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Untapped Aspects of Innovation and Competition within a European Resilient Circular Economy. A Dual Comparative Study

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Abstract: The paper aims to develop—based on a particular dual comparative analysis that follows the current European concerns—the concepts of competitiveness and innovation as pillars uprighting companies' resilience, creating ecoinnovative jobs and social inclusion. In their struggle to meet the Circular Economy principles and Green Deal objectives, the countries chosen for analyses—Romania and Serbia—have started implementing added-value blockchain concepts in their societies to thrive in the resilient European market and build empowered societies. According to the World Economic Forum Global Sources of Competitiveness, skills considered in our study refer to businesses' versatility and societies' innovation capability. Based on specific data provided by Eurostat, the results showed a correlation between the ecoinnovation index and R&D personnel by sector and helped design a regression model. Hence, we demonstrate that R&D creativity, once stimulated through innovative teaching, blooms, having positive effects at society and market levels as reflected in the ecoinnovation index. Furthermore, cluster analysis within E.U. innovation helped identify strengths and weaknesses, provided new grounds in applying innovation, and led to further recommendations.

Keywords: circular economy; innovation capability and resilience; business dynamics; ecoinnovation index; R&D personnel by sector

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1. Introduction

The European Union has placed a clear emphasis on the recovery of E.U. members from the COVID-19 pandemic in the Annual Plan for Sustainable Growth in 2021. It is envisaged that within the national strategies, member states will take special measures to support the following postulates: productivity, environmental sustainability, equity, and macroeconomic stability. All the stated goals ensure the full implementation of the Green Agreement mentioned above and lay the basis for revitalizing the European economy and society after the appearance of the SARS-CoV-2 virus. In line with these goals, the E.U. budget for 2021 is planned to be 672.5 billion Euros, including nonrefundable aid to all member states to "green recover". In this way, the importance of economic growth and preservation of the environment is further emphasised through sustainable investments based on saving resources and maximising the use of available materials (Annual Sustainable Growth Strategy, 2021). In addition, there is a "need to encourage a larger contribution of scholars from the Business and Economics area to explore the viability and profitability of CE strategies and related managerial practices to overcome akin issues" [1].

The circular economy (CE) represents a compelling management topic of the last decades. Expected and designed as a regenerative system, it subsists of effective and efficient utilisation of all resources of the ecosystem to optimise performance [2]. However, the scientific literature developed outside of management is mainly focused on defining innovative models to be adopted and implemented by companies [3].

This paper successfully investigated how Romania and Serbia, emerging country from the E.U. and E.U. accession countriy, acknowledge and adopt CE principles and Green Deal objectives, focusing on the CE Fourth Indicator—Competitiveness and Innovation. A regression model and a K-means cluster analysis showed a correlation between the ecoinnovation index and R&D personnel by sector, under the assumption that innovative teaching can stimulate the R&D creativity, as reflected in the ecoinnovation index increase. The K-means cluster analysis based on the PPIE subcriterion emphasises the (non) E.U. countries, showing specific week points that are to be acknowledged and corrected.

Regarding the motivation of the research, the authors motivated for their home countries to follow other countries in their transition from linear to circular economies reached the agreement that their purpose and tasks have been demonstrated and achieved. Sustainability is not a race, but there should be a shared interest among scientists, experts, national authorities, and society regarding the considerable expense in assisting countries lagging due to insufficient investment, knowledge, or other constraints. The research aims to help Serbia and Romania to choose the right path.

This article intended to measure innovation and competitiveness within the circular economy model by focusing on Romania's and Serbia's national elements and comparing each country's leadership and position with those of other countries. In this way, progress on Romania's and Serbia's paths to a circular economy and resilient development would be quantified based on current positions, representing the innovative contributions of the research. The paper touched its purposesș the primary findings indicate a lack of investment in Serbia and Romania, the critical importance of additional research and development investments, the use of new technologies (such as blockchain), and the importance of benchmarking.

One of the significant challenges is the absence of comparable data specific to the E.U. member countries, since Serbia is not a E.U member yet and compatible data is not available. This, however, is offset by other types of data and qualitative research. Regarding the study structure, after the introduction, chapter two presents the theoretical background of the research, prepared with document analysis. Chapter three outlines the data, variables, and research process and provides the results of the regression analysis and cluster analysis. The fourth chapter discusses the study results and divides the narrative into two separate subchapters: Romania and Serbia. Finally, the fifth chapter, the conclusion, summarises the most important research results, while chapter six addresses the study's limitations, mainly the lack of comparative and empirical data. Results achieved, based on the initial purposes of the research show that assumptions have been overpassed and goals achieved.

2. Theoretical Background

Innovation and competition within the circular economy are of growing interest for countries, companies, stakeholders, and civil society. CE is a unique system of achievements of efficient economies by narrowing and slowing different energy flows [4]. We introduce here the two socioeconomic terms of resilience and sustainability to better define the need for robustness and to point the value of innovative structural transformation. Hence, while sustainability defines the methods or process of harvesting by using resources that do not use up or destroy natural resources or permanently damage the environment, resilience represents the ability to create, adopt, and absorb new assets as energy; to translate knowledge into new types of behaviour and versatile policies; and give to the society a more comfortable shape after structural changes.

