RESEARCH ON THE CORRELATION BETWEEN THE USE OF MODERN INFORMATION AND COMMUNICATION TECHNOLOGIES BY ORGANIZATIONS AND REGIONAL SUSTAINABLE DEVELOPMENT

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Abstract: *Nowadays sustainable development concerns not only corporations, companies of all types and sizes, but also local or national communities and development regions at national or global level. The unprecedented development of information and communication technologies (ICT) lately, their use in all areas of economic, social, cultural life, etc. has determined the researchers to study and evaluate to what extent they influence the development of companies and local, regional or national communities. The paper analyzed, through statistical models, the correlation between the level of use of communication technologies by organizations and the territorial sustainable development of the local communities in which these organizations operate. Empirical findings showed that the use of new communication technologies led directly to the increase of activities from priority areas for the sustainable development of the local community, such as the health, the production and supply of energy and drinking water, and the waste processing. These results can encourage the managers of organizations to implement such technologies and the decision makers from local and central administration to promote and stimulate these ICT activities.*

Keywords: *sustainable development, sustainable regional development, information and communication technologies, regression model*

Introduction

Within each economy, the economic growth is ensured, at the level of companies, by their competitiveness. The competitiveness of the companies is given by *their performance*, by the ability to ensure "a certain level of productivity and effectiveness, a sustainable presence on the markets" [1]. Until recently, the main task of the management of any company has been to ensure its competitiveness, for its development and adaptation to a growing competition, in an increasingly dynamic market.

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The industrial development over the last 50 years was highly supported by the development and dynamics of information and communication technologies in all fields, leading to a powerful, even aggressive, economic growth. But this industrial development came with an excessive consumption of natural resources, uncontrolled effects of increasingly voluminous and diversified waste resulting from the activity of companies, an increasingly aggressive environmental pollution caused by the lack or non-observance of strict rules regarding the protection of the environment. These influenced directly the life of local communities and the environment in which they lived. In the absence of responsibility rules and social cohesion, major gaps appeared between poverty and wealth, vulnerable groups, depletion of natural resources, etc.

Natural resources are limited in time and space, and their excessive consumption, together with the excessive pollution of water, air, soil resources endangers the very existence of life. If these inconveniences are added to the increased level of population, urban agglomerations and climate change, then the approach of economic development of companies will be achieved only through competitiveness which is unacceptable today. Sustainable development speaks of a world that needs a fundamental transformation, of its present needs and of future generations [2]. Thus, new development requirements, such as the application of measures of social responsibility, environmental protection, involvement in the life of the local community, are required in order to improve its living standard and working conditions, safety at work [3], to contribute to its education and health [8].

The present concerns of specialists, researchers and global, regional or national bodies, as well as of policy makers are related to the *sustainable development* of companies, regions, nations and all activities carried out, to their *social responsibility* and the obligation to ensure environmental protection and human rights. It is certain and compulsory, enforced by regulations established by specialists and political decision-makers, to approach the sustainable development of all entities in the world: companies of all types and sizes and local, regional communities. The latter take into account the local, regional or national specificities, in the analysis and decisions that are taken to stimulate and ensure sustainable regional development. Under such circumstances, as the competitiveness was studied by specialists also at the territorial level, so is the increasing need for the study, analysis and concrete solutions of sustainable development at local, regional or national level. The specialists defined, in this regard, the concept of *long-term competitiveness* [4], which satisfies, in addition to the requirements of development under conditions of maximum efficiency of any entity, the requirements of sustainable development as well.

In the first part the paper we presented the overview of the specialized literature on regional sustainable development outlining the rapid development of ICT and the latest implementation of communication technologies. In the second part of the paper we presented the research methodology, the data used, the working

hypotheses, the models and the results. We estimated the sustainable development of the local communities by the value of three indexes defined by the National Institute of Statistics of Romania: the turnover of the organizations in the following activities: *Electricity, gas, steam and air conditioning production and supply, Water supply; sewerage, waste management and decontamination activities* and *Human health and social work activities*. There are three areas of activity that are particularly important for the life of a territorial community, in which the production and distribution of energy and water influence directly both the health of the community and the quality of the environment, through the innovative processes of energy production, waste processing, water decontamination etc. In the final part of the paper we presented the conclusions of the research and how our study could influence decision makers.

1. Literature Review and Working Hypotheses

1.1. Prior research on sustainable regional development and its relationship with the use of communication technologies within organizations

Sustainable development has now become a global matter, a complex concept which concerns the development of all organizations, which is very difficult to evaluate objectively and scientifically [5]. Sustainable development has even become the existence requisite of the companies of all types and sizes on the current market, which is highly diversified, dynamic and demanding regarding the current requirements of consumers. Thus, a multitude of policies, debates, measures have been adopted at global, European, national or local level to define, regulate and force companies to comply with the requirements of sustainable development.

The main objective of all these major concerns of the decision makers all around the world is the welfare of people, individually and collectively, their material well-being, their culture and physical and mental health, conditioned not only by the economic development, but also by the environment and the community in which people work and live. All these required the identification of new forms of organization and management of activities within companies, new forms of interrelating them with the client, the environment, the market, the local community, with other companies or research centers, and some forms of new work organization, of communication with all these to ensure an efficient management.The competitive advantage of companies, given first of all their economic development in terms of efficiency, is no longer sufficient today. In order to maintain it, the competitive advantage should appear if there are possibilities of sustainable development for the company and the community in which it operates. To this end, it is necessary for all organizations to identify solutions that help them to become more flexible, efficient and more easily adaptable to change, in order to implement measures of social responsibility and environmental protection.

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Sustainable development was first defined in the Brundtland Report as "the development that meets current needs, without compromising the ability of future generations to meet their own needs" [6]. The issue was then debated and regulated within the UN [7], measures for its implementation were taken [8], for the sustainable development of strategic activities, for the sustainable development of the global society, such as climate change, water, waste [9], transport [10,11], energy [12,13]. The European Union, through its institutions, responded to these demands by developing the Sustainable Development Strategy in Europe [14,15], the Sustainable Growth Financing Plan [16], a series of directives and regulations aimed at imposing and stimulating sustainable development for all member countries. Romania promptly met these requirements and developed its national strategy for sustainable development [17].

