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Environmental, Social and Economic Sustainability in Mining Companies as a Result of the Interaction between Knowledge Management and Green Innovation—The SEM Approach

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Abstract: The mining industry is one of the greatest polluters of the environment and has direct positive and negative impacts on all three pillars of sustainable development: economy, environment and society. Due to the aforementioned, primarily negative impacts on the environment, it is important to implement sustainability principles in the operations of companies in the mining industry. The implementation of the sustainability principle enables the economically profitable, ecologically clean and socially responsible exploitation and processing of mineral raw materials. This means of doing business requires the introduction of clean or green technologies, which are the product of green innovation. The innovation process is highly dependent on knowledge. Knowledge has a great contribution to creativity and the creation of innovation. Accordingly, knowledge management activities and the ability of a company to use and combine different sources of knowledge are essential for the creation of different types of innovation, including green innovation. The research, including the pilot test, was carried out in the period of May–August 2022, whereby convenience sampling was used to obtain 626 employees in six mining companies in Serbia. The structural equation modeling approach was used to evaluate the causal relationship between knowledge management, green innovation and the sustainable operations of the mining industry. The indirect effects of the dimensions of knowledge management, through the dimensions of green innovation, on the dimensions of sustainable development were examined using the bootstrap procedure. The results of the study confirmed the positive direct and indirect relations between the constructs. The research indicates the importance of including all components of knowledge management and green innovation in achieving all components of business sustainability.

Keywords: sustainable development; business sustainability; mining industry; mineral resources; structural equation modeling

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1. Introduction

The basis of industrial development is non-renewable mineral resources (ores, nonmetals and raw energy materials). Thus, industrial and economic development is conditioned by the existence of natural sources of raw materials and energy, and the survival of civilization by the production of healthy food and industrial products and the preservation of the environment, which is the most threatened by industrial development.

The first serious warnings about the uncontrolled growth in production and the consumption of natural resources, and the increasing pollution of the environment, were published in "The Limits of Growth", by the Club of Rome, in 1972 [1]. Twenty years later, at the UN Conference on Environment and Development in Rio de Janeiro in 1992, the Sustainable Development Strategy was adopted. The strategy highlights three major

goals: the preservation of ecological balance, the fair distribution of natural resources between generations and the development of the underdeveloped part of the world. As stated in the Brunthald report, which contains the most widely used definition of sustainable development, "Sustainable development meets the needs of the present, without denying the ability of future generations to meet their own needs" [2]. From the aspect of environmental protection, sustainable development should ensure that the emission of pollutants does not exceed the capacity of the soil, water and air to preserve their quality, which is at least sufficient for the lives of people, plants and animals. From the social aspect, sustainable development should enable social justice through the elimination of poverty and the improvement of quality of life. From the economic aspect, sustainable development should enable the development of the economy while creating standards.

From the socioeconomic aspect, the positive effects of the mining industry can be explained through the growth of the mining industry, which contributes to an increase in the share of this sector in the gross domestic product (GDP) of a country and thus has a positive effect on the economy [3]. Moreover, the growth of the mining industry leads to increasing employment, which is significant in achieving the economic and social goals of sustainable development [4]. However, there are both positive and negative effects of the mining industry on the social aspect of sustainable development. The mining industry is at the top of the list of active polluters of waterways, soil and air. The exploitation and processing of mineral raw materials cause major environmental pollution, accompanied by the following phenomena: the major degradation of land surfaces; and large amounts of waste, such as mine and flotation tailings, ash, sulfur dioxide, carbon dioxide and large amounts of wastewater; and oil spills. In the process of coal mining, gangue is formed, which poses a serious threat to the environment [5]. Such pollution contributes to climate change, destroys natural habitats and leads to a loss of biodiversity [6]. Non-products that are created in the mining industry and that pollute the environment indirectly harm people's health, and this is an evident negative impact of the mining sector on the social aspect [7].

