed economy. The level of digitization of the EU member states is evaluated, starting from 2014, through reports on the digital economy and society index (DESI). The main purpose of these reports is to assess the progress made by each Member State in the digital field and its progress against the EU average. From an economic point of view, the digitalization process of the European Union will ensure a prosperous European market. In this context, this paper proposes the analysis of the implications and impact of the digitization process in the growth of a sustainable economy.

2. Analysis of specialized literature

In the current context, digitization and methods of development in a sustainable way of the economy require special attention among several researchers.

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The given problem is laboriously addressed by Bressanelli et al. (2018), where they approach digital technology from the perspective of an "engine of economic growth", thus highlighting the need for a high level of digitization that favors national economic results. The support by the authors of the digital factor as being of increased importance and necessity in achieving the dynamics of the economy reflects its potential, respectively its efficient and effective contribution to national development.

A reference analysis on the digital economy, carried out by Lewandowski (2016), aims at bibliographic research, discovering new models of innovation and development of modern digital methods, tactics and techniques whose approach covers the characteristics of the sustainable economy: environmental, social and economic.

Also, authors such as Farboodi and Veldkamp (2021) argue that the new economy is generated by the growth of digital technology and electronic databases. The same perspective is addressed by Aytekin et al. , (2021) highlighting the fact that through the digitization of several structures, information becomes transparent and knowledge accessible. The research of these authors proposes three premises: the collection and use of computer data is a factor of economic activity, the data can represent a binder in future decisions and the possession of information reduces uncertainty and implicitly generates profitability.

In 2019, Kravchenko et al. , approaches the digitization process like a global trend but also a main factor of economic growth. The authors analyzed the countries with the greatest economic potential and their contribution to global trade and proposed an international hierarchy of 10 world economies from that period, according to the level of digitization according to the DESI (EU) Index and Digital Evolution indicators. This year, Romania was ranked 9th in the DESI (EU) Index ranking.

The Organization for Economic Co-operation and Development (OECD) proposes 9 directions of action for the thorough monitoring and control of the digital transformation:

- Highlighting the digital economy as part of the world economy;
- Accepting and understanding the economic impact of digital development;
- Visibility of the effects of digitization and their influence on the environmental, social and economic factor;
- Implementation of a new vision and strategy in the field of data collection;
- Widespread introduction of artificial intelligence and blockchain;
- Improving the procedures for measuring and processing computer data;
- The necessary preparation for digital development;
- Quantifying trust in the online environment through risk mitigation methods and security management;
- The impact of implementing the digitization of government.

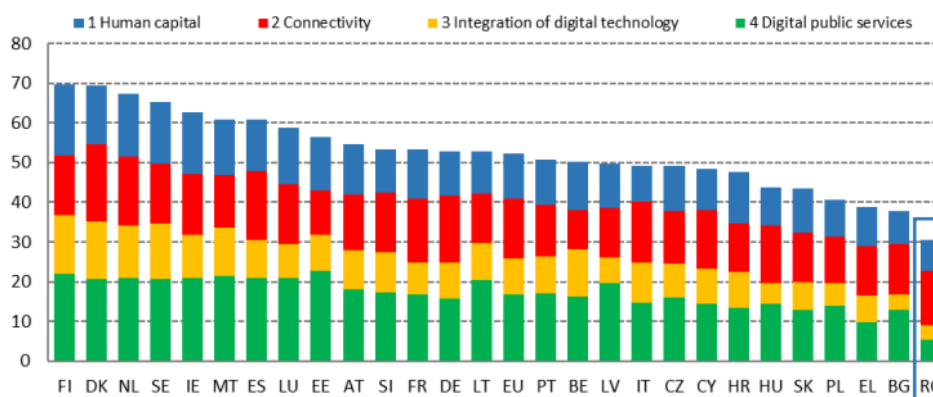
From the analysis of specialized literature, it is noted that digitization is a field targeted by researchers and a major concern for them from the perspective of the impact and consequences this process brings on national development.

3. Research methodology

In the framework of this research, we sought to highlight the respective impact and contribution of several indicators in the growth of the economy in a sustainable way. Digitization has emerged as a global necessity to restructure and reorganize both the public and private environment. This solution aimed to improve and optimize the services of all organizations worldwide.

In the European context, Romania's position is not at all favorable when we evaluate the progress made in the digitalization field. From the point of view of progress in the field of achieving the objectives related to the increase in the level of digitization, in 2022, Romania is in last place among the 27 member states by direct reference to the DESI indicators.