The importance of this issue caught the attention of researchers, economists, theorists and practitioners, who first defined the concept and requirements of sustainable development of companies. Analyzing companies that are closely related to the life and environment of the communities in which they operate, we outline the territorial, regional or national sustainable development. This was defined by specialists [18,19], who researched and identified a multitude of factors that determine it, grouped into three subsystems: economic, social and environmental.

Being concerned with finding a calculation algorithm and a model for evaluating territorial sustainable development, a number of specialists studied and proposed the calculation of one or more composite indexes and different models, which were controversial and much debated. Each model had a theoretical and/or practical justification, trying to make a more accurate evaluation of the territorial sustainable development considering some important factors: Italy [20], [21] Poland and China [22]. By means of the calculated index, comparisons can be made between regions, cities, development areas, between sectors of the economy and the important activities of the national economy, allowing decision makers to intervene through policies, laws and norms to stimulate them. A number of studies in China were conducted to analyze the sustainable development of urban agglomerations [23,24,25]. Other studies dealt with the analysis of important branches of the economy, with a special role in environmental protection and economic development, such as energy [9,26,27,28].

After 2011, the industrial revolution brought a new wave, that of the new information and communication technologies, which spread and developed, being more and more present in all the forms of manifestation of our life and society. The information society determined a major impact of the ICT sector on the economic, social and environmental subsystems of territorial sustainable development. Researchers and specialists in the economic field studied this impact to analyze the extent to which the new communications technologies influence directly the sustainable development at the organization or territorial level.

Analyzing the role of the ICT sector in the field of sustainable development, in the study [29] the author found a top-level approach: from a resource-based economy to a knowledge-based economy, an economy in which information became a major factor in production. The implementation of the new technologies had direct effects on the sustainable development of companies, at least through the following:

- a sustained technological development, innovative and automated production processes, aimed at ensuring increased labor productivity [30], greater efficiency of using all resources with less waste, less pollution of the environment, etc., implementation of new business models (online sales, online courses, contracting and online payments, etc.), new ways of structuring and monitoring work processes (virtual office, remote work, home work, etc.), as well as an adequate quality of the products or services (high quality standards, quality control and verification norms, etc.).

- an efficient management, namely an efficient management and coordination of processes within the company with the help of integrated software products.

The direct effects were the extensive and intensive development of the production of goods and services, the increase of the labor productivity, followed by the increase of employment rate and the improvement of life quality [29].

All these direct effects of ICT on the economic and social subsystem trigerred a series of activities of the companies through which measures of social responsibility were implemented, both in relation to the protection of the environment and vital natural resources (water, air, soil), as well as for the community in which they carried out their activities. Thus, the development of companies' production and services led to an increase in the number of beneficial jobs for improving the standard of living, and the highly skilled and specialized workforce, which had access to information and education through ICT improved the economic performance of the companies. In addition, a human resource that worked in good conditions of health and safety at work [31] and learned constantly throughout life, will maximize the financial efficiency of the company.

In a nutshell, the economic development of a territorial community (region, country) cannot be achieved without healthy and well-prepared human resources, within the community or the environment in which they live.

The International Institute for Sustainable Development dealt with the impact of new communications technologies on the territorial sustainable development. The papers [32,33] talked about the digital economy or the internet economy, an economy in which the ICT sector was an important source of employment and "a contributor to the Gross Domestic Product", to productivity and territorial economic growth, to globalization of all activities, through the development of interactive relationships with suppliers and customers through the use of the Internet and new communication resources. ICT built new business models

(installation and maintenance of computers, provision of internet and cloud services, online sales, eLearning platforms, e-government, etc.) and created jobs for a large number of highly qualified people (software designers, programmers, analysts, network administrators, database administrators, etc.), contributing to the economic growth of companies and the territorial community, and to the improvement of working conditions, life, health and education. Furthermore, the study showed the influence of the technological development in the field of communications in increasing the volume of electronic waste, including the toxic waste. However, they allowed the widespread dissemination of information needed to adapt to climate change regarding weather, terrestrial and water resources, thus consistently helping to protect the environment and the territorial sustainability [34,35].

Other studies analyzed the future development of new communication technologies, which stimulated research and innovation [36,37], by using the Internet and enhancing the collaboration among the research, academic and production centers to solve specific problems in the economic, social or environmental field (robots, artificial intelligence, cloud computing services, etc.) [38]. The use of ICT in diagnostics and treatments in health [39,40,41] is the focus of the specialists in the field. In addition, the new technologies, robotics, artificial intelligence, virtual reality, cloud computing, allow for unprecedented technological development of the companies, contributing substantially to the automation of production, work, sales and marketing processes, education, culture, etc., as well as to the management of all these processes automatically and in an integrated manner.These are objectives of sustainable regional development, related not only to the economic subsystem, but also to the social and environmental one [37].

We can take into account that the diversity and complexity of business models in the economic and social field, their behavior, relationships and conditionalities between them, which are increasingly dynamic and unpredictable, are significant and require further studies, especially when using new information technologies.

1.2. Prior research on energy, water and health, as important factors of territorial sustainable development. Working hypotheses

Nowadays sustainable regional development requires a comprehensive approach, within a reasonable timeframe, of sustainable development at all levels, for all organizations, in order to ensure economic development while improving the quality of people's life and social cohesion, and ensuring environmental and natural resources protection. International, regional or territorial bodies established sustainable development strategies, objectives, indicators for measuring the sustainable development of companies, the quality of life and environment, the human resources, the education, etc. As a result, a number of specialists in the field, researchers, and scientists tried to verify, analyze and evaluate the extent to

which various organizations act to develop or modernize various activities, in accordance with the latest standards in the field, for the sustainable development of the territorial community.

