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Coordination of Configurations of Technologically Integrated "European Green Deal" Projects

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Abstract: An analysis of the state of affairs in the theory and practice of implementation of technologically integrated projects in various applied fields was carried out. The peculiarities of the implementation of the technologically integrated projects of the "European Green Deal" for the production of ecologically clean fuel from agricultural waste were analyzed. The expediency of developing a method of coordinating the configurations of technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste on the territory of a given region, taking into account their specific project environments, was substantiated. As a result of the conducted research, a method of coordinating configurations of the technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste in the territory of a given region, taking into account their specific project environment, was developed. This method involves the implementation of five stages, which ensure consideration of the specific design environment of each region and the type of agricultural raw materials for energy production. This method involves the modeling of individual projects, which makes it possible to increase the accuracy of determining their value indicators, taking into account risk. The balancing of the technologically integrated projects of the "European Green Deal" for the production of clean energy from agricultural waste was carried out on the basis of maximizing value for stakeholders and minimizing risk. On the basis of the proposed method, the computer program "Balancing technologically integrated projects" was developed. The use of this computer program for the given project environment (conditions of LLC "Lutsk Agrarian Company" of the Volyn region, Ukraine) made it possible to forecast the specific value and risk of individual projects involving harvesting raw materials from corn waste. The statistical characteristics of the distribution of the projected specific value of the project of harvesting raw materials from corn waste were established: the estimate of mathematical expectation—EUR 9/ton; dispersion—EUR 25/ton; the estimation of root mean square deviation—EUR 5/ton. The technologically integrated projects of the "European Green Deal" for the production of ecologically clean energy from corn waste with the greatest interconnections in terms of value were identified. The ranking of raw material procurement projects from corn waste was carried out according to their specific values and risks. Among the considered projects, priority was given to project #7 and project #1, which provided the greatest values, 37.6% and 36.6%, respectively, of the total value of the considered projects. The obtained results made it possible to establish priority projects and carry out their balancing by value and risk.

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1. Introduction

Providing the population and individual industries in the world with quality and environmentally friendly energy remains an urgent and unresolved problem for mankind [1–4]. Part of this problem is the reduction of greenhouse gas emissions generated by human activities. This is due to the use of fossil fuels, which are the main raw materials for energy production in most countries [5–7]. Combustion of fossil fuels produces carbon dioxide (CO_2). It is known [5] that even a small amount of carbon dioxide can be toxic and cause biochemical changes in the human blood, joint pain, weakness, acid–base imbalance, decreased immunity, kidney disease, and cardiovascular disease.

All the above factors have led to the strengthening of EU requirements for the quality of raw materials for energy production. In particular, they promote the use of environmentally friendly fuels. The EU declared that by 2050, Europe will be the first continent whose economy does not destroy nature. In particular, this was provided for in the European Green Deal policy initiatives initiated by the European Commission.

Regarding environmentally friendly raw materials for energy production, EU countries pay special attention to agricultural waste [8–11]. Some scientific papers [10–12] state that countries that use agricultural waste to produce clean energy are able to ensure their own energy security and achieve the energy policy goals laid out in the European Green Deal.

Integrated projects need to be implemented in individual EU regions to implement European Green Deal initiatives. At the same time, there are a number of scientific and applied problems, the solutions to which will increase the efficiency of European Green Deal projects [1,2,6]. One such task, which unfortunately remains unsolved to this day, is the coordination of the configurations of the technologically integrated "European Green Deal" projects.

Existing scientific publications [13,14] have noted that integrated projects require the coordination of their configurations. Given that the basic projects of the European Green Deal with the use of agricultural waste include projects for the procurement of agricultural waste and the production of clean energy, there is a need to harmonize their configurations.

The analysis performed on the state of the issue in practice showed that currently, the scientific and applied task of coordinating the configurations of the technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste in the given region remains unresolved. At the same time, there are no scientific works related to the coordination of the configurations of the technologically integrated "European Green Deal" projects taking into account the characteristics of the project environment where they are implemented. The type of raw materials for energy production is of great importance in the formation of an effective configuration of "European Green Deal" projects. This determines the content of the work performed in the specified projects and the need for certain types of resources (technical, human, material, etc.) [15–18].

All the above factors indicate the need to develop a method of matching the configurations of the technologically integrated "European Green Deal" projects. This should take into account both the changing characteristics of the project environment for the region where they are implemented and the parameters of their configuration objects, which depend on the type of agricultural raw materials used.