Figure 1: Ranking of EU countries regarding the results of the DESI index in 2022



Source: DESI 2022 Romania

In order to identify the causes that hindered or slowed down the digitization process at the national level, we considered it necessary to carry out a factor analysis that would allow us to indicate the main factors that could contribute to intensifying efforts to integrate digital processes and systems within the national economy, while also aiming to achieve the objectives of sustainable development. In this sense, we have selected different influencing factors of the DESI dimensions represented by: human capital, connectivity, the integration of digital technology and digital public services that could have an influence on the degree of development at the national level. In the same perspective, we selected sustainable development indicators that could influence national economic progress. In this research I used the factor analysis method through the SPSS (Statistical Package for the Social Sciences) software. Factor analysis is a method used to reduce the number of variables and determine the main influencing factors that have direct implication and dependent relationships with other types of data. This method is also known as Principal Component Analysis with the aim of highlighting linear combinations (principal components) from a set of variables. The input data are represented by factors of the DESI dimensions and indicators of sustainable development whose fluctuations can influence the economic evolution (GDP). The independent values of the database are represented by DESI indicators available in the period 2017-2022, as well as ESG indicators from the reference period.

Independent Variables:

- ✓ Internet User Skill - Above Basic digital skills;
- ✓ Digital technologies for businesses-ICT for environmental sustainability;
- ✓ Digital technologies for businesses-e-Invoices;
- ✓ e-Commerce SMEs selling online;
- ✓ ICT Specialists;
- ✓ Selling online cross-border SMEs;
- ✓ e-Government -Digital public services;
- ✓ Gross domestic expenditure on GDP;
- ✓ High-speed internet coverage;
- ✓ Tertiary educational attainment.

Figure 2: The structure of the SPSS database regarding the selected indicators in the period 2017-2022

IUS	DTB	DTI	ECO	ICTS	SCB	EGOV C	EGOV B	GRO	ICOVE R	EDUC
2.68	3.46	1.52	4.77	2.00	1.93	1.48	.00	.50	61.00	25.60
2.74	3.95	1.78	5.13	2.10	1.84	2.17	.00	.48	62.70	24.90
2.92	4.79	2.03	5.51	2.20	1.84	2.57	.00	.47	68.10	25.50
3.02	5.10	2.03	7.60	2.30	5.79	3.05	.00	.50	75.90	24.90
3.12	5.42	1.69	11.50	2.40	5.79	3.55	.31	.50	87.10	23.30
3.31	5.42	1.69	7.81	2.60	4.10	4.06	1.08	.50	87.10	23.30

4. Research results obtained by mathematical modeling of data using factor analysis

After applying the factor analysis method we obtained a series of results such as correlation matrix, communality, total explained variance, Scree Plot image, Component matrix and component matrix after rotation. The correlation matrix describes the correlation, the dependence, between the selected elements. Following the analysis, we observed positive but also negative links between the variables as well as strong, moderate and low degrees of correlation established between the independent factors.

If the recorded value is in the range [-0.25;+0.25] no correlative relationships are established between the variables, for the range (-0.25;-0.5) and (0.25;0.5) the relationship that is established is weak, for the intervals (-0.5;-0.75] and (0.5;0.75] a moderate correlation is highlighted and for (-0.75;-1] and (0.75;1) the relationship between the elements is strong. Later establishing the degree of correlation between the elements is highlighted of the level of significance between them. Thus, it is generally assumed that this level of significance will be .05 or .01, representing the fact that the chances of the correlation occurring by chance is 5 in 100 (*) and 1 in 100(* *).

In fig.2, numerous strong correlations can be observed between the factors of the digital economy and society index (DESI) and factors of sustainable development (ESG), which reveals that the evolution of the digitalization process is strongly correlated with sustainable development at the national level.

Figure 3: Correlation matrix

	1	2	3	4	5	6	7	8	9	10
1 INTERNET USER SKILL										
2 DIGITAL TEHNOLOGY SUSTENABILITY	.94**									
3 DIGITAL TEHNOLOGY E-INVOICES	.13	.38								
4 E COMMERCE SSELLING ONLINE	.71	.79	-.05							
5 ICT SPECIALISTS	.99**	.91*	.09	.69						
6 SELLING CROSS BORDER	.69	.77	.15	.87*	.66					
7 E GOVERNMENT CITIZEN	.98**	.95**	.17	.76	.99**	.72				
8 E GOVERNMENT BUSINESS	.82*	.57	-.31	.40	.86*	.30	.77			
9 GROSS DOMESTIC EXPENDITURE	.37	.22	-.52	.50	.37	.66	.32	.40		
10 HIGHT SPEED INTERNET COVERAGE	.96**	.92**	.00	.88*	.95**	.81	.96**	.74	.50	
11 TERTIARY EDUCATIONAL ATTAINMENT	-.84*	-.74	.26	-.83*	-.87*	-.66	-.87*	-.79	-.49	-.92*

Communality is represented by the Pohlmann factor structure that shows the commonality of several variables. The minimum values indicate that the factorial model applied is not representative of the series of recorded indicators. In the given case, the values recorded in the communality table are well represented by the model used, they register values very close to 1.