The specialists showed that the sustainable development objectives, which must be implemented at national, regional, continental or global level, are interdependent and mutually conditioned and must be treated as an integrated system, in which the exchange of expertise and knowledge is made between nations [42].

Sustainable urban development is considered by specialists an important challenge, especially if we talk about large urban agglomerations. Within it, urban public health is a very important issue for the life of the respective community. Cities are complex systems affected by a number of economic, social and environmental factors, which interact and influence one another. A number of studies analyzed the situation in several large cities in China and identified important indexes such as the number of hospital beds, health centers per 10,000 persons and the overall investment in the treatment of environmental pollution [23,43].

But the health of the population and the environment are largely dependent on the degree of pollution. Global pollution is strongly linked to the growing global demand for energy, largely obtained from fossil fuels (coal and agricultural wastes) which cause greenhouse gas emissions and a number of other air pollutants, such as carbon dioxide, nitrogen oxides and sulfur dioxide. Researchers analyzed this problem and offered solutions proposed by specialists in the field. Thus, the growing demand for energy worldwide, which is necessary for the production development and social development, can be solved by obtaining solar renewable electricity [44] which has undeniable beneficial effects, or by wind energy and biomass, which must be stimulated to be increasingly expanded through research and innovation activities [45].

However, the health of the population is conditioned by the quality of the water. Therefore, some researchers focused on the issue of management of river basins and urban waters, for which they tried to identify best practices in the field [46] or modern technical solutions for wastewater treatment with the purpose to promote them [47] in order to fill the gaps by the joint efforts of researchers and practitioners.

In a study on the sustainable development of large cities, the performance of their energy and environmental systems was analyzed and evaluated in an integrated approach.for 12 cities in Southern Europe [9]. A special challenge today is to identify ways to improve the efficiency of all resources by integrating different life support systems: energy, heating, cooling, transport, water and wastewater, waste, industry, agriculture [48]. The identification of technical, practical and efficient solutions for the myriad of problems due to the increase of the population and of the demands of the global market for production and services could not be achieved without the use of ICT and Internet technologies. Thus,

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specialists who have studied the effects of the large-scale expansion of new ICT technologies [49] have shown the benefit of their use at least in the next fields: mass robotization in the automotive industry, close interactive relationships with suppliers and customers through the use of telephony, Internet and other new communication resources in the supply chain, modernization of financial markets through electronic trading, major changes in the way businesses are run, increased volume of independent activities, development of online commerce and online payments, increased access to education, culture, health, recreation, social interactions, information in all fields, etc.

In Romania the issue of regional sustainable development is current and paramount as there are industrial pollution centers and accumulations of environmental degradation, a high share of deforestation, a generally aggressive attitude towards the environment, polluting enterprises, high energy consumers, and a large part of the population is still poorly informed and little interested in environmental issues etc. However, Romania has taken all the necessary measures to comply with European legislation and norms. That is why, in 2017, the Government of Romania established the Department for Sustainable Development [50], which coordinates at national level the implementation of the sustainable development objectives. Romania is committed to implementing these objectives both nationally and internationally.

Taking all of the above into account, we analyze to what extent the new communication technologies within the development regions of Romania influence the indexes of regional sustainable development for the field of energy and health.

In this study we considered the following working hypotheses:

Hypothesis 1. The turnover of all organizations in the activity *Electricity, gas, steam and air conditioning production and supply* is correlated with the *number of employees* in the *Information and communication activity*.

Hypothesis 2. The turnover of all organizations in the activity *Water supply activity; sewerage, waste management and decontamination activities* is correlated with the *number of employees* in the *Information and communication activity*.

Hypothesis 3. The turnover of all organizations in the activity *Human health and social work activities* is correlated with the *number of employees* in the *Information and communication activity*.

2. Data and Methodology

2.1. Description of the data sample and the used variables

The data sample used in the econometric models consisted of data between 2009 and 2016, taken from the Statistical Yearbook of Romania and a series of indexes considered relevant in characterizing the sustainable development of the regions. It is known that Romania has 8 development regions, recognized and measured by

indexes from the National Institute of Statistics of Romania, as follows: 1. North-West; 2. Center; 3. North-East; 4. South-East; 5. South-Muntenia; 6. Bucharest-Ilfov; 7. South-West Oltenia; 8. West.

Considering the latest exponential development of the information and communications technologies, we verified through the econometric methods of simple linear regression if the number of employees in this field is in correlation with the indexes specified in the three working hypotheses. For the models we used the variables in Table 1, which represent values corresponding to the local companies by size groups, according to the number of employees (0-9,10-49, 50-249, over 250), for the 8 development regions, between 2009 and 2016 [60]. Therefore, the data series had 256 values for each index (8 years * 8 regions * 4 types of companies, by size).

Table 1. Description of the used variables

Cr. no	Associated Variable	Variable definition	Variable Type
1.	X	Number of employees in the activity *Information and communication*	Independent
2.	Y1	Turnover of the organizations in the activity *Electricity, gas, steam and air conditioning production and supply*	Dependent
3.	Y2	Turnover of the organizations in the activity *Water supply; sewerage, waste management and decontamination activities*	Dependent
4.	Y3	Turnover of the organizations in the activity *Human health and social work activities*	Dependent

An analysis of the variables values used totally, calculated by years (between 2009 and 2016) is presented below. The graph (fig. 1) shows that an increase in the values of X is followed by an increase in the values of Y (an increasing trend for both variables).