2. Analysis of Literature Data and Problem Statement

An analysis of scientific publications showed that some of them relate to the implementation of technologically integrated projects in various fields [14]. However, there are

no publications on the coordination of the configurations of technologically integrated "European Green Deal" projects.

Regarding the management of the configuration of projects in various fields of human activity, a number of standards have been developed [19–21], and some scientific papers are devoted to this issue [22–27]. The mentioned research concerns projects of agro-industrial production [24], fire extinguishing [23,26,27], milk procurement [13,17,20], energy [25], and others. Unfortunately, the analyzed scientific works have not used differentiated approaches to the coordination of configurations of technologically integrated projects taking into account the characteristics of the project environment.

The emergence of a practical standard for project configuration management [18] became the basis of an in-depth study of the project configuration management process. Studies on this issue have revealed a number of inconsistencies in this area of knowledge [28,29]. However, these publications, as well as the standard itself [18], have not disclosed the process of matching the configurations of technologically integrated "European Green Deal" projects in a given region, taking into account the characteristics of their design environment and the type of agricultural raw materials used. This determines the specifics and features of European Green Deal projects using agricultural raw materials. To reveal these features, we used both knowledge of project management [19–21] and the results of special studies in projects of various applied industries [30–32], including agricultural production and energy [3,8–13].

An analysis of many scientific papers [6–9] showed that existing methods and models of project configuration management cannot be used to reconcile the configurations of technologically integrated "European Green Deal" projects in a given region with their project environment due to a number of shortcomings. In addition, scientific works on risk management in projects were identified [33–39]. However, they have not taken into account the peculiarities of the changing design environment of the PMC. In addition, they have not provided for the identification of the configuration of projects on the basis of modeling their products, which makes it impossible to obtain maximum systemic value for stakeholders. In order to objectively coordinate the configurations of "European Green Deal" projects, tools should be developed that will take into account the region-specific type of agricultural raw materials for energy production, which will ensure maximum value for stakeholders [40,41].

The aim of the work was to develop a method of coordinating the configurations of technologically integrated "European Green Deal" projects for clean energy from agricultural waste in the region, taking into account their specific design environment; this method is based on individual projects as separate organizational and technical systems and modeling to determine the value indicators in a given scenario of project implementation, which ensures the balancing of their configurations according to the value criterion.

To achieve the goal of the study, the following tasks were completed:

- To propose a method of coordinating configurations in technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste in the region, taking into account their specific project environments;
- On the basis of the use of the proposed method, to coordinate the configurations of the technologically integrated "European Green Deal" projects for the production of clean energy from corn waste in Ukraine, taking into account the specifics of the project environment of the region.

3. The Method of Coordination of Configurations of Technologically Integrated "European Green Deal" Projects for the Production of Clean Energy from Agricultural Waste in the Region

Coordinating the configurations of technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste in the region, taking into account their specific project environments, involves the installation of components (projects) that will provide maximum value for stakeholders in a changing project environment [17,18,23]. To propose project configurations, we proposed a method based on

the consideration of projects as separate organizational and technical systems. In addition, the proposed method provides for the modeling of individual projects to determine the indicators of their value in a given implementation scenario, which ensures the balancing of their configurations by the criterion of value. The proposed method involved the implementation of five steps, which are presented in Figure 1.

Figure 1. Stages of the method of coordination of configurations of technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste in the region.

Stage 1. The technologically integrated projects "European Green Deal" for the production of clean energy from agricultural waste include many projects that belong to different levels of their consideration. In particular, as mentioned above, there are two levels of consideration for projects—agricultural waste procurement projects and clean energy projects. Both these types of projects have their own specifics that should be taken into account when agreeing on their configurations. They underlie the process of structuring technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste [24,32]. This process ensures the definition of the type of project and its belonging in individual regions, as well as changes that occur as a result of these projects.

Stage 2. The next stage involves the description of the product configuration of technologically integrated "European Green Deal" projects. It addresses (1) the type of agricultural waste that will be used for the project; (2) the number and qualification of involved performers; (3) the type and quantity of technical equipment; (4) the characteristics of the project environment (area of fields for growing crops, their soils and fertility, the number of fields, the share of alienation of raw materials for energy production, etc.). At the same time, natural resources, the type of agricultural raw materials, and the share of alienation of raw materials for energy production are of the greatest value in the region of implementation of technologically integrated "European Green Deal" projects.