Sustainability or circularity means continuous changes towards the way firms generate their business and values. Researchers are still analysing these fields as a synergy of economic performance and environmental resilience, bringing apparent benefits to future generations [4,5].

In 2015, the European Commission regulated the investment framework, affecting it with alterations favouring competitiveness and innovations and leading countries to foster their growth in the future. On 11 December 2019, the same organisation earmarked the so-called European Green Deal as an essential work priority in the next decade. This program is the basis for fulfilling the signed goals from the Paris Agreement, which means reducing CO_2 emissions to 50% by 2030. The idea is for the European continent to become the first carbon-neutral territory and a world leader in the circular economy. The described set of economic measures concentrates on reducing and eliminating waste, taking better care of it, but also on saving energy by 2030 [6]. By 2030, it is estimated that the possible potential economic gain emanating from the transition to a circular economy would amount to 1.8 billion Euros [7]. Within the circular economy, creativity and innovation are essential pillars that support intelligent, resilient companies in their struggle to lead the market by creating new ecoinnovative jobs and social inclusion. The organisation model needs to be transformed to production–consumption–reuse as all stakeholders must be represented within the model [8].

The paper emphasises also the fact that companies need to rethink circular economy principles and processes by using resilient solutions and, for example, blockchain technologies in solving environmental problems [9,10]. Once understood and accepted, CE will drive sustainable behaviour. Blockchain technology is a practical solution that all countries can use to reduce waste management costs, ecological footprint, and fraud in green procurement as well as to enhance the green economy [11,12]. Nevertheless, the most critical impact that blockchain has is a significant, resilient change in the life-chain of different industries, with a positive impact on changing human mindset and sustainability [13,14]. Analysing the January 2021 model of innovation in teal and pluralistic organisations within CE (Figure 1), we noticed that blockchain facilities for the entire value-added life-chain infrastructure would create new opportunities for sustainable ecoinnovation within companies. Furthermore, many studies emphasise that blockchain technologies provide the secure implementation of CE R-Strategies (reduce, reuse, recycle, recover, repair, remanufacture) which is also our fulfilled intention [15,16].

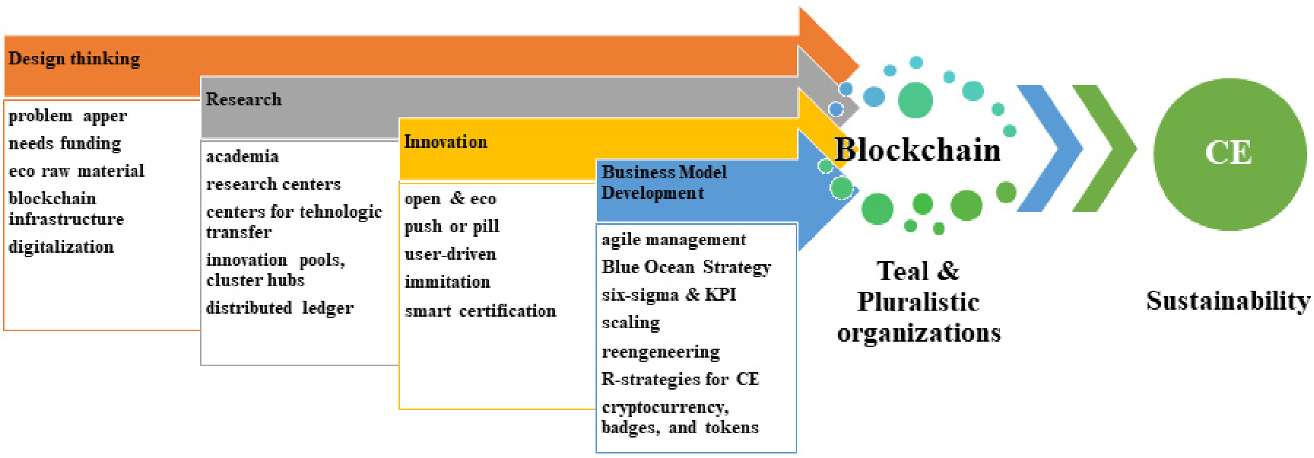

Figure 1. Innovation process in teal and pluralistic organisations in the context of circular economy.

Blockchain infrastructure will ensure material certification (expanding the use of non-polluting materials), smart contracts, and asset tracking (ensuring traceability, transparency, security of information for all the entire life cycle assessment (LCA)); nudge ecological behaviour and reward green employees through cryptocurrency, badges, and tokens; and stimulate corporate responsibility through credit rating trust mechanisms, and distributed ledger [17]. Furthermore, the decentralised ledger will facilitate information flux regarding the materials and their sources [15].

Thus, blockchain technology will also ensure security and privacy, effectiveness, cost reduction/profitability, decentralisation, new business models, and streamlining/automation [18]. For these reasons, blockchain may be a good solution in surpassing the challenges of CE [19]. Digitalisation (networks that provide real-time information about materials and ensure supply chain transparency and traceability) will be translated into resilient actions such as circular resource flows and waste management. Human resources have to develop new ideas for practical innovation [19]. Tracking all the activities in an LCA from a distance and blockchain safety proved to be an appropriate solution in the time of the COVID-19 pandemic.