In general, the conclusions of numerous studies on the impact of the mining industry on environmental pollution and sustainable development point to the necessity of changing the existing practices in the mining industry in order to protect the environment and human health and achieve the sustainable development goals [8,9]. These changes imply a transition to sustainable business. Sustainable business implies the application of green innovation. This means that the existing technology in the mining industry must be replaced with green technology. Moreover, an appropriate knowledge management process is necessary for sustainable business. The knowledge management process enables the dissemination of knowledge within the organization [10] and facilitates the creation of innovation for sustainable business [11,12].

The subject of this study is environmental, social and economic sustainability, as dimensions of sustainable business, in mining companies as a result of the interaction between knowledge management and green innovation. The study aims to determine (1) whether knowledge management practices have a direct positive effect on green innovation, (2) whether knowledge management practices have a direct positive effect on sustainable business, (3) whether green innovation has a direct positive effect on sustainable business and (4) whether green innovation dimensions are a significant mediator of the relationship between knowledge management dimensions and sustainable business dimensions in mining companies.

The basic organization of the work's content is determined by the objectives established as well as the research methods. The paper is divided into six sections as a result. The subject and objectives are discussed in the first section of the paper. The research background is presented in the second section. This section gives a brief summary of prior studies that have looked at this issue, specifically how knowledge management, green innovation and sustainable business are intertwined. In the third section of the study, the research methodology is presented. This part includes the description of the research data, the model,

the research hypotheses and the applied data analysis method. The fourth section of the paper includes the research results. Within this part, the results of testing the assumptions of the model, namely the adequacy of the sample, multicollinearity and common method bias test, are first presented; then, the measurement and structural model are analyzed; and, finally, the results of testing the mediator role are presented. In the fifth part, the results of the research are discussed. The sixth part contains the key conclusions of the research; the limitations of the current research are pointed out and recommendations are given for future researchers of this topic.

2. Research Background

Sustainable business was created as an extension of the concept of sustainable development; it is essentially connected with sustainable development and represents a means of doing business without which it is not possible to achieve sustainable development [13]. The importance of sustainable business was highlighted during the COVID-19 pandemic, which significantly affected the business of small and medium-sized family and non-family firms [14], but also large companies in the mining sector [15]. According to [16], changes leading to sustainable business require a fundamental change in the purpose of business and all aspects of business management. Sustainable business implies the application of business models that create a competitive advantage and contribute to the sustainable development of the company and society [17]. The ultimate goal of sustainable business is to preserve the environment and improve quality of life [18]. It can be said that sustainable business involves achieving a balance between economy and ecology for the sake of achieving social benefits. Research has shown that it is possible to achieve a balance between economy and ecology [19] and maximize company revenues through the introduction of sustainable business practices [20]. According to [21], one of the key challenges of sustainable business is designing business models that allow an organization to create economic value while providing social and environmental benefits. Sustainable business involves the company's cooperation with its environment and the harmonization of the interests of all stakeholders [22]. Ogrean and Herciu [23] defined sustainable business as the integration of economic, social and environmental goals into the organization's operations, while taking into account the interests and claims of its (current and future) stakeholders. In [24], sustainable business is defined as "a corporate activity that seeks to achieve a balance of sustainability when performing business activities and communicating with stakeholders, which consists of the dimensions of economic, social and environmental responsibility, and includes present and future time". Socially responsible business, as a company's positive attitude towards the public, the environment, its employees and its suppliers, is important for sustainable business [25]. The application of sustainable business practices focused on the efficient use of resources or eco-innovations has proven to be successful in reducing environmental impacts and increasing social value [26].

From the perspective of the mining sector, changing existing practices and transitioning to sustainable business implies the application of new tools and methods of waste reduction in the mining sector, and the application of green technologies and innovations in the mining industry [27]. The question of integrating elements of the circular economy into the mining industry was considered in [28]. The authors of this study concluded that the implementation of circular business models in mining companies' strategies will contribute to the sustainable operations of these companies, as well as the achievement of sustainable development goals. Adequate data on the achievement of the sustainable development goals and the impact of mining companies on the environment can be obtained from the sustainability reports that mining companies publish [29]. In addition to providing information about companies' impacts on the environment, these reports have a positive impact on corporate reputation [30].