Table 2. The values calculated for the total variables X and Y1 between 2009 and 2016

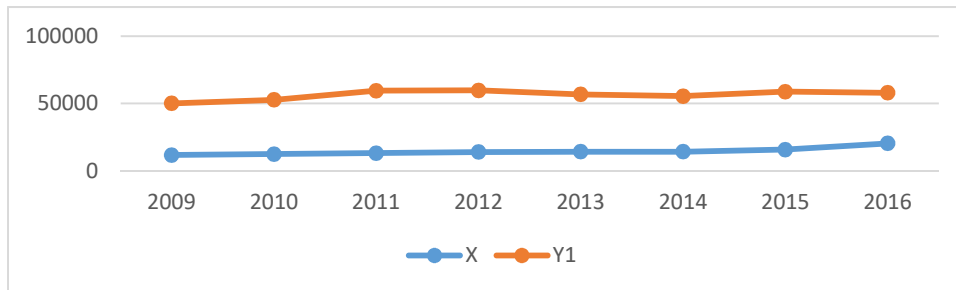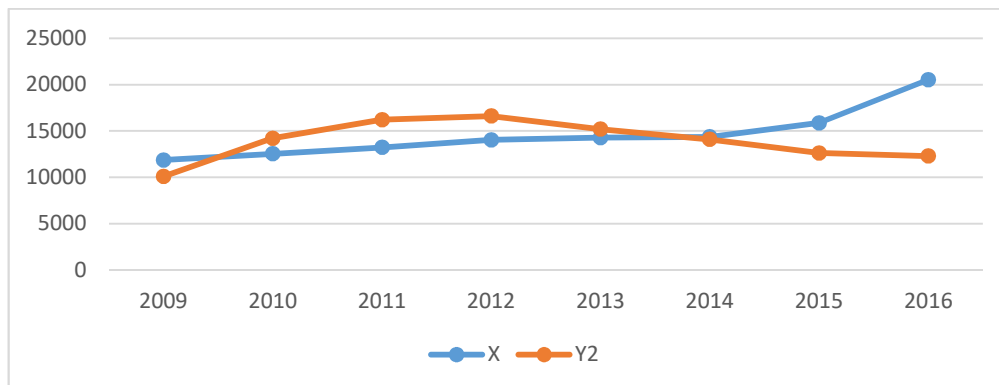| YEAR	X	Y1
2009	11859	50109
2010	12546	52747
2011	13237	59568
2012	14041	59764
2013	14274	56821
2014	14365	55488
2015	15874	58796
2016	20522	57936

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Figure 1. The graph of the Y1 variable values between 2009 and 2016

Table 3. The values calculated for the total variables X and Y2 between 2009 and 2016

YEAR	X	Y2
2009	11859	10094
2010	12546	14212
2011	13237	16206
2012	14041	16605
2013	14274	15190
2014	14365	14092
2015	15874	12627
2016	20522	12303

Figure 2. The graph of the Y2 variable values between 2009 and 2016

Table 4. The values calculated for the total variables X and Y3 between 2009 and 2016

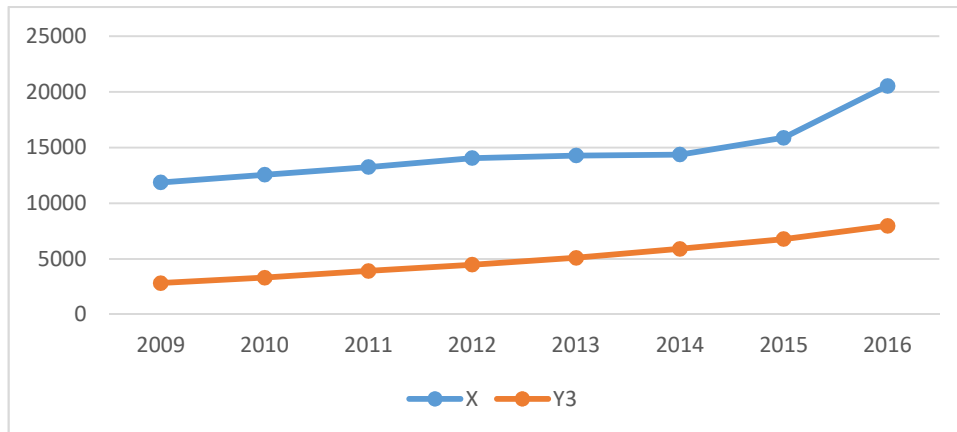| YEAR	X	Y3
2009	11859	2826
2010	12546	3309
2011	13237	3911
2012	14041	4472
2013	14274	5097
2014	14365	5897
2015	15874	6774
2016	20522	7973

Figure 3. The graph of the Y3 variable values between 2009 and 2016

Analyzing these graphs we noticed they showed an existing dependence between variables. Therefore, we further verified, by simple linear regression models, if the correlations described in the formulated working hypotheses were maintained. Therefore, we checked whether a development of ICT activities complied with the following: hypothesis 1, determining the development and diversification of the production and distribution of clean energy, as described in the studies [43,44,45,47]; hypothesis 2, determining the development and identification of new solutions in the activities of water supply, sewage, waste management and decontamination, as described in the studies [46,47,48]; hypothesis 3, determining the development of activities of health and social assistance, as described in the studies [41,42].

2.2. Econometric Models. Results and Discussions

In order to verify the hypotheses, we constructed simple linear regression econometric models for each hypothesis.

Model A analyzed the extent to which the exponential development of information and communication technologies influenced the development of activities in the field of production and supply of electricity and gas, thus contributing to the growth of regional sustainable development.

The used variables were:

- Y1 as the *dependent* variable which represented the turnover of the organizations in the activity *Electricity, gas, steam and air conditioning production and supply* between 2009 and 2016, out of the 8 development regions, considering all companies and the 4 size groups.

- X as the *independent* variable which represented the number of employees in the *Information and communication activity*, considering the same type of data structure.

The regression model A verified, according to hypothesis 1, whether there was a correlation between the activity of companies in the field of production and supply of electricity and gas, measured by turnover (variable Y1) and the number of employees working in the *Information and communication activity* (variable X). The proposed simple linear regression model was:

$$y = \beta_0 + \beta_1 x + \varepsilon \tag{1}$$

or, replacing:

$Y1 = \beta_0 + \beta_1 * X + \varepsilon$, where:

- X, Y1 are the described variables;
- ε – is the random eror variable (residue);
- β_0, β_1 are the parameters of the regression model.