Figure 4: Commonality of variables

Communalities		
	Initial	Extraction
INTERNET USER SKILL	1.000	.982
DIGITAL TEHNOLOGY SUSTENABILITY	1.000	.992
DIGITAL TEHNOLOGY E-INVOICES	1.000	.960
E COMMERCE SSELLING ONLINE	1.000	.878
ICT SPECIALISTS	1.000	.991
SELLING CROSS BORDER	1.000	.983
E GOVERNMENT CITIZEN	1.000	.997
E GOVERNMENT BUSINESS	1.000	.978
GROSS DOMESTIC EXPENDITURE	1.000	.876
HIGHT SPEED INTERNET COVERAGE	1.000	.992
TERTIARY EDUCATIONAL ATTAINMENT	1.000	.911

Extraction Method: Principal Component Analysis.

Information relevant to the factor analysis model is provided by Total Variance Explained. Following the application of the Principal Components Analysis method, the eleven main variables were generated and after applying the selection criterion, the initial eigenvalues to be greater than or equal to 1, only 3 significant factors were established in the analysis. In the columns of the Execution Sums of Squared Loadings section, the following are recorded: the eigenvalues considered significant (Total), the explained variance (the % of Variance column) highlighting the change in each factor and the cumulative variance (the Cumulative %) column representing the total variation of the influencing factors. The separation of the 3 main components can be seen in the Total Extraction column. Regarding the variation explained by each component, it is distributed as follows: the first factor 70.145%, the second 15.697% and the third 9.969%. The subsequent accumulation of the values of the individual variables justifies the dynamics of a percentage of 95.811% of the analyzed phenomenon. The columns of the Rotation Sums of Squared Loadings section show values of the three factors, after applying the rotation procedure. Thus, in the context of the same value of the total variation of 95.811%, a redistribution of the variation rendered by each influence factor is observed: the first factor 51.098%, the second 29.025% and the third 15.689%. Through the rotation method, the elements can lose their saturation level, it being distributed in a different proportion to the factors.

Figure 5: The table regarding the total variation of the factors

Component	Total Variance Explained								
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.716	70.145	70.145	7.716	70.145	70.145	5.621	51.098	51.098
2	1.727	15.697	85.842	1.727	15.697	85.842	3.193	29.025	80.122
3	1.097	9.969	95.811	1.097	9.969	95.811	1.726	15.689	95.811
4	.399	3.627	99.438						
5	.062	.562	100.000						
6	1.051E-15	9.552E-15	100.000						
7	3.040E-16	2.763E-15	100.000						
8	2.174E-16	1.976E-15	100.000						
9	-5.666E-17	-5.151E-16	100.000						
10	-4.244E-16	-3.858E-15	100.000						
11	-5.408E-16	-4.917E-15	100.000						

Extraction Method: Principal Component Analysis.

The graphic representation of the eigenvalues recorded after the analysis of the main components is shown in fig.6. The number of components is highlighted in the chart structure by the descending linear pattern. The graph highlights the existence of a 3-factor solution as a linear decrease is noted.

Figure 6: Graphic representation of the total variance of the factors

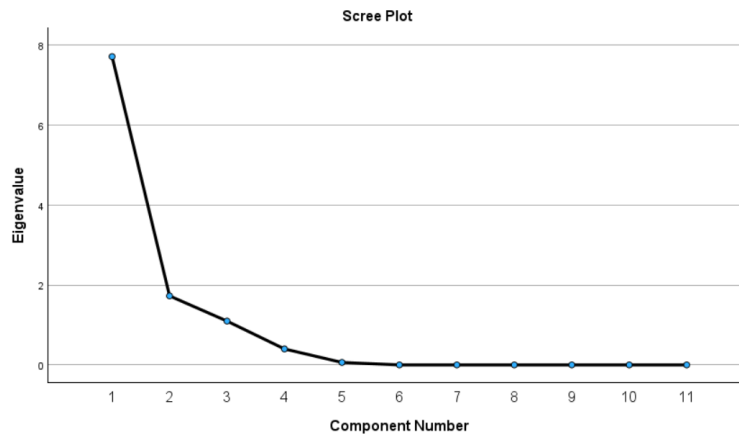


Figure 7: Matrix of components and influence coefficients

	Component Matrix ^a		
	Component 1	Component 2	Component 3
INTERNET USER SKILL	.965	.137	-.178
DIGITAL TEHNOLOGY SUSTENABILITY	.917	.387	.036
DIGITAL TEHNOLOGY E-INVOICES	.010	.967	.157
E COMMERCE SSELLING ONLINE	.852	-.050	.386
ICT SPECIALISTS	.964	.097	-.229
SELLING CROSS BORDER	.809	.031	.573
E GOVERNMENT CITIZEN	.972	.186	-.135
E GOVERNMENT BUSINESS	.766	-.270	-.564
GROSS DOMESTIC EXPENDITURE	.513	-.672	.400
HIGHT SPEED INTERNET COVERAGE	.996	.005	.025
TERTIARY EDUCATIONAL ATTAINMENT	-.921	.224	.109

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

The component matrix (Component Matrix) the variables and the contribution of each to the influencing factors on the final phenomenon. Obviously, the more the factors register an influence value closer to 1, the more significant they are in its dynamics.