Innovation is one of the most important factors in business activity and has positive effects on company performance [31], as well as positive, direct and indirect effects on economic growth and development in general [32]. With the increase in the number of

environmental problems and the awareness of sustainable development and sustainable business, there is a need for innovations that can contribute to solving the mentioned problems. These are green innovations, for which different authors use different terms, such as "eco-innovations", "ecological innovations" or "sustainable innovations". Regardless of the use of different terms in discussions of these innovations, the common aspect in all of them is that they refer to new technologies, production methods, products or services that result in a reduction in environmental risks [33] and contribute to quality of life [34], with the minimal use of natural resources [35]. In general, it can be said that green innovations bring both economic and environmental benefits [36]. In addition to technologies, products and processes, according to the OECD definition, green innovations also include marketing methods, organizational structures and institutional arrangements that—with or without intention—lead to environmental improvements [37]. Therefore, in addition to technological achievements, management practices are equally important for sustainable business. In support of the application of technological innovation, managerial and organizational innovations help to preserve the natural environment [38]. Research points to three main categories of green innovation: green product innovation, green process innovation and green management [39]. This classification results in two basic dimensions of green innovation: green technological innovation and green management innovation [11].

Research has shown the indisputable importance of green innovation in the mining sector [8,40], as well as the essential role of knowledge management in the development of green innovation [11,41,42]. Therefore, the appearance of a large number of environmental and socioeconomic problems requires a large amount of knowledge to solve them, which conditions the need to introduce the concept of knowledge management in organizations. New knowledge, especially external knowledge, can be a powerful stimulus for organizational change and improvement [11]. In the knowledge economy, knowledge management is a significant income generation factor [43]. Accordingly, it is necessary that modern production and service organizations have the ability to develop and use the value of knowledge [44]. The application of knowledge enables creativity, facilitates the creation of innovation and forms competencies that contribute to the improvement of overall organizational performance in all sectors [45].

In [46], knowledge management is defined as "the management function that creates or locates knowledge, manages the flow of knowledge within organizations, and ensures that knowledge is used effectively and efficiently for the long-term benefit of the organization". In [47], knowledge management is described as organizational practices based on the application and use of knowledge. It can be said that knowledge management enables the effective use of human capital. Walczak [48] points to the importance of knowledge culture and states that knowledge management refers to the creation of an adequate organizational culture that facilitates and encourages the creation and sharing of knowledge within the organization.

Several dimensions of knowledge management appear in the literature. In this research, four dimensions of knowledge are used, which are the creation (creation) of knowledge, the acquisition of knowledge, the dissemination (sharing) of knowledge and the application of knowledge [11].

According to Borghini [44,49], knowledge makes a great contribution to creativity and the creation of innovation, and therefore there is a close relationship between organizational knowledge and the capacity to innovate. Knowledge-sharing facilitators that can improve organizational innovation are also important [50]. According to [51], the knowledge management process drives the innovation activities of companies. Knowledge is a critical input in business processes and, in this sense, knowledge management refers to the ability of a company to use and combine different sources of knowledge that can transform existing resources into value in the form of products, processes or other types of innovation [45].

Knowledge management enables changes and innovations to lead to the improvement of the organization's key competencies [52], and it is capable of solving contemporary

environmental and socioeconomic problems [43]. Mikalauskienė and Atkočiūnienė [53] investigated the impact of knowledge management on sustainable development and concluded that organizations that aim to contribute to the creation of social well-being, the preservation of the environment and the creation of social health must create an environment suitable for the development of knowledge processes and the creation of innovation. Robinson et al. [54] attempted to consider the role of knowledge management in promoting sustainable business practices in the context of the construction industry by proposing a five-stage road map. According to [55], knowledge management enables the transfer of useful information and intellectual property and thus contributes to the sustainable operation of an organization. Wu et al. [56] showed that improving corporate sustainability and doing business according to sustainable development principles relies on knowledge management and creating strong links for knowledge exchange between the organization and the external environment. Shahzad et al. [57] pointed out the essential importance of acquiring knowledge in achieving sustainable development. There are various studies that have shown that knowledge management practices have a positive impact on green innovation [12,42] and on sustainable business results [58,59]. In [60], the authors showed that green innovation affects sustainable development by improving the production average and resource utilization, as well as improving the relationship between companies and stakeholders and increasing market shares. In [61], the results obtained showed the existence of a significant relationship between green innovation and environmental performance.