The simple linear regression model was: $\hat{y} = b_0 + b_1 x$ (2)

where: b_0 estimated parameter β_0 and b_1 estimated parameter β_1. We estimated the parameter values for the simple linear regression model, using the smallest squares method, as shown in table 5. The model was tested and validated, and the result is presented in table 5.

$b_0 = 191{,}80715$ $b_1 = 0{,}335340$

Thus, $\hat{y} = 191{,}80715 + 0{,}335340 * x$ and the equation is:

$Y1 = 191{,}8071516 + 0{,}335340 * X$

Table 5. Estimated parameters of the simple linear regression model **A** by using the method of least squares

Variable	Coefficient	Std. Error t-Statistic		Prob.
C	191.8072	128.0563	1.497834	0.1354
X	0.335340	0.015379	21.80514	0.0000
R-squared	0.651799	Mean dependent var		1762.613
Adjusted R-squared	0.650428	S.D. dependent var		2865.058
S.E. of regression	1693.954	Akaike info criterion		17.71530
Sum squared resid	7.29E+08	Schwarz criterion		17.74300
Log likelihood	-2265.558	Hannan–Quinn criter		17.72644
F-statistic	475.4641	Durbin–Watson stat		0.503330
Prob(F-statistic)	0.000000			

Source: Authors' estimations. Notes: dependent variable: Y1. Method: least squares. Sample: 1 256. Included observations: 256.

Conclusions for model A: Testing the validity of the model, we found that at a significance level of 5%, *the model was valid*, and the variation of the values of the independent variable - *number of employees* in the *Information and communication activity* (X) justified by 65.18% the variation of the dependent variable - turnover of the organizations in the *Electricity, gas, steam and air conditioning production and supply activity* (Y1). The slope of the regression line b1 = 0.335340 showed that if the value of the independent variable (X) changed by 1000 people, then the

dependent variable Y1 changed on average by 335.34 million lei in the same direction. Hypothesis 1 was, therefore, confirmed. Hence the increase of the number of employees in the field of ICT, in other words the increase of their activities, definitely determined a significant growth of activities in the field of production and supply of energy and gas, using modern technologies and ICT support. This actually led to the development of companies in the field of clean energy production and distribution, a correct estimation of energy consumption using models of neural networks [51], algorithms for its optimization and storage of large volumes of data [52], identification of new sources of clean energy [53] and to a major impact on the quality of people's life [27,35].

Model B analyzed, according to hypothesis 2, whether there was a correlation between the number of employees in the *Information and communication* activity (X-independent variable) and the other index - the turnover of the organizations in the *Water supply activity; sewerage, waste management and decontamination activities* (Y2-dependent variable). The model was built and tested in the same way as model A, and the result is shown in Table 6.

$b_0 = 311,1721$ $b_1 = 0,026409$

Thus, $\hat{y} = 311,1721 + 0,026409 * x$ or

   $Y2 = 311,1721 + 0,026409 * X$

Table 6. Estimated parameters of the simple linear regression model **B** by using the method of least squares

Variable	Coefficient	Std. Error *t*-Statistic	Prob.
C	311.1721	21.96630 14.16589	0.0000
X	0.026409	0.002638 10.01092	0.0000
R-squared	0.282928	Mean dependent var	434.8789
Adjusted R-squared	0.280105	S.D. dependent var	342.4702
S.E. of regression	290.5744	Akaike info criterion	14.18938
Sum squared resid	21446101	Schwarz criterion	14.21707
Log likelihood	-1814.240	Hannan–Quinn criter	14.20052
F-statistic	100.2185	Durbin–Watson stat	0.319041
Prob(F-statistic)	0.000000		

Source: Authors' estimations. Notes: dependent variable:Y2. Method: least squares. Sample: 1 256. Included observations: 256

Conclusions for model B: At a significance level of 5%, *the model was valid*, and the variation of the values of the independent variable - *number of employees* in the *Information and communication activity* (X) justified by 28.29% the variation of the dependent variable - turnover of the organizations in the *Water supply activity; sewerage, waste management and decontamination activities* (Y2). The slope of the regression line b1 = 0.026409 showed that if the value of the independent

variable (X) changed by 1000 persons, then the dependent variable Y2 changed on average by 26.41 million lei in the same direction. Hypothesis 2 was, also confirmed. Hence the increase of the number of employees in the field of information and communication technologies, in other words the increase of their activities, definitely determined a significant growth of activities in the field of water supply, sewage, waste management and decontamination, as described in the studies [46,47].

Model C analyzed, according to hypothesis 3, whether there was a correlation between the number of employees in the Information and communication activity (X-independent variable) and the index - turnover of the organizations in the Human health and social work activities (Y3-dependent variable). The model was built and tested in the same way as model A, and the result is shown in table 7.

$b_0 = 23{,}83069$ $b_1 = 0{,}028485$

Thus, $\hat{y} = 23{,}83069 + 0{,}028485 * x$ or

Y3 = 23,83069+ 0,028485*X

Table 7. Estimated parameters of the simple linear regression model **C** by using the method of least squares

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	23.83069	7.957288 2.994826		0.0030
X	0.028485	0.000956 29.80774		0.0000
R-squared	0.777681	Mean dependent var		157.2617
Adjusted R-squared	0.776806	S.D. dependent var		222.8044
S.E. of regression	105.2605	Akaike info criterion		12.15854
Sum squared resid	2814264	Schwarz criterion		12.18623
Log likelihood	-1554.293	Hannan–Quinn criter		12.16968
F-statistic	888.5015	Durbin–Watson stat		0.770621
Prob(F-statistic)	0.000000			

Source: Authors' estimations. Notes: dependent variable: Y3. Method: least squares. Sample: 1 256. Included observations: 256.