The development of information technologies-conditioned changes in business models, especially the innovations brought by the digital revolution, concerning the fusion of technologies and their potentials in enabling changes in business and social spheres [20,21], have had a similar impact on new business models. Companies (especially) need to innovate within their business ecosystem networks. The authors of this paper present a model monitoring the entire life cycle of a product/service (awareness and training, analysis, product design, communication/certification) and the supply chain for the large companies and state institutions, based on blockchain technology, to invest in an open innovation platform and licenses. All companies with a new idea of a product/service can become members of the ecosystem (Figure 1) [22–24]. Similarly, Gassman et al. believe that the most significant innovation potential lies not in products or processes but innovative business models [25]. The Figure 1 shows innovation process developed by the authors of this paper as an adaptation after [26]).

Many researchers have already studied the impact of CE on the growth and development of environmental protection [27,28]. At the same time, others have focused on studying the impact of CE on progress in ecology and analysed the importance of its sustainability and the ramifications for the country's economic development as a whole [8,29]. The main pillars of sustainable implementation of CE principles are innovative and creative human resources, which can benefit from the hardware and software support of blockchain technology in developing green products using innovative green methods. These products can be easier to dismantle and convert into green raw materials, mitigating the energy expenditure and the ecological footprint. Waste management and averting pollution is also the responsibility of human resources departments in their struggle to implement CE strategies [30–32]. Referring to the CE sphere, there is a direct link to the workforce, investment, employment, and innovation [33]. Other studies have also argued that innovation in, for instance, the recycling sector is the basis for GDP growth [34]. Innovation is usually considered the most effective tool to achieve a certain standard of living and overcome environmental problems. However, production and service innovations in the field of CE are mainly observed from a long-term point of view. They are not always easy to generate, and therefore more researchers in this field deal with efficient business models that represent innovation through strategic business policies [35].

Schiederig et al. define ecoinnovation as "an object that is defined by its market orientation as well as its environmental benefit over its entire life cycle and that establishes a new innovation or green standard for the company, regardless of whether its primary objective is environmental or economic" [36]. Literature shows many types of ecoinnovation, such as [24,26,27,35,37–39].

1. Product innovation—involves significant improvements in the capabilities, characteristics, and utility of goods and services, or the design of completely new goods and services. Improvements are observed in the technical specifications, functional characteristics, components and materials from which products are made, product software, and utility and ergonomics in use. Examples include new car models and Tesla batteries [24].

2. Process innovation—involves important improvements in production or delivery methods. Innovation is based on significant changes in technologies, equipment

and/or software (AI, machine learning, chatbot, blockchain, IoT, 5G, XR, robots, etc.). Process innovation creates new jobs and eliminate some of those based on functionally outdated technologies.

3. Marketing Innovation—involves important improvements in marketing methods or even the discovery of new methods such as neuroscience or VR/AR (virtual reality/augmented reality) technologies used with great success in marketing. Innovations in marketing include 7P + 1G (price, product, promotion, placement, process, people, physical environment/location, green marketing). This innovation can be seen in: (a) product design and packaging (based on information provided by neuro-marketing/market surveys, focus groups have proved to be quite ineffective in market research; large companies choose the best advertising, packaging, presentation, etc. after analysing their impact on an experimental group by monitoring brain and emotional activity); (b) new promotion methods (e.g., with VR/AR you can place the customer in another time and space); placing products (e.g., moving a car showroom to the city centre, in very small spaces, where the customer experiences all the sensations of VR driving); (c) methods of pricing goods and services (e.g., online prices changing constantly depending on the number of product/service and web traffic requests and on the principle of auctions); (d) communicating with employees and customers on the basis of new discoveries in neuroscience; (e) the use of recyclable materials for production, in ecolabelling, etc. The goal of these innovations is to better meet the needs of customers and educate them by creating new needs and opening up new markets [2,7,35,37–39].

4. Organizational innovation—refers to the implementation of new organizational methods. In this context, leadership has a very strong impact on the modern management of the company. Large companies like Google invest in relaxation, leisure (meal breaks), kindergartens specially designed within the company, etc. to provide comfort to employees at work and stimulate innovation and productivity. Organizational innovation also includes the implementation of the concepts of corporate responsibility, a circular sustainable economy and one-health [24,26].

5. Management innovation—refers management principles and processes that ultimately change managerial practice. This is done through project management. Modern managers use new business resource management methods such as Six-Sigma and new management methods such as Agile. Outstanding results in human resources have been achieved in management. Neuroscience has shown that the most innovative and productive companies present are those that are directly concerned with the health and happiness of employees, materialised by methods of motivating mindfulness [26,33].

Summarising, the concept of ecoinnovation is important for both business and society. Correctly approached, it becomes a useful tool for policy makers to fully apply innovations for the benefit of the market and the environment. The value of ecoinnovation is higher if its analysis is holistic and serviceable, with environmental benefits. Defined by international bodies (e.g., OECD, European Commission) as a tool in measuring "the creation or implementation of the new", the qualities of ecoinnovation are in line with the most important book of innovation and quality—the Oslo Manual.