The tightening of environmental regulations in the mining sector to protect the environment and achieve sustainable development has led to the necessity of applying green innovation in mining companies [8]. Based on the previously stated facts about the problems of sustainable development and the impact of the mining sector on it, it is possible to point out the significant role of knowledge management in the development of green innovation and its contribution to sustainable business. Namely, studies have shown that both knowledge management and green innovation can influence the sustainable operations of companies [11,41,62], and their positive connection is often mentioned. Moreover, the findings of earlier studies indicate a positive influence of knowledge management on green innovation [11,41]. In this sense, the results of the current research are expected to confirm these relationships.

Only a few empirical studies, such as [11,41], investigate the dimensions of knowledge management and green innovation as determinants of the dimensions of sustainable business, and this paper contributes to the body of existing literature by empirically investigating the role of the dimensions of green innovation as a mediator of the relationship between the dimensions of knowledge management and the dimensions of sustainable business of mining companies in Serbia.

3. Research Methodology

3.1. Data Collection, Sample of Respondents and Questionnaire

The quantitative research (Supplementary Materials) was carried out using the method of surveying employees in six mining companies in Serbia, in the period from the beginning of May to the end of August 2022. Online surveys were used to collect data. Respondents were informed about the objectives and anonymity of the survey and were then asked to rate items in the questionnaire, keeping in mind the mining company that they worked for. A total of 647 questionnaires were collected. Examination of the questionnaires revealed that, due to irregularities such as missing data or random filling, 21 questionnaires had to be excluded from further analysis.

The convenience sampling approach yielded 626 respondents, of which 70.3% were men and 29.7% were women. The largest percentage of respondents belonged to the age group of 41–50 years (33.1%), while the fewest respondents were 20–30 years old (17.9%). The largest percentage of respondents had completed university (60.2%), and the smallest had a doctorate (1.1%). Most of the respondents had worked for more than 15 years in the

same mining company (36.4%), followed by at least 10–15 years (19.2%). Most respondents were from lower management (41.5%), and the least were from senior management (2.9%). More detailed information on the sociodemographic characteristics of the respondents is shown in Table 1.

Table 1. Sociodemographic characteristics of the respondents.

		Frequency	Percentage
Gender	Male	440	70.3
	Female	186	29.7
Age	≥30	79	15.8
	31–40	126	25.2
	41–50	146	29.2
	≤51	127	25.4
Education	High school	242	38.7
	University—bachlor's and master's	377	60.2
	Post-university (PhD)	7	1.1
Years of work experience	≥5	151	24.1
	6–10	127	20.3
	11–15	120	19.2
	≤15	228	36.4
Hierarchical level of work	Senior management	18	2.9
	Middle management	132	21.1
	Lower management	260	41.5
	Officer/coordinator	216	34.5

The structured questionnaire consisted of 4 parts. The first part of the questionnaire contained questions about the sociodemographic characteristics of the respondents (gender, age, level of education, work experience and hierarchical job level). The second part of the questionnaire concerned the attitudes of employees in the mining industry regarding knowledge management (KM) practices. The knowledge management measurement scale consisted of fourteen items, divided into four dimensions: (1) knowledge creation (KC)—3 items; (2) knowledge acquisition (KAC)—4 items; (3) knowledge sharing (KS)—3 items and (4) knowledge application (KAP)—4 items. Items were taken and adapted from [46,63–65]. The third part of the questionnaire concerned employees' attitudes toward green innovation (GI). The green innovation measurement scale consisted of six items, divided into two dimensions: (1) green technological innovation (GTI)—3 items and (2) green management innovation (GMI)—3 items, taken and adapted from [66,67]. The fourth part of the questionnaire concerned employees' attitudes toward sustainable business (SB). The sustainable business measurement scale consisted of ten items, divided into three dimensions: (1) environmental sustainability (ENVS)—3 items, (2) social sustainability (SOCS)—3 items and (3) economic sustainability (ECOS)—4 items, which were taken and adapted according to the items used by other authors in their research [68–71]. A 5-point Likert scale was used to evaluate items (1—do not agree at all, 5—absolutely agree).