Stage 3. According to the known configurations of technologically integrated "European Green Deal" project products, project modeling is performed in order to determine the value indicators for each of the formed organizational and technical systems. The most valuable are those projects whose products provide the minimum cost of resources for the production of a unit of product (raw materials or energy). The defining indicator of an individual project is the use of resources ($P_{i,j}^{m}$), i.e., the use of j-th resources in the i-th organizational and technical system of the т-th level of consideration. To determine

this indicator, the simulation model developed in [2] is used, which makes it possible to determine the use of resources ($P_{i,j}^m$), i.e., j-th resources in the i-th organizational and technical system:

$$P_{i,j}^m = f\left(P_{i,hr}^m, P_{i,tr}^m, P_{i,mr}^m\right) \quad (1)$$

where $P_{i,hr}^m$, $P_{i,tr}^m$, $P_{i,mr}^m$—the use of human, technical, and material resources, respectively, in the i-th organizational and technical system of the m-th level of consideration.

Comparing the quantitative values of resource use ($P_{i,j}^m$) of the j-th resources in the i-th organizational and technical system obtained on the basis of simulation, the cost levels (R_{ij}^m) for the implementation of projects under the given scenario are determined.

Stage 4. To select priority projects "European Green Deal", a model of their value is built (Figure 2).

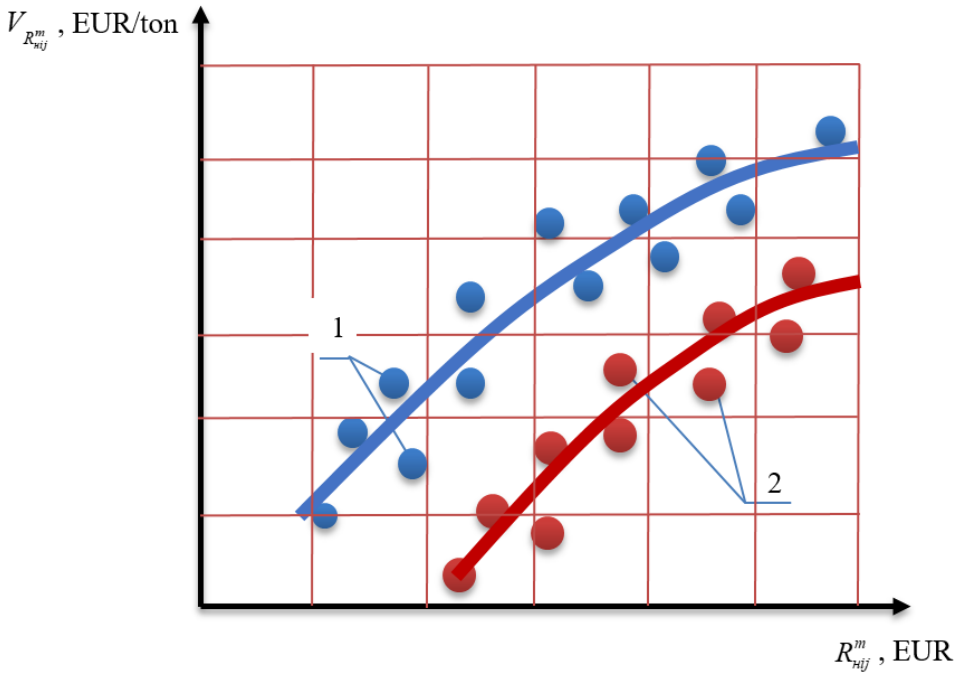

Figure 2. Value model of technologically integrated "European Green Deal" projects that claim to be included in effective technologically integrated projects: R_{ij}^m, $V_{R_{ij}^m}$ —projects of the *t*-th level of their consideration (1—projects of agricultural waste procurement; 2—projects of environmentally friendly energy production).

Figure 2 presents the value model of projects that claim to be included in effective technologically integrated projects, which is based on known cost levels (R_{ij}^m) for project implementation and unit values ($V_{R_{ij}^m}$) according to the level of costs and the given level of their consideration.

The authors of the work suggested that the value ($V_{R_{ij}^m}$) of the "European Green Deal" projects should be determined by the level of costs (R_{ij}^m) of their implementation:

$$V_{R_{ij}^m} = \frac{R_{ij}^m}{N_p^m} \quad (2)$$

where $V_{R_{ij}^m}$—the specific value by the level of costs (R_{ij}^m) for project implementation, EUR/ton; R_{ij}^m—the level of costs (R_{ij}^m) for the implementation of projects in their given scenario, EUR; N_p^m—the amount of product obtained from the implementation of individual projects for a given t-th level of their consideration, tons.