In connection to direct measurement—number of innovations, descriptions of individual innovations, data on sales of new products—inputs like R&D or patents help the indirect measurement of changes in resource efficiency and productivity using decomposition analysis. This approach, less explored, require a particular attention as it may enlarge and accelerate the knowledge base [40]. At the E.U. level, only two types of innovations are standardised with indicators: product and process innovation, which are measured through enterprises that introduce innovation (product and process innovative enterprises, PPIE). Thus, we choose to analyse PPIE in our paper and see which factors influence it.

Having these concerns in mind, we moved further and designed a research methodology to evaluate the relationship among ecoinnovation, R&D, and PPIE in E.U. countries. We analysed two primary skills: businesses' versatility and societies' innovation capability (World Economic Forum Global Sources of Competitiveness). Then we expanded/deepened our study on a detailed comparison of two partner countries, one from the E.U. (Romania) and one not (Serbia), dedicated to implementing CE principles. The purpose of this comparison was to see how the two countries (one with the support of the E.U. and the other without) perform in the context of the circular economy.

3. Experimental Data Complex Analysis and Significant Results

3.1. Data and Variables

The article used data published about Serbia and Romania by WEF and Innovation Balanced Scorecards. In addition, Eurostat databases were consulted to analyse the factors and degree of innovation in both countries, and three variables were included in statistical interpretations. The variables included in the initial conceptual framework were:

1. PPIE = product and process innovative enterprises that introduced innovation by type of innovation, innovation developer, NACE Rev.2 activity, and size class (Table 1) (INN_CIS10_PROD$DEFAULTVIEW) (last updated 03/07/2019) [41]
2. ECO-INNIV = ecoinnovation index (T2020_RT200) 2013–2019 (last updated 08/02/2021) [42]
3. R&D = R&D personnel by sector (SDG_09_30) 2013–2019 (last updated 10/03/2021)—percentage of active population—numerator in full-time equivalent (FTE) [43]

Table 1. Subcriterion of product and process innovative enterprises which introduced innovation PPIE (variable coding-own source).

E.I. (R&D)	Enterprise Itself (R&D Performers)
E.I. (non-R&D)	Enterprise itself (non-R&D performers)
E.T. (R&D)	Enterprise together with other enterprises or organisations (R&D performers)
E.T. (non-R&D)	Enterprise together with other enterprises or organisations (non-R&D performers)
E.A. (R&D)	Enterprise by adapting or modifying products and process originally developed by other enterprises or organisations (R&D performers)
E.A. (non-R&D)	Enterprise by adapting or modifying products and/or process originally developed by other enterprises or organisations (non-R&D performers)
O.E. (R&D)	Other enterprises or organisations (R&D performers)
O.E. (R&D)	Other enterprises or organisations (non-R&D performers)

We chose to analyse the ecoinnovation index because it brings a holistic perspective of economic, environmental, and social performance, in accordance with CE principles of sustainability. It is composed of 16 subindexes, grouped into five categories: (1) ecoinnovation inputs (related to socioeconomic objectives and HR in science/technology and investments); (2) ecoinnovation activities (related to certification in innovation); (3) ecoinnovation outputs (related to patents, academic publication, and media coverage); (4) resource efficiency outcomes (GDP, domestic material consumption, freshwater abstraction, primary energy consumption, and greenhouse gas emissions); and (5) socioeconomic outcomes (exports of products from ecoindustries and employment/revenue in ecoindustries and the circular economy) [42]. At a closer look, we may observe that all these subindexes are in strong correlation with or depend on HR. As the index emphasises that ecoinnovation depends on research and development, we decided to analyse R&D personnel by sector. The literature review shows that innovation can be associated with product, processes, marketing, management, and organization. From Eurostat we can extract information regarding only two types of innovation (process and product); thus, we decided to include this PPIE indicator in our research.

3.2. Research Process

Our previous research regarding innovation within a network business environment [44] urged us to check if there is a relation between ecoinnovation and R&D. Innovation can be the result of many factors, including product and process innovative enterprises. Also, the market experience and other international studies provided by OSCE, WEF, CGI led us to the same assumption. In this regard, we decided to collect data from Eurostat. Having in mind the opportunities brought by introducing blockchain technology into the L.C.A. to gain a sustainable economy we collected data from Eurostat to ground our study on very specific elements that can have an impact on innovation, such as PPIE and R&D. Literature review and our model (Figure 1) prove that a sustainable economy is facilitated by using blockchain technology for the entire L.C.A. Also, other studies show that there is a relation between ecoinnovation and smart working [21]. We applied, in this study, a more profound analysis to verify how ecoinnovation is influenced by R&D personnel by sector and PPIE (Product and process innovative enterprises which introduced innovation by type of innovation, and innovation developer), having the support and security offered by blockchain technology. Thus, our study evaluates if there is any relation between ecoinnovation, R&D, and PPIE. In addition, our study evaluates the impact of R&D, and PPIE (and their subindexes) on the ecoinnovation index. In order to deepen our analysis, we designed a cluster analysis to find out where innovation potential comes from.