3.2. Model and Research Hypotheses and Analysis

Following the model, which was applied in [11,41], the current study examined how knowledge management, directly and indirectly, through green innovation, affects sustainable business in mining companies. A novelty of the research is the examination of the mediating role of green innovation between knowledge management and sustainable business on a dimensional level. Figure 1 shows the research model.

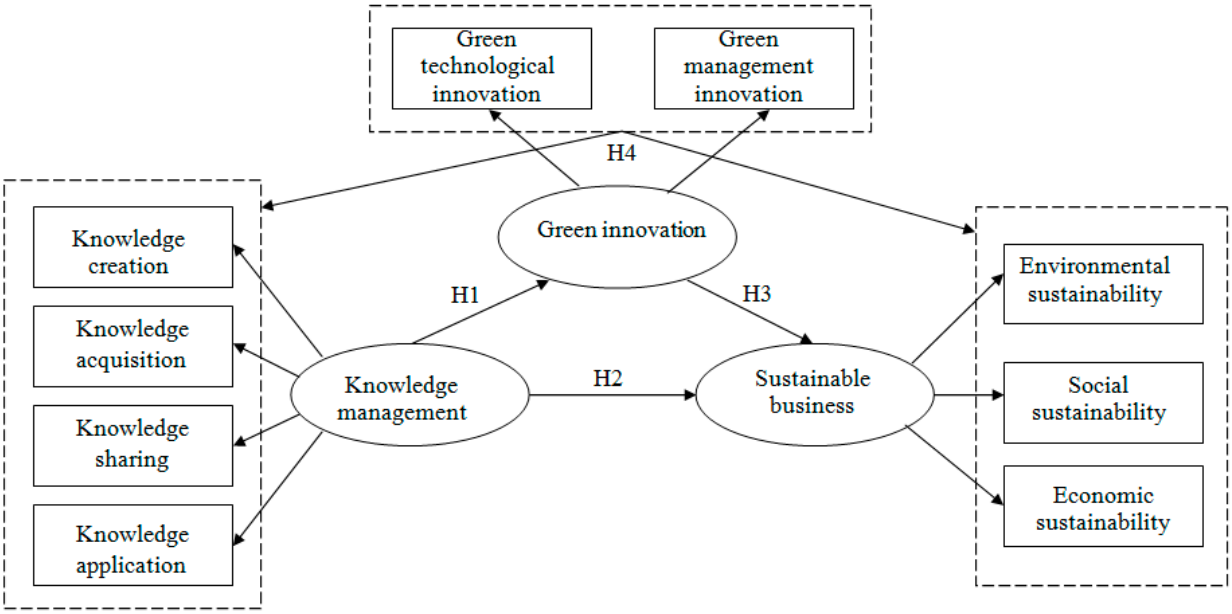

Figure 1. Research model.

Taking into account the subject and objectives of the research, as well as previous research on this topic, the following hypotheses were defined.

H1. *Knowledge management has a significant direct positive effect on green innovation in mining companies.*

H2. *Knowledge management has a significant direct positive effect on sustainable business in mining companies.*

H3. *Green innovation has a direct significant and positive effect on sustainable business in mining companies.*

H4. *Green innovation dimensions mediate the relationship between knowledge management dimensions and sustainable business dimensions in mining companies.*

Structural equation modeling (SEM) was used to test hypotheses H1, H2 and H3, i.e., to examine the causal links between knowledge management, green innovation and sustainable business. Structural equation modeling is a method that has similar goals to multiple regression, but the SEM approach is much broader, taking into account interaction modeling, nonlinearity, dependent and independent variables, measurement errors and multiple latent independent variables [72]. It can be used as an alternative to multiple regression, path analysis, factor analysis, time series analysis and the analysis of covariance. These procedures can be considered special cases of SEM, i.e., viewed from another perspective, SEM is an extension of the general linear model (GLM), of which multiple regression is a part [72,73]. Relationships between constructs were tested based on the approach proposed in [74], which includes two steps: measurement model assessment and structural model assessment. To test hypothesis H4, the bootstrap procedure was used, which examined the indirect effects of dimensions of knowledge management, through dimensions of green innovation, on dimensions of sustainable business, i.e., the mediating role of dimensions of green innovation in the relationship between dimensions of knowledge management and sustainable business.