Stage 5. At the stage of balancing technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste, the priority projects selected in the previous stage are ranked according to their specific value in ascending order:

$$V_{R_1^m} \geq V_{R_2^m} \geq \ldots \geq V_{R_n^m} \quad (3)$$

After that, technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste in the region are selected on the basis of the condition:

$$\{Q_i^m\} \leq Q_{TI}, i = 1, n \quad (4)$$

where $\{Q_i^m\}$—the volume of the received product from the realization of i-th priority projects for the set t-th level of their consideration, tons; Q_{TI}—the total product volume of projects for the production of clean energy from agricultural waste, tons; n—the number of projects included in effective technologically integrated projects, units.

When balancing the technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste, preference should be given to projects of high value. At the same time, it should be ensured that projects with high levels of implementation costs (R_{ij}^m) and a correspondingly high risk of non-implementation should have as small a share as possible in the structure of technologically integrated projects.

4. Results of Coordination of Configurations of Technologically Integrated "European Green Deal" Projects for the Production of Clean Energy from Corn Waste in Ukraine

First, on the basis of statistical data, we performed an analysis of the state of the raw material base in Ukraine for the production of ecologically clean energy. It was established that today, in the majority of large agricultural enterprises in Ukraine, corn makes up 40–50% of the crop rotation structure. At the same time, the amount of corn sown per grain shows an increasing trend (Figure 3).

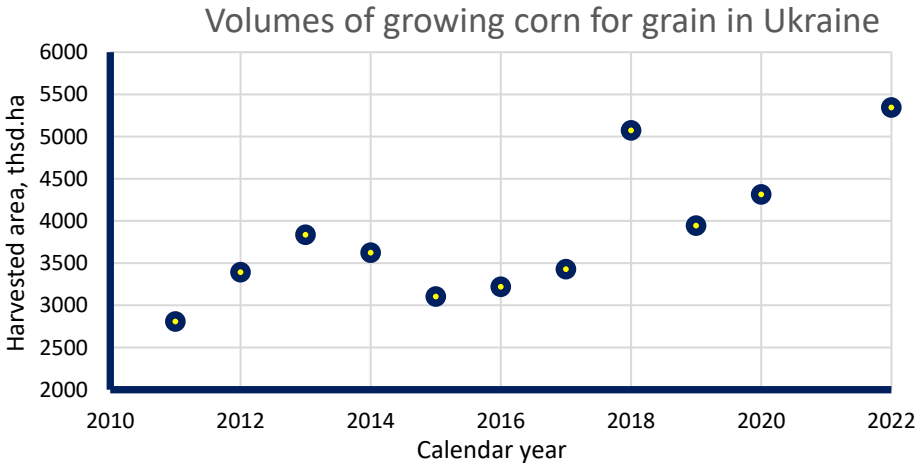

Figure 3. Trends in changes in the amount of corn grown for grain in Ukraine.

Taking into account the above, the production of ecologically clean energy from corn waste was chosen for further research.

On the basis of the disclosure of the content of the stages of the proposed method, which is presented in Figure 1, a corresponding computer program was developed. The specified computer program, "Balancing technologically integrated projects", was developed at the Department of Information Technologies of the Lviv National University of Natural Sciences. It ensured the coordination of configurations of projects for the production of clean energy from agricultural waste in the region. The proposed computer program was tested for adequacy using the generally accepted paired t-test. At the same time, an adequacy check was performed with a comparison of real data for the conditions

of "Lutsk Agrarian Company" LLC of the Volyn region (Ukraine) obtained as a result of the use of a computer program for coordinating the configurations of technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste. It was determined that the actual data values ($V_{R_{ij}^m}$) of the projects of harvesting raw materials from corn waste obtained as a result of the use of the proposed computer program deviated within insignificant limits—1.6 . . . 4.9%. This indicates that the proposed computer program adequately ensures the coordination of project configurations for the production of ecologically clean energy from agricultural waste in the given region.