Hypothesis 1 (H1). *R&D and PPIE have no influence on ECO_INNOV.*

Hypothesis 2 (H2). *R&D has a strong and positive correlation with ECO_INNOV, emphasising the importance of stimulating the creativity, motivation, cooperation, and communication of human resources, which in turn positively impact ecoinnovation resilient development.*

Hypothesis 3 (H3). *Product and process innovative enterprises (PPIE) have a significant impact on the ecoinnovation index.*

In the first stage, our research purpose was to choose what kind of data can be analysed to achieve our aim, based on our previous findings from the literature review: ecoinnovation, R&D, and PPIE. Different analytical tools were applied to Eurostat data for the 2013–2019 period [41–43]. A forecast for 2020–2021 was added. The data gathered was inserted in tables and graphs (Table 1, Figure 2). After correlating data, the variables were introduced into a regression model assuming that the ecoinnovation index depends on R&D personnel by sector and PPIE.

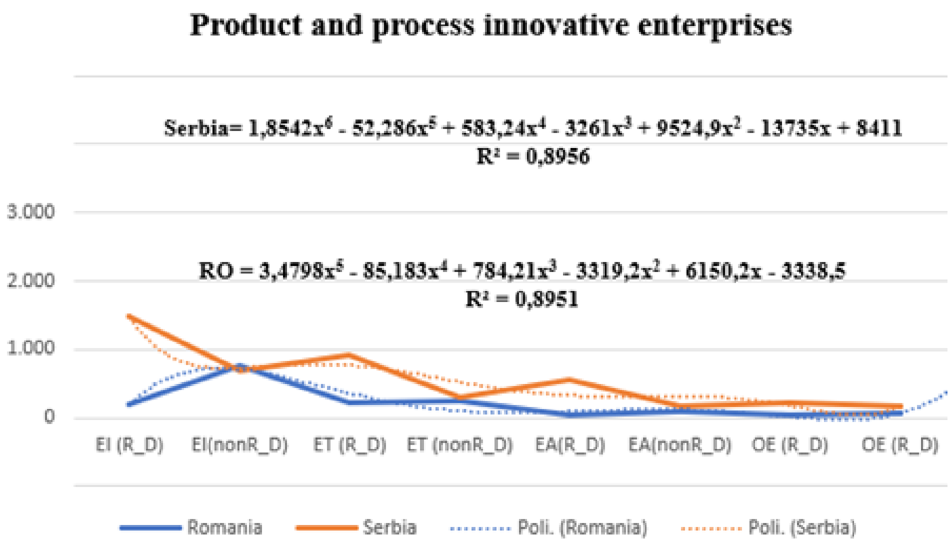

Figure 2. Product and process innovative enterprises that implemented innovation in Romania and Serbia, by type of innovation (polynomial regression).

In the second step of our analysis, a K-means cluster analysis was implemented to understand the data better and see where Romania and Serbia are situated vis-à-vis the

E.U. from the point of view of competitiveness and innovation. This analysis grouped the countries by product and process innovative enterprises. which introduced innovation PPIE subcriteria (Table 1). PPIE represents the criterion for introducing the data into groups and the countries into a certain particular cluster.

3.3. Results

The results of the study are divided into separate subchapters. The first subchapter discusses the results of conducted regression analysis, and the second discusses the results of the cluster analysis.

3.3.1. The First Stage—Regression Analysis Results

The ecoinnovation, R&D, and PPIE variables were introduced into a regression model. The Pearson correlation coefficient (0.847) shows a strong positive correlation between the percentage of the active population employed in R&D (R&D variable) and innovation by circular economy principles (ECO_INNOV variable), with minimal probability of mistake (Sig. = 0.000 < 0.01), as seen in Table 2. We may assume that the H1 (null hypothesis) was rejected and H2 (alternative hypothesis) was accepted. Product and process innovative enterprises, PPIE, had a moderate influence, but an ANOVA test excluded this factor from the model. Thus, the H3 hypothesis was partially confirmed. We may explain this partial influence with the fact that innovation in marketing, management, and organizations are not included in PPIE. For this reason, the PPIE was analysed separately and represented a criterion in our cluster analyses.

Table 2. Correlation, regression model, coefficients, and ANOVA.

		ECO_INNOV	**R&D**
Pearson Correlation	ECO_INNOV	1.000	0.847
	R&D	0.847	1.000
Sig. (1-tailed)	ECO_INNOV		0.000
	R&D	0.000	
N	ECO_INNOV	22	22
	R&D	22	22

R Square	**Adjusted R Square**	**Std. Err Estimate**	**Change Statistics**					**Durbin–Watson**
			R Square Change	F Change	df1	df2	Sig. F Ch.	
0.718	0.703	15.57	0.718	50.816	1	20	0.000	1.409

Coeff	**Unstandardized Coefficients**		**Standard. Coeff.**	**T**	**Sig.**	**95% Confidence Interval for B**		**Collinearity Statistics**	
	B	Std. Error	Beta			Lower	Upper	Tolerance	VIF
(Constant)	31.052	8.480		3.662	0.002	13.363	48.741		
R&D	48.614	6.820	0.847	7.129	0.000	34.389	62.839	1.000	1.000

ANOVA	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Regression	12,312.769	1	12,312.769	50.816	0.000
Residual	4846.004	20	242.300		
Total	17,158.773	21			

Our regression model well estimated data series, having an R^2 = 0.718 with a Sig. = 0.000 < 0.01. The R^2 value empowers us to say that 71% of the variance of the dependent variable (ECO_INNOV) is explained by the variance of the independent variable (R&D), emphasising the importance of human resources in ecoinnovation. The companies have to support the creativity and motivation of human resources and stimulate cooperation and communication between clusters, to gain highly skilled employees. Durbin–Watson's statistic confirms this assumption by being very close to the interval 1.5–2.5, where there is no autocorrelation between variables. The value of Durbin–Watson's statistic =1.4 shows that the residuals might have a very small linear autocorrelation.