Data were processed using SPSS IBM Statistics Version 21 and AMOS Graphics.

4. Results

4.1. Adequacy of the Sample, Multicollinearity and Common Method Bias Test

Conducting multivariate analysis, followed by structural equation modeling, implies an adequate sample, the absence of multicollinearity and a common method variance bias test [75]. Since the sample size in the current study was 626 respondents, which was more than the 200 respondents recommended by [76] for a factor analysis, this criterion was met. In addition, the VIF test values ranged from 1.649 to 2.866, being less than 3, indicating that there were no multicollinearity problems in the data. For CMB analysis, Harman's single-factor test was used. Results indicated that there was no CMB in the data, since the value of a single factor's contribution was 28,161, and, according to [77], the contribution of a single factor should not exceed 50%.

4.2. Analysis of Measurement and Structural Model

To evaluate the measurement model, confirmatory factor analysis was first conducted. Walts et al. [78] recommend that the normalized chi-square (χ^2df) should be equal to or less than 3. The NFI, TLI and CFI values should be around 0.9 or more, while RMSEA and SRMR should be 0.08 or less for the model fit to be adequate [79]. According to the obtained results, the initial measurement model required modifications. The research model was modified based on suggestions for a potential revision (Amos Graphics modification indices) and after considering the modifications that were suggested., all fit indicators were improved, so that acceptable fit indicators of the structural model were achieved (Table 2).

Table 2. Model fit indicators.

Fit Indicators	χ^2/df	NFI	TLI	CFI	RMSEA	SRMR
Adequate fit	≤3	≥0.90	≥0.90	≥0.90	≤0.08	≤0.08
Measurement model χ^2 = 112.304, df = 24, $p < 0.001$	4.679	0.960	0.952	0.968	0.077	0.032
Structural model χ^2 = 54.951, df = 22, $p < 0.001$	2.498	0.980	0.980	0.988	0.049	0.023

In the next step, the convergent and discriminant validity of the constructs was assessed. In [80,81], the authors recommend Cronbach's α and the composite reliability values for the construct must be above 0.7. In [81], the authors suggest that for a measurement model to demonstrate sufficient convergent validity, the AVE for each construct in the model must be above 0.5. Fulfillment of convergent validity is indicated by standardized factor loadings greater than 0.50, internal reliability coefficient values (Cronbach's alpha) and composite reliability (CR), as well as values of the share explained in the total variability (AVE). Results are shown in Table 3.

Table 3. Factor loadings, reliability coefficients and convergent validity.

Construct	Factor Loading	Cronbach's Alpha	CR	AVE
KM		0.836	0.828	0.552
KC	0.647			
KAC	0.604			
KS	0.799			
KAP	0.886			
GI		0.713	0.849	0.583
GTI	0.660			
GMI	0.841			
SB		0.783	0.724	0.571
ENVS	0.708			
SOCS	0.697			
ECOS	0.728			

According to the Fornell-Larker criterion [82], the AVE's square root was calculated to test the discriminant validity. The obtained values of $\sqrt{}$AVE were, for each construct, higher than its correlation with the other two constructs, so that the discriminant validity was confirmed (Table 4).

Table 4. Discriminant validity.

Construct	KM	GI	SB
KM	0.743 *		
GI	0.604	0.764 *	
SB	0.655	0.721	0.756 *

Note: *—square root of AVE.

Based on the obtained research results (Table 5), it was determined that knowledge management has a significant direct positive effect on green innovation ($\beta = 0.802$, $p < 0.01$) and sustainable business ($\beta = 0.336$, $p < 0.01$). On the other hand, it was determined that green innovation has a significant direct positive effect on sustainable business ($\beta = 0.650$, $p < 0.01$).