Figure 8: Component matrix after rotation

Rotated Component Matrix^a

	Component		
	1	2	3
INTERNET USER SKILL	.909	.386	.081
DIGITAL TEHNOLOGY SUSTENABILITY	.774	.516	.356
DIGITAL TEHNOLOGY E-INVOICES	.013	.061	.978
E COMMERCE SSELLING ONLINE	.485	.801	-.035
ICT SPECIALISTS	.933	.346	.035
SELLING CROSS BORDER	.353	.924	.068
E GOVERNMENT CITIZEN	.896	.421	.134
E GOVERNMENT BUSINESS	.921	-.014	-.360
GROSS DOMESTIC EXPENDITURE	.139	.669	-.639
HIGHT SPEED INTERNET COVERAGE	.809	.580	-.028
TERTIARY EDUCATIONAL ATTAINMENT	-.801	-.445	.267

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization. ^a

a. Rotation converged in 5 iterations.

The data recorded in figure 7 help us outline the final conclusions regarding the dynamics and structure of the analyzed phenomenon:

- The first factor is made up of the variables Internet user skill (0.909), ICT Specialists (0.933), E-government citizen (0.896), E-government business (0.921) and Hight speed internet coverage (0.809).
- The second factor is made up of E-commerce selling online (0.801) and Selling cross border (0.924).
- The third factor is made up of Digital technology e-invoices (0.978).

5. Conclusions

Digitization is a global phenomenon that leads to the adoption of new standards and the implementation of strategies that facilitate the achievement of digital goals and the integration of national economies into the single European market. Thus, using this type of analysis, we identified the main factors of digitization with direct implications in the sustainable development of the national economy. The variation of the first factor has influences on sustainable economic growth in terms of the quality of the human resource in the field of technology, an aspect that also targets the "Quality Education" objective of sustainable development according to the national strategy. The recent transformations of the economic sector require a substantial effort from human resources to adapt and build qualities/qualifications that correspond to the orientations of the activity sectors. Having the basic skills to use technology is a necessity imposed by the dynamics of digital transformation at the national level. The values recorded by the Internet user skill indicator as well as ICT Specialists aim at the obligation to increase efforts in terms of creating a workforce characterized by adaptability and flexibility within this developing economy. Regarding the E-government indicators, there is an intensification of efforts to integrate digital technology at the level of institutions and public administrations. The daily presence of electronic services led to the establishment of a new social order thus determining the integration of digital information services and operations at the state level. In this sense, the aim is to improve the quality of public services offered to citizens as well as private administrations, contributing to a better

flow of information and increasing the interaction between the state component and functional, respectively institutional, economic agents. The High speed internet coverage indicator also has implications on the acceleration of economic processes through the lens of access to information of the population in disadvantaged areas. Considering the fact that a percentage of 86% of the Romanian population has access to the Internet reinforces the idea that this factor is representative in the digital and sustainable development of the economy. The strong correlation between the indicator that characterizes the quality of the workforce in the digital field and the coverage area of high-speed Internet and the lack of culture of the population in the field of efficient use of the services provided indicates the need to develop the educational branch. The second influencing factor concerns trade, a vital component in national economic development. The development of technology and the digitization of the commercial sector has definitely had a positive impact in increasing the accessibility of customers in the commercial markets. Also, the optimal development of the first influence factor can determine the emergence of new economic agents in the online environment and the increase of internal and external commercial relations. The third factor aims at the digitization of relations between private administrations and other economic agents with whom they interact. The digitization of payment methods ensures that business relationships are completed quickly and without difficulty. Easing the transaction processes between economic partners, through digital invoices, implicitly determines the attraction of new potential customers. The implementation of digital supporting documents increases the confidence of the population to use online services by optimizing commercial relations. Using this type of factor analysis, we obtained the factors of the digitization process that have a direct and strong influence on sustainable economic growth. This method offers the possibility to follow the upward and downward evolutions of the main influencing factors of digitization efforts, providing the basis for appropriate justifications for the decisions of the parties involved in the implementation of digital processes. In the current context, it is necessary to intensify the development of the factors determined to support the process of economic growth in a sustainable way.

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