Since the adjusted R^2 value is close to the value of R^2, this allows the extension of the proposed regression model assumptions to the entire population. In this case, the variance of the dependent variable decreases with the difference between the two coefficients (0.718 − 0.703 = 0.015). This difference can be seen to be below 1%. The *t*-test for a constant and R&D variable validates the model and contributes to the predictive power of regression. The significance threshold (Sig.) of the variables is less than 0.01, meaning that the coefficients are very well estimated.

SPSS statistics offer us the regression equation coefficients with a very small probability of error. This fact was confirmed by ANOVA analysis. On the other hand, the F-statistic offers arguments in supporting or rejecting the null hypothesis (H1). As the F-statistic has a low value (0.00), the probability of making a mistake if H1 was rejected was very small; thus, H2 (that R&D personnel influence the ecoinnovation index) was accepted.

Regression equation: ECO_INNOV = 31.052 + 48.614 × R&D

3.3.2. The Second Stage—K-Means Cluster Analysis Results

In the second step of our research, the analysis focused on product and process innovative enterprises that implemented innovation PPIE subcriterion because statistics showed a moderate influence. We observed some differences between Serbia and Romania. When it comes to R&D performers in Serbia, more enterprises tend to innovate independently or in collaboration with other enterprises or organisations, or to adapt or modify products and/or processes developed initially by other enterprises or organisations, than in Romania. When talking about non-R&D performers, both countries have the same behaviours (Figure 2).

Designing clusters on these criteria, Italy formed cluster 1, and France cluster 3, by themselves, with the highest centre values (Appendix A). These countries appear to have many innovative enterprises, either independently or in collaboration with others, in both cases: performers and nonperformers of R&D. They make relatively few adaptations or modifications to products and processes developed by other businesses (Table 3—Final cluster centres). Italy is known for the high spirit of entrepreneurship. In Italy, there are regions, such as Bassano, where the number of SMEs is higher than that of families. Cluster 4 is formed by Belgium and the Netherlands, and Cluster 5 comprises Austria, Spain, Poland, Switzerland, the Czech Republic, and Portugal. Belgium and the Netherlands are very innovative countries [36], but they innovate within consolidated hubs and consortiums. This is the reason for the lack of many enterprises that innovate by themselves. In cluster 5, there are innovative countries, but in this cluster, the category "other enterprises or organisations" seems to have a higher weight than other cluster structures. Cluster 2, which contains Serbia and Romania, is the least innovative across all criteria. The software allocated countries to clusters. The main criteria were ANOVA and F-test, confirming that the cluster was chosen to maximise the differences among cases in different clusters.

Table 3. Cluster analysis.

Final Cluster Centres					
Innovation Subcriteria	**Cluster**				
	1	**2**	**3**	**4**	**5**
EIR&D	21,949	934	15,648	5334	3720
EInonR&D	17,674	705	15,092	1147	3148
ETR&D	12,688	666	10,157	3851	2367
ETnonR&D	8682	408	7954	1023	1470
EAR&D	5377	353	5424	1773	814
EAnonR&D	3782	255	4839	545	810
OER&D	2518	222	2650	1148	672
OEnonR&D	3026	260	3308	1029	1331

Table 3. *Cont.*

Final Cluster Centres					
COUNTRY	**Cluster**	**Distance**	**COUNTRY**	**Cluster**	**Distance**
Italy	1	0.000	Croatia	2	252.595
France	3	0.000	Hungary	2	448.024
Belgium	4	2270.924	Bulgaria	2	558.451
Netherlands	4	2270.924	**Serbia**	**2**	**656.321**
Austria	5	1119.004	Estonia	2	706.716
Spain	5	1387.060	Latvia	2	774.156
Poland	5	1575.197	Slovenia	2	779.269
Switzerland	5	1624.932	Slovakia	2	795.558
Czech R.	5	1821.724	Lithuania	2	935.163
Portugal	5	2268.435	**Romania**	**2**	**991.201**
			Luxembourg	2	998.966
			N Macedonia	2	1145.697
			Cyprus	2	1171.157
			Norway	2	1741.533
			Greece	2	1992.155
			Finland	2	2935.487

4. Discussions and Further Recommendations

Our study started from the innovation process model in teal and pluralistic organisations in the circular economy proposed by January 2021 [26] (Figure 1). To adapt it to the opportunities opened by the COVID-19 pandemic, we propose a model that includes the facilities brought by a blockchain infrastructure for the entire value-added life-chain infrastructure (raw material identification and management to reduce the ecological footprint; data transparency, traceability, and security; human resources training for stimulating innovation and creativity, rewarded by virtual currency, badges, and tokens; product (re)design, reengineering, and R-strategies; communication/certification through smart contracts; and new business models adapted to the digital circular economy.)