Table 5. Results of testing hypotheses H1, H2 and H3.

Hypothesis	Path	β	t	Decision
H1	KM → GI	0.802 ***	18.477	Supported
H2	KM → SB	0.336 ***	4.014	Supported
H3	GI → SB	0.650 ***	6.767	Supported

Note: ***—$p < 0.01$.

4.3. Mediation Analysis

In order to examine the indirect effects of the dimensions of knowledge management on the dimensions of the sustainable business of mining companies, we used a two-step approach, proposed in [80], which included first the assessment of indirect effects and then the assessment of direct effects in the presence of a mediator; 24 mediation analyses were conducted.

In the first step, the indirect effects of the dimensions of knowledge management (KC, KAC, KS, KAP) on the dimensions of sustainable business (ENVS, SOCS, ECOS) through the dimensions of green innovation (GTI, GMI) were assessed. The obtained results indicated a significant indirect effect of knowledge management dimensions on sustainable business dimensions. In the second step, the direct effects of knowledge management dimensions on sustainable business dimensions were assessed, in the presence of mediators (GTI, GMI). According to the obtained results, the direct effects were also significant. Such results indicated partial mediation. More detailed results are shown in Table 6.

Table 6. Indirect and direct effects of knowledge management dimensions on sustainable business dimensions (GTI and GMI as mediators).

Hypothesis	Path	Indirect Effect	Direct Effect	Decision
H4	KC → GTI → ENVS	0.140 ***	0.290 ***	Supported partial mediation
	KC → GTI → SOCS	0.108 ***	0.309 ***	Supported partial mediation
	KC → GTI → ECOS	0.135 ***	0.254 ***	Supported partial mediation
	KAC → GTI → ENVS	0.161 ***	0.232 ***	Supported partial mediation
	KAC → GTI → SOCS	0.127 ***	0.240 ***	Supported partial mediation
	KAC → GTI → ECOS	0.145 ***	0.257 ***	Supported partial mediation
	KS → GTI → ENVS	0.141 ***	0.363 ***	Supported partial mediation
	KS → GTI → SOCS	0.099 ***	0.402 ***	Supported partial mediation
	KS → GTI → ECOS	0.130 ***	0.357 ***	Supported partial mediation
	KAP → GTI → ENVS	0.128 ***	0.434 ***	Supported partial mediation
	KAP → GTI → SOCS	0.087 ***	0.463 ***	Supported partial mediation
	KAP → GTI → ECOS	0.106 ***	0.483 ***	Supported partial mediation
	KC → GMI → ENVS	0.198 ***	0.233 ***	Supported partial mediation
	KC → GMI → SOCS	0.208 ***	0.209 ***	Supported partial mediation
	KC → GMI → ECOS	0.228 ***	0.161 ***	Supported partial mediation
	KAC → GMI → ENVS	0.192 ***	0.201 ***	Supported partial mediation
	KAC → GMI → SOCS	0.204 ***	0.163 ***	Supported partial mediation
	KAC → GMI → ECOS	0.209 ***	0.194 ***	Supported partial mediation
	KS → GMI → ENVS	0.212 ***	0.292 ***	Supported partial mediation
	KS → GMI → SOCS	0.224 ***	0.201 ***	Supported partial mediation
	KS → GMI → ECOS	0.248 ***	0.240 ***	Supported partial mediation
	KAP → GMI → ENVS	0.206 ***	0.356 ***	Supported partial mediation
	KAP → GMI → SOCS	0.226 ***	0.323 ***	Supported partial mediation
	KAP → GMI → ECOS	0.228 ***	0.361 ***	Supported partial mediation

Note: ***—$p < 0.01$.

5. Discussion

The current study considered the connection between knowledge management, green innovation and sustainable business in mining companies in Serbia, with special reference to direct and indirect impacts at the dimensional level of the observed constructs.