On the basis of the use of the computer program, a study was conducted to coordinate the configurations of technologically integrated "European Green Deal" projects for the production of clean energy from corn waste for a given design environment (conditions Lutsk Agrarian Company LLC, Volyn region, Ukraine). The conducted computer experiments made it possible to predict the specific values ($V_{R_{ij}^m}$) of individual projects for the procurement of raw materials from corn waste, which were implemented in different fields. This provided the determination of the specific cost of the disposal of corn waste (Table 1).

Table 1. Results of forecasting the specific values ($V_{R_{ij}^m}$) of individual projects for the procurement of raw materials from corn waste.

Indicator	Project Implementation Scenario						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Planned unit cost of maize waste disposal, EUR/ton	14	20	17	18	12	15	11
Market share of maize waste, EUR/ton	24						
Estimated specific value ($V_{R_{ij}^m}$) of projects for procurement of raw materials from corn waste	9	14	11	12	8	10	7

The results of the visualization of the distribution of the projected specific value ($V_{R_{ij}^m}$) for project No. 1 for the procurement of raw materials from corn waste are presented in Figure 4.

Statistical processing of the obtained data on the distribution of the projected specific value ($V_{R_{ij}^m}$) for project No. 1 for the procurement of raw materials from corn waste allowed the determination of the numerical characteristics and the justification of the model (Figure 4), which are described by the normal distribution law with a differential function:

$$f\left(V_{R_{i1}^m}\right) = 0.079 \cdot \exp\left(-\frac{\left(V_{R_{i1}^m} - 9\right)^2}{50}\right) \quad (5)$$

where $V_{R_{ij}^m}$—projected specific value of the project of procurement of raw materials from corn waste, EUR/ton.

The main statistical characteristics of the distribution of the projected specific value ($V_{R_{i1}^m}$) for project No. 1 for the procurement of raw materials from corn waste were as follows: estimation of mathematical expectation—EUR 9/ton; dispersion—EUR 25/ton; estimate of standard deviation—EUR 5/ton.

The conducted research provided the construction of covariance and correlation matrices of the forecasted specific values ($V_{R_{ij}^m}$) of separate considered projects for the preparation of raw materials from corn waste (Figures 5 and 6).

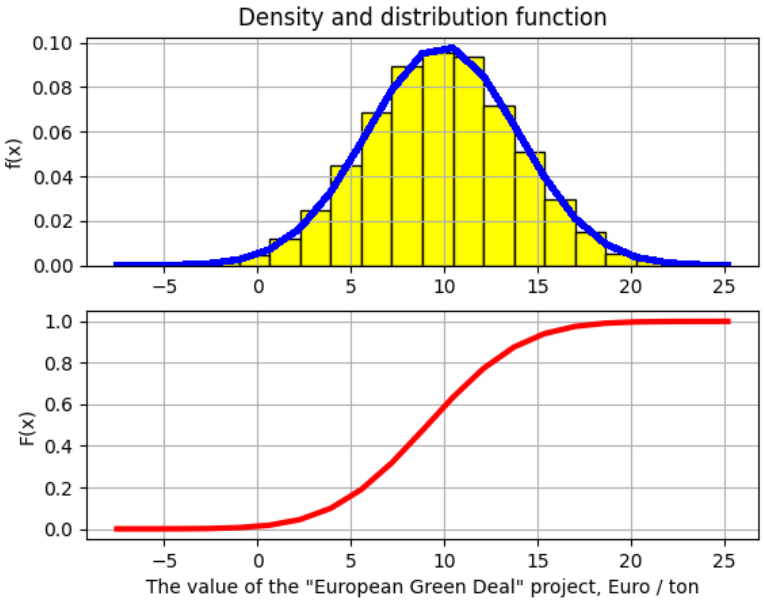

Figure 4. Histogram and theoretical curve of distribution of projected specific value ($V_{R_{ij}^m}$) for project No. 1 for the procurement of raw materials from corn waste, EUR/ton.