Numerous studies and case studies demonstrate that the life-cycle value added in the circular economy (CE) can be implemented using blockchain technology, thereby securing CE R-Strategies (reduce, reuse, recycle, recover, repair, remanufacturing) in a variety of activity fields, including information technology/electronics/industries, construction, agriculture and food, manufacturing, and plastics [15,16]. The ingenuity and creativity of human resources, as well as the hardware and software support for blockchain, are the primary foundations of blockchain deployment in the CE. Human creativity is critical in developing innovative methods for designing green products that are easier to disassemble, recycle, consume less energy, and have a smaller ecological footprint. The creativity of human resources is also important in the waste management process and in preventing environmental pollution. Human innovation is required in R strategies; in transforming waste into new raw materials, products, or energy; and in saving resources and energy [30–32].

This model is strengthened by the regression model, which shows a positive relation between ecoinnovation and R&D, meaning that investments in R&D and new innovative methods of stimulating creativity ensure greater ecoinnovation, which can lead to a sustainable economy. In the second step, a deeper K-means analysis was done on the subcriteria of PPIE. The graphs (Figure 2) and analysis (Table 3) show that both Serbia and Romania were included in cluster 2, with the smallest values for all innovation subcriteria. Therefore, we continue with a detailed discussion on Romania and Serbia. The novelty and valuable contribution to the field of sustainable development might be observed after introducing blockchain facilities in LCA, implementing the innovation model developed by us and presented in Figure 1.

4.1. Discussion on Romania

According to recent data on European innovation calculated by European Innovation Scoreboard (https://ec.europa.euodest Innovators group—June 2020), based on 27 major indicators, the E.U. countries fall into four groups—Innovation Leaders, Strong Innovators, Moderate Innovators, and Modest Innovators. Romania ranks the last group together with Bulgaria, demonstrating long-term policy and national strategy misconduct. Romania has some achievements and good results in the field of “innovation-friendly environment” and “sales impacts”, while the “innovators”, “firm investments”, and “human resources” are the weakest. “Broadband penetration” and “medium- and high-tech product exports” are the only two indicators showing close to EU average performance.

In Romania, technological innovation is based primarily on R&D and knowledge development from a highly skilled young working force driven by experienced specialists in different fields. These factors are associated with highly populated countries' economies [45,46]. Romania exports medium- and high-tech products with outstanding productivity and have “high performance on knowledge generation—both R&D-based and nontechnological—and are very successful in attracting money (R&D funding, FDI, ESIF funds, new enterprises), talents, and people into the region. They also have the most educated workforce and are experiencing positive population change”. Private enterprises accessed most FP7 funds, demonstrating a direct correlation between innovation and the R&D system in Romanian enterprises [47]. Universities in Romania became a pillar in stimulating this cooperation, responsible for nudging creativity and “interests in knowledge, technology, and innovation transfer”, contributing to a robust economy [48]. Furthermore, in Romania, heritage tourism brings important economic capitalization [48,49]. Green procurement sustained in Romania depends on market participants' level of knowledge and skills [50]. Companies that apply agile management and foster the working force's motivation through innovative organisational culture have high productivity rates with a low footprint on the environment [51,52].

Our regression model's close relation between ecoinnovation and R&D personnel includes Romania. Romania holds innovation capability, but the overall business dynamism is not very relevant because of the very long time needed to start a business and a very high insolvency rate. A smoother procedure to set up a business, more governmental support, consultancy, and knowledge technological transfer support are needed for sustainable innovation. Romania also has to improve its entrepreneurial culture.

4.2. Discussion on Serbia

The Serbian legal framework in the field of innovation started to develop after the adoption of the Law of innovation in 2010. This law enables the formation of establishments supports for innovative activities and technological transfers, the setup of intellectual property rights, and the Serbian Innovation Fund. If ten years ago there were no bodies effectively tracking the key metrics to evaluate the innovation capacity of companies in need to assess particular sectors of interest to foreign direct investors, today the situation is totally different and shows people and market versatility as well as the desire to provide a strategic and legislative framework for innovation. [53–61].

Infrastructure and support for high-tech research expand academic applicative programs, create venture/private equity investment, and channel R&D entrepreneurship to preserve the environment. Serbia has the ability to absorb new knowledge and adapt imported/purchased technologies—an essential capability to grow and innovate within an official service enabled to advertise competences and capacities to foreign investors, learn metrics and innovation auditing, and create a set of key metrics to track for each industry group [53–61].

Thanks to the analysed effects of competitiveness and innovation in the field of CE in Serbia, it is certain that the introduction of the circular economy would move the country from the manufacturing industry to an innovative industry that would automatically have a higher value of finished products—this would assume a much faster transition from manufacturing to services. Multiple connections would be established with foreign companies and potential investors, so Serbia would become more competitive in offering products and services in the circular economy. The latter would mean automatic access to several financial sources that would significantly support innovation processes and improve relations with those countries that support CE through cooperation programs. All of the above would inevitably lead to technological and educational independence and reduce the economic gap between Serbia and other highly developed countries in the region and beyond. It is important to emphasise that Serbia will not be admitted to the European Union unless it changes the way it uses existing resources; the implementation of CE is a unique opportunity for accelerated accession to this community [53–61].