The empirical results of the conducted study indicate that knowledge management is a significant determinant of both green innovation and sustainable business in mining companies. By sharing knowledge and collaborating with employees in other organizations, managers can apply the experience of their colleagues and "develop environment-friendly technology" [11]. On the other hand, green innovation is a significant determinant of sustainable business. In relation to studies by other authors, the results of the current study can most appropriately be compared with the results in [11]. The mentioned studies, using SEM, examined the role of knowledge management in activities of green innovation and corporate sustainable development and determined the significant impacts of knowledge management on green innovation and sustainable business, as well as green innovation on sustainable business in manufacturing and service companies, in Pakistan. The results of the current study are also consistent with the results of [41], which examined the operability of knowledge management processes in improving green innovation and tried to clarify the role of green innovation in achieving sustainable enterprise development in manufacturing industries.

The results of the study indicate that both dimensions of green innovation, i.e., green technological and green management innovation, partially mediate the relationship between the dimensions of knowledge management (creation, acquisition, sharing and application of knowledge) and the dimensions of sustainable business (environmental, social and economic sustainability). Based on the review of the existing available literature, to the best of our knowledge, the studies of other authors do not consider the dimensional level of the observed constructs; in this way, the obtained research results cannot be compared

with the results of other authors. However, taking into account the positive and significant influences between the dimensions of the observed constructs, which are indicated by the results of a large number of studies by different authors [11,41,55,66,83–85], a positive and significant role of green innovation dimensions can be expected, as a mediator in the relationship between knowledge management dimensions and sustainable business dimensions. Milojević et al. [86] considered methods of data acceptance in financial analysis in enterprises in the metallurgical industry. Within the framework of green technologies, Đurđevac-Ignjatović et al. [87] considered the significant economic and environmental advantages of cement paste, especially in the mining industry.

6. Conclusions and Future Perspectives

The results of the conducted study indicate the significant direct effects of knowledge management on green innovation and sustainable business in mining companies in Serbia. In addition, the obtained results indicate a significant positive and direct impact of green innovation on sustainable business. The obtained results are in line with the results of earlier research, which also concluded a positive, direct and significant relationship between knowledge management and green innovation, as well as knowledge management and sustainable business. The results indicate significant direct and indirect effects of knowledge management dimensions on sustainable business dimensions, through green innovation dimensions. The direct effects of knowledge management dimensions on the dimensions of sustainable business are indicated by the results of earlier studies. Regarding indirect effects, some authors obtained results according to which knowledge management, through green innovation, has a significant indirect effect on sustainable business. However, based on the review of the existing literature, it can be noted that earlier research did not examine the role of green innovation, as a mediator of the relationship between knowledge management and sustainable business, on a dimensional level.

This study explored a still under-researched area and attempted to empirically examine the importance of knowledge management and its dimensions in improving green innovation and its dimensions and sustainable business and its dimensions. Since positive relationships were found, it can be concluded that the inclusion of all components of knowledge management and green innovation in the implementation of sustainable business is very important for the efficient management of limited resources.

The practical implications of the current study are reflected in highlighting the importance of knowledge management in promoting green innovation and improving business sustainability for policymakers, and the results suggest that various government sectors should encourage training programs for the professional development of managers, thereby supporting the development of a sustainable organization.

Empirically, this study examined the previously unresearched mediating role of the green innovation dimensions between the knowledge management and sustainable business dimensions, which contributes to the existing literature that covers these topics. The current study also has certain limitations. The focus of the study was only Serbia. In this sense, future research could focus on other countries, or a group of countries, and on comparing the obtained results with the results from the current study. In addition, the current study only examined the perceptions of managers, and, in this sense, future research could also consider the perceptions of non-managerial staff. The current study considered only the mining sector, which is one of the greatest polluters of the environment. Future research could apply the proposed model to other sectors as well. Moreover, the proposed model can be extended by adding new constructs and moderators, such as environmental turbulence.

Finally, the results of the current study highlight the importance of knowledge management processes and green innovation in achieving sustainable business in mining companies; therefore, the need for additional empirical research on this topic is, in fact, one of the main practical implications of this study.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su151612122/s1, Questionnaire.

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