Conclusions for model C: At a significance level of 5% *the model was valid*, and the variation of the values of the independent variable - *number of employees* in the *Information and communication activity* (X) justified by 77.76% the variation of the dependent variable - turnover of organizations for the activities in the field of *Human health and social work* (Y3).

The slope of the regression line b1 = 0.028485 showed that if the value of the independent variable X changed by 1000 persons, then the dependent variable Y3 changed on average by 28.49 million lei in the same direction. Hypothesis 3 was confirmed, too. Hence, the increase of the number of employees in the field of

information and communication technologies, basically the increase of their activities, definitely determined a significant growth of activities in the field of human health and social assistance, as described in the studies [39,40,54].

3. Conclusions and Future Research

We believe this study has practical implications at managerial and political level. Thus, the models can be analyzed by specialists, economists, managers from all organizations, who, based on them, can enhance the use or implementation of new information and communication technologies as a safe solution for modern, scientific management, and efficient, competitive economic development of the organization, allowing the implementation of measures of social responsibility and environmental protection, thus leading to a sustainable development. This ensures the foundation of the flexibility requirement for modern management, which must be informed, adapt to the new demands of the global market, identify and use the opportunities, and deal with the arising risks, in order to ensure both competitive and sustainable development of the organization [4].

The analysis of the presented models showed that there was a correlation between the *number of employees* in the *Information and communication activity* and:
- the turnover of organizations in the activity of *Electricity, gas, steam and air conditioning production and supply* (A)
- the turnover of organizations in the activity of *Water supply; sewerage, waste management and decontamination* (B)
- the turnover of organizations in the activity of *Human health and social work activities* (C)

This means that the prevalence and development of activities in the field of information and communication technologies will lead to a significant growth of activities in the field of *Electricity, gas, steam and air conditioning production and supply and Water supply; sewerage, waste management and decontamination*;

Basically, the new information and communication technologies allow, within any organization, the introduction of high specialization technologies, robotization and automation of processes in their field of activity, but also a computerized management of the other processes within organizations, such as modern procedures for quality control of products, [55], staff training, improvement of health and safety conditions at work [3], environmental protection measures, etc. Therefore, we are certain that ICT implementation is a factor of multiplying the degree of development for other areas of activity within the local communities. A powerful company, developed with new production technologies and ICT technologies, will be able to support many activities in the areas of social and environmental responsibility and implicitly will enhance sustainable development at local (development region) or national level.

Political decision makers, at local or central administration level, can intervene in stimulating organizations to use and implement new communication and information technologies [56]. These have direct beneficial impact on each organization such as better management, more efficient work processes, and a healthier and safer work environment, as well as in the local community, which will have a lower unemployment rate, a highly specialized workforce with better paid jobs, better environmental and living standard. Moreover, in Romania the introduction of new computer and communication technologies was supported by the government increasing the number of specializations in the field of Information and communication for secondary and higher education, as well as by political measures to stimulate the specialists working in this field [57]. Basically the digital revolution has played a key role in the transformation of society, as it changed the shape and size of new business models, it changed completely the production process and the sale of products and services, work and education, culture and leisure, governance [58], the global economy on the whole. And thus, the new technologies, used on the planetary scale have become the tools of change related to sustainable development [42,59].

Our study is limited regarding the data selected from the Statistical Yearbook of Romania, for the number of employees in the ICT field, because many companies, especially the small ones, have employees who perform specific ICT tasks but are assigned to positions of economists or engineers. This means that the development of ICT activities is not rigorously represented by the *number of employees*, which in fact has a higher growth. We will conduct further research analyzing other priority factors of regional sustainable development, such as urban transport, education, research, innovation, waste processing and others.

References

[1] Niculescu M., Lavalette G, *Strategii de creştere*, Editura Economică, Bucureşti, 1999

[2] Momete Daniela Cristina, *Saferational approach to a valid sustainable development*, (2014), Proced. Econ. Financ, 8, 497–504. https://doi.org/ 10.1016/S2212-5671(14)00119-1

[3] Costica Bejinariu, Doru-Costin Darabont, Elena-Raluca Baciu, Iuliana-Silvia Georgescu, Mihai-Adrian Bernevig-Sava and Constantin Baciu, *Considerations on Applying the Method for Assessing the Level of Safety atWork,*Sustainability 2017, 9, 1263; doi:10.3390/su9071263

[4] Valeria Andreoni, Apollonia Miola, (2016), *Competitiveness and Sustainable Development Goals*, Luxembourg: Publications Office of the European Union, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC103576/lb-na-28316-en-n.pdf

[5] Yifei Shi, Xinghang Ge, Xueliang Yuan,Qingsong Wang, Jon Kellett, Fangqiu Li and Kaiming Ba,*An Integrated Indicator System and Evaluation Model for*

Regional Sustainable Development, Sustainability 2019, 11, 2183; https://www.mdpi.com/2071-1050/11/7/2183/htm

[6] Raportul Brundtland, (1987), Commission on the Environment and Development within the United Nations, known as the "Brundtland Commission"

[7] United Nations, *AGENDA 21*, Conference on Environment & Development, Rio de Janerio, Brazil, June 1992, https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

[8] United Nations, (2015), *The Sustainable Development Goals2030 Agenda*, https://sustainabledevelopment.un.org/

[9] Kılkış¸S. *Sustainable development of energy, water and environment systems index for Southeast European cities*, J. Clean. Prod. 2016, 130, 222–234 https://doi.org/10.1016/j.jclepro.2015.07.121

[10] United Nations,*The Climate Technology Centre and Network (CTCN)*, Climate Strategies 2020, Dec, 2019, https://www.ctc-n.org/news/new-publication-climate-strategies-2020

[11] United Nations, (2016), *High-level Advisory Group on Sustainable Transport*, Mobilizing Sustainable Transport for Development, 2016, https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=2375&menu=35

[12] Madlener, R.; Sunak, Y,*Impacts of urbanization on urban structures and energy demand: What can we learn for urban energy planning and urbanization management,?* Sustain. Cities Soc. 2011, 1, 45–53.