5. Conclusions

We conducted an analysis of competitiveness and innovation in the E.U. based on Eurostat data: ecoinnovation index, R&D personnel, and PPIE (with its subcriteria). A regression model on innovation and a K-means analysis proved that investments in human resources and proper management of LCA, based on blockchain technology, will create new models of business and innovation that will ensure a sustainable economy. Our analysis revealed that R&D stimulates HR creativity, innovation, and collaboration, which in turn have a positive impact on ecoinnovation and sustainable development. Secondly, product and process innovative enterprises (PPIE) have a relatively moderate impact on ecoinnovation. Cluster analyses on this criterion grouped the E.U. countries from the point of view of ecoinnovation. This revealed that Serbia and Romania are weak innovators.

Innovations in a business organisation can be stimulated and initiated, so they can also be managed, keeping in mind that good ideas may also come from the environment and the company itself. Wisdom is to recognise which ideas are good, realistic, achievable, and profitable enough to turn into innovations. It is much easier to copy a product than an organisation with unique people, ideas, and values. A part of an organisation's "magic" reflects its ability to be new, different, and better than the competition, thanks to new ideas. Combined with other abilities, innovation gives companies a competitive advantage, depending on how revolutionary the innovation is and how long it takes the competition to copy it or develop an equally revolutionary idea. The market race never stops.

In implementing these activities, it is desirable to actively involve representatives of the employees who are part of the team changes that are necessary to implement to achieve betterment in society. The importance of involving all actors identified through a particular working group for CE should not be emphasised. Additionally, intensive capacity-building and training for the economy and public administration are needed in order to be ready to prepare project proposals for available transitional E.U. grants. It is necessary to actively monitor E.U. policy regarding the coherent framework of production policies for different sectors and the measurability of their contribution to CE, but also to monitor the use of best available techniques in the context of CE. It is also essential to actively raise the capacity of the economy for the transition to the CE model. It is imperative to harmonise the time frames for activities in the waste management sector following the new policies and the needs of CE implementation.

6. The Limitations of the Study and Future Research Agenda

The main limitation of this study is that we based our analysis mainly on Eurostat, WEF, OSCE, and CGI data in the absence of strong contact with the business field (we got information only from our universities and their partners, their entire value-added life cycle). Another problem lies in the fact that Serbia does not have a comparative CE methodology as a non-EU country. We have already developed a survey that contains questions regarding (1) entrepreneurial and hybrid university capabilities and characteristics, (2) blockchain platform implementation case studies and future recommendations, (3) green procurement, green methodologies, and policies within the economic–social environment, and (4) future sustainability pillars regarding ecoinnovation and R&D, especially in relation with human resources. This survey will be promoted through the U.S.H. Pro-Business Centre, the Wallachia Hub Consortium, CERMAND (Centre for Renewable Energy on the Black Sea and the Danube), the DANUBE Furniture Cluster, the DANUBE Engineering Hub Bio Concept Valea Prahovei Cluster, and the Smart eHub Consortium in Romania.

As part of the Annual Sustainable Growth Strategy for 2021, the E.U. has focused on the mechanism for recovery and resilience. With national plans, recovery measures are expected in the context of a Sustainable Growth Strategy that contains environmental sustainability, productivity, equity, and macroeconomic stability [61]. The concept of the circular economy and CE business models, which are increasingly discussed in Serbia, could create conditions for faster recovery of the national economy. Such a transition in the industry is possible with a clearly defined public policy of green recovery and financial support. This document presents the regulatory and economic directions designed to recover from the economic and social crisis caused by the COVID-19 pandemic through the transition to a business based on CE principles. The "green recovery" and sustainable ways of doing business constitute the path that the E.U. has traced and dedicated significant financial resources to, the latter of which have been made available to both the member states and the countries of the Western Balkans.

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Appendix A

Table A1. Cluster statistics.

Distances between Final Cluster Centres					
Cluster	**1**	**2**	**3**	**4**	**5**
1		31,514.587	7383.879	26,745.590	27,162.729
2	31,514.587		25,147.985	5798.475	4428.874
3	7383.879	25,147.985		20,685.780	20,808.642
4	26,745.590	5798.475	20,685.780		3212.406
5	27,162.729	4428.874	20,808.642	3212.406	

Table A1. *Cont.*

Distances between Final Cluster Centres						
ANOVA	**Cluster**		**Error**		**F**	**Sig.**
	Mean Square	df	Mean Square	df		
EIR&D	149,794,115.544	4	849,412.426	21	176.350	0.000
EInonR&D	111,631,962.669	4	591,626.973	21	188.686	0.000
ETR&D	54,111,814.566	4	476,959.599	21	113.452	0.000
ETnonR&D	27,956,253.821	4	135,775.135	21	205.901	0.000
EAR&D	11,694,031.173	4	173,269.441	21	67.490	0.000
EAnonR&D	7,476,563.816	4	61,461.766	21	121.646	0.000
OER&D	2,697,414.000	4	66,485.071	21	40.572	0.000
OEnonR&D	4,427,127.404	4	101,218.738	21	43.738	0.000

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