[13] Streimikiene, D., Strielkowski, W., Bilan, Y., & Mikalauskas, I. (2016). *Energy dependency and sustainable regional development in the Baltic States-a review,*Geographica Pannonica, 20(2), 79-87.

[14] European Comission (2005), *Report of the European Comission for the Council and the European parliament regarding the Sustainable Development Strategy*, Bruxelles, December.

[15] Commission of the European Communities (2002). *Corporate Social Responsibility: A business contribution to Sustainable Development,* Brussels.

[16] Comunicare a Comisiei către Parlamentul European, Consiliul European, Consiliu, Banca Centrală Europeană, Comitetul Economic și Social European și Comitetul Regiunilor, Plan de acțiune: Finanțarea creșterii durabile, 8.03.2018

[17] Government of Romania (2008), "National Sustainable Development Strategy for Romania*"*, pp. 29-32: http://www.insse.ro/cms/files/IDDT%202012/StategiaDD.pdf

[18] Jovovic, R., Draskovic, M., Delibasic, M., & Jovovic, M. (2017). *The concept of sustainable regional development – institutional aspects, policies and prospects,*Journal of International Studies, 10(1), 255-266. doi:10.14254/2071-8330.2017/10-1/18

[19] Zilahy, G., & Huisingh, D. (2009),*The roles of academia in regional sustainability initiatives,*Journal of Cleaner Production,*17*(12), 1057-1066

[20] Salvati, L.; Carlucci, M.(2014),*A composite index of sustainable development at the local scale: Italy as a case study*, Ecol. Indic, 43, 162–171, https://doi.org/10.1016/j.ecolind.2014.02.021

[21] Kocmanova, A.; Docekalova, M. (2012),*Construction of the economic indicators of performance in relation to environmental, social and corporate governance (ESG) factors,* Acta Universitatis Agriculturaeet Silviculturae Mendelianae Brunensis 60(4): 141–149, http://dx.doi.org/10.11118/actaun201260040195

[22] Yifei Shi, Xinghang Ge, Xueliang Yuan, Qingsong Wang, Jon Kellett, Fangqiu Li and Kaiming Ba, (2019), *An Integrated Indicator System and Evaluation Model for Regional Sustainable Development,* Sustainability 2019, 11, 2183; doi:10.3390/su11072183

[23] Zhang, H.Y.; Uwasu, M.; Hara, K.; Yabar, H,(2011),*Sustainable urban development and land use change—A case study of the Yangtze River Delta in China,* Sustainability, 3, 1074–1089.

[24] Zhao, C.R.; Zhou, B.; Su, X,(2014), *Evaluation of urban eco-security—A case study of Mianyang city, China*, Sustainability 2014, 6, 2281–2299. [CrossRef]

[25] Yin, K; Wang, R; An, Q; Yao, L; Liang, J, (2014), *Using eco-efficiency as an indicator for sustainable urban development:A case study of Chinese provincial capital cities,* Ecol Indic. 2014, 36, 665 [26] Tsai,W.T,*Energy sustainability from analysis of sustainable development indicators: A case study in Taiwan*, (2010), Renew. Sustain. Energy Rev. 2010, 14, 2131–2138. [CrossRef]

[27] Ray, S.; Ghosh, B.; Bardhan, S.; Bhattacharyya, B, (2016), *Studies on the impact of energy quality on humandevelopment index*. Renew. Energy 2016, 92, 117–126. [CrossRef]

[28] Omer, A. M. (2008*). Energy, environment and sustainable development,* Renewable & Sustainable Energy Reviews, 12(9), 2265–2300. https://doi.org/10.1016/j.rser.2007.05.001

[29] Teodorescu Ana Maria, (2015), *The role of the ict sector in achieving sustainable development,*Annals of the „Constantin Brâncuşi" University of Târgu Jiu, Economy Series,Special Issue/2015 - Information society and sustainable development, http://www.utgjiu.ro/revista/ec/pdf/2015-03%20Special/24_Teodorescu.pdf

[30] Paolo Neirotti, Danilo Pesce, (2019), *ICT-based innovation and its competitive outcome: the role of information intensity,* European Journal of Innovation Management, March 2019

[31] Darabont, Doru Costin; Bejinariu, Costică; Ioniță, Iulian; Bernevig-Sava, Mihai-Adrian; Baciu, Constantin; Baciu, Elena-Raluca, (2018), *Considerations on improving occupational health and safety performance in companies*

using ISO 45001 STANDARD, Environmental Engineering and Management Journal, Vol 17, Issue: 11, Pg: 2711-2718,

[32] David Souter, *ICTs, the Internet and Sustainability: A discussion paper*, (2012), International Institute for Sustainable Development, https://www. iisd.org/pdf/2012/icts_internet_sustainability.pdf

[33] Robin Mansell, *ICT innovation and sustainable development*, (2012), In: Souter, David and MacLean, Don, (eds.) *Changing our understanding of sustainability: the impact of ICTs and the internet,* International Institute for Sustainable Development
http://eprints.lse.ac.uk/47900/1/__Libfile_repository_Content_Mansell,R_ICT%20innovation%20and%20sustainable%20development%20(pending%20copyright%20permission)_Mansell_ICT_%20innovation_%20sustainable_2012.pdf

[34] Souter, D., MacLean, D., Creech, H. & Akoh, B. (2010). *ICTs, the Internet and sustainable development: Towards a new paradigm*. Winnipeg, MB: IISD.

[35] Mohamed Bibri, (2009), *Sustaining ICT for Sustainability:Towards Mainstreaming De–carbonization–oriented Design& Enabling the Energy–Efficient, Low Carbon Economy*, School of Computing, Blekinge Institute of Technology, Karlskrona, Sweden 2009, https://www.diva-portal.org/smash/get/diva2:833352/FULLTEXT01.pdf

[36] Changwei Pang, Qiong Wang, Yuan Li, Guang Duan, (2019), *Integrative capability, business model innovation and performance,*European Journal of Innovation Management, ISSN: 1460

[37] Jinsong Wu, Song Guo, Huawei Huang, William Liu, and Yong Xiang, (2018),*Information and Communications Technologies for Sustainable Development Goals: State-of-the-Art, Needs and Perspectives*, IEEE, 2018, https://arxiv.org/pdf/1802.09345.pdf

[38] ITU-Kaleidoscope Academia Conference 2016: *ICTs for a sustainable world. International Telecommunications Union*, http://www.itu.int/en/ITU-T/academia/kaleidoscope/2016/Pages/default.aspx

[39] S. M. R. Islam, D. Kwak, M. H. Kabir, M. Hossain, and K. S. Kwak, (2015), *The internet of things for health care: A comprehensive survey*, IEEE Access, vol. 3, pp. 678–708, 2015.

[40] K. Wang, Y. Shao, L. Shu, C. Zhu, and Y. Zhang, (2016), *Mobile big data fault-tolerant processing for ehealth networks*, IEEE Network, vol. 30, no. 1, pp. 36–42, 2016

[41] J. Wu, S. Guo, J. Li, and D. Zeng, (2016), *Big data meet green challenges: Big data toward green applications*, IEEE Systems Journal, vol. 10, no. 3, pp. 873–887, 2016.

[42] Marlon E Cerf,(2019), *Sustainable Development Goal Integration, Interdependence, and Implementation: the Environment–Economic–Health*

Nexus and Universal Health Coverage, Global Challenges, Vol 3(9), https://onlinelibrary.wiley.com/doi/full/10.1002/gch2.201900021

[43] Xie, X.F.; Pu, L.J. (2017), *Assessment of urban ecosystem health based on matter element analysis: A case study of 13 cities in Jiangsu Province, China.* Int. J. Environ. Res. Public Health

[44] Shahsavari, A., Akbari, M., & Kazmerski, L. (2018), *Potential of solar energy in developing countries for reducing energy-related emissions.* Renewable & Sustainable Energy Reviews, 90, 275–291 https://doi.org/10.1016/j.rser.2018.03.065

[45] Larissa Pupo Nogueira de Oliveira, Pedro Rua Rodriguez Rochedo, JoanaPortugal-Pereira, Bettina Susanne Hoffmann, Raymundo Aragão, Rodrigo Milani, André F.P.de Lucena, Alexandre Szklo, Roberto Schaeffer, (2016),*Critical technologies for sustainable energy development in Brazil: technological foresight based on scenario modelling*, Journal of Cleaner Production, Vol 130, 12-24, https://doi.org/10.1016/j.jclepro.2016.03.010

[46] Winz, I., Brierley, G., & Trowsdale, S. (2009). *The use of system dynamics simulation in water resources management*,Water Resources Management, 23(7), 1301,https://doi.org/10.1007/s11269-008-9328-7

[47] Londoño, N.A.C.; Suárez, D.G.; Velásquez, H.I.; Ruiz-Mercado, G.J. (2017), *Emergy analysis for the sustainableutilization of bio solids generated in a municipal wastewater treatment plant.* J. Clean. Prod. 2017, 141,182–193. [CrossRef]

[48] Krzysztof Urbaniec, Hrvoje Mikulčić, Neven Duić, Rodrigo Lozano, (2016), *SDEWES 2014 – Sustainable Development of Energy, Water and Environment Systems,*Journal of Cleaner Production, Volume 130, Pag 1-11, https://doi.org/10.1016/j.jclepro.2016.04.062

[49] David Souter, (2012),*ICTs, the Internet and Sustainability: A discussion paper*,International Institute for Sustainable Development, https://www.iisd.org/pdf/2012/icts_internet_sustainability.pdf

[50] HG nr. 313/2017 privind înființarea, organizarea și funcționarea Departamentului pentru dezvoltare durabilă, București, 11 mai 2017.

[51] Zeng, Y.R.; Zeng, Y.; Choi, B.; Wang, L. (2017), *Multifactor-influenced energy consumption forecasting usingenhanced back-propagation neural network*, Energy 2017, 127, 381–396.

[52] Simona Vasilica Oprea, Adela Bâra, Vlad Diaconita, (2019), *Sliding Time Window Electricity Consumption Optimization Algorithm for Communities in the Context of Big Data Processing,* IEEE Access, vol 7, 13050, https://ieeexplore.ieee.org/abstract/document/8611319/authors#authors

[53] X. P. Zhang, (2012), *Marine energy: The key for the development of sustainable energy supply [point of view]*, Proceedings of the IEEE, vol. 100, no. 1, pp. 3–5

[54] M. Skubic, R. D. Guevara and M. Rantz, (2015), *Automated health alerts using in-home sensor data for embedded health assessment*, IEEE Journal of Translational Engineering in Health and Medicine, vol.3, pp.1–11, 2015.

[55] Mihai Alexandru BOTEZATU, Claudiu Pirnau, Radu Mircea Carp Ciocardia, (2019),*A Modern Quality Assurance System - Condition and Support to an Efficient Management*, TEM Journal. Vol 8(1), 125, http://www.temjournal.com/content/81/TEMJournalFebruary2019_125_131.pdf

[56] Malik, K., & Ciesielska, M. (2011), *Sustainability within the region: the role of institutional governance,*Economic and Environmental Studies, 11(2), 167-187.

[57] Legea nr. 227/2015 privind Codul fiscal

[58] Mihai Alexandru Botezatu, Claudiu Pirnau, Radu Mircea Carp Ciocardia, (2017), *Interdependence between e-governance and knowledge-based economy specific factors*, Journal of Information Systems & Operations Management, Vol. 11 No.2/ Dec 2017, pag. 369, http://jisom.rau.ro/Vol. 11%20No.2%20-%202017/JISOM-WI17-A15.pdf

[59] The Digital Revolution on and Sustainable Development: Opportunities es and Challenges, 2019

[60] Romanian Statistical Yearbook 2010–2017