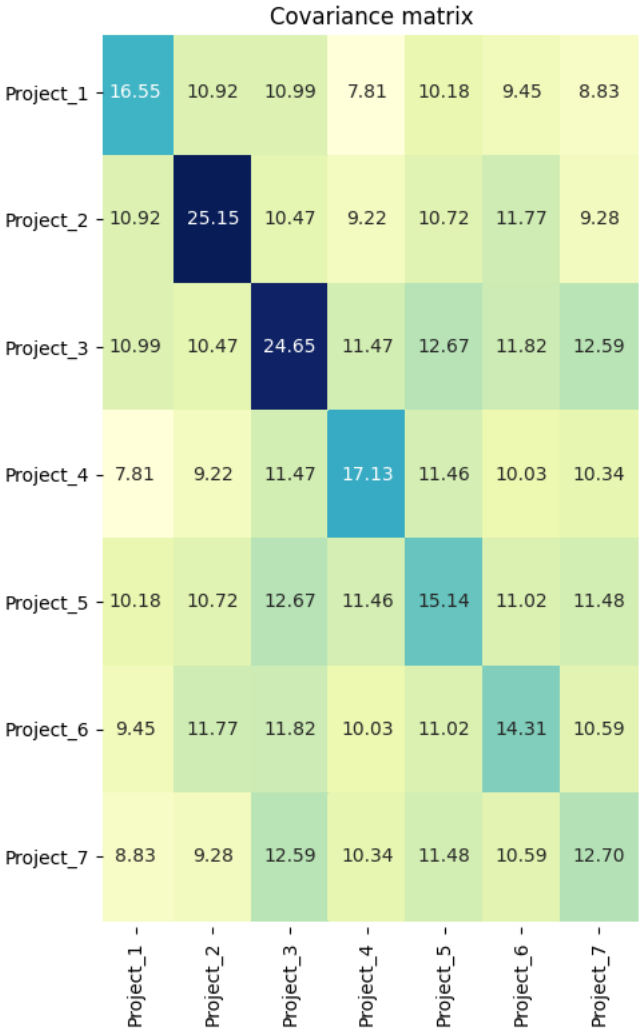

Figure 5. Covariance matrix between the projected specific values ($V_{R_{ij}^m}$) of the individual projects under consideration for the procurement of raw materials from corn waste.

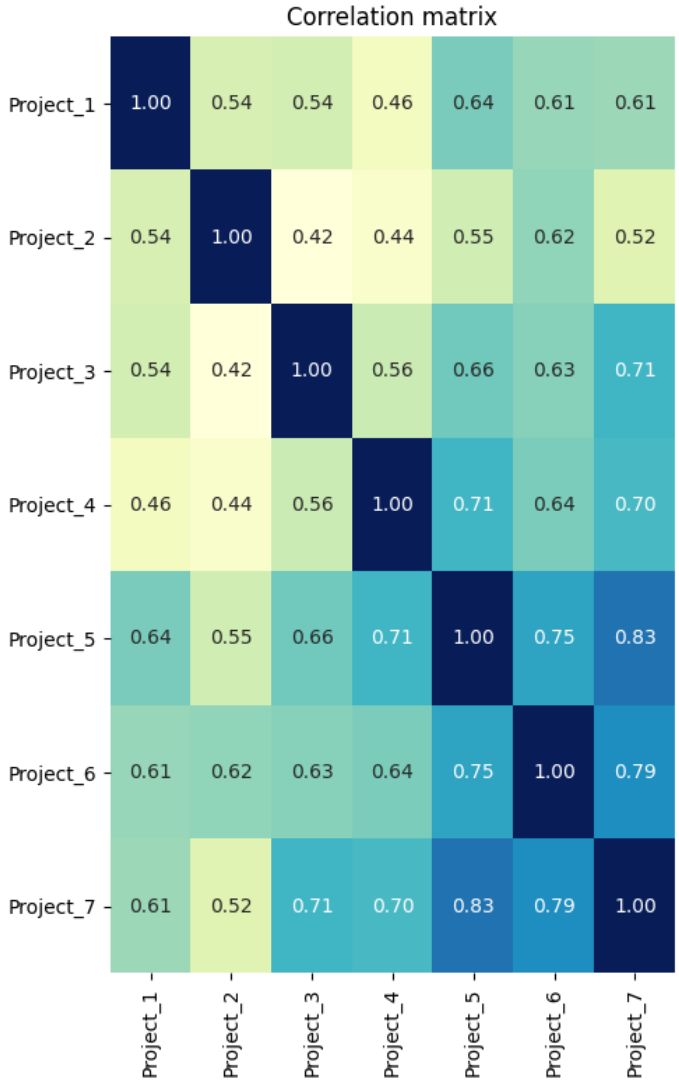

Figure 6. Correlation matrix between the projected specific value ($V_{R_{ij}^m}$) of the individual projects under consideration for the procurement of raw materials from corn waste.

In the resulting covariance matrix of the predicted specific value ($V_{R_{ij}^m}$) of the individual considered projects for harvesting raw materials from corn waste (Figure 5), the diagonal contains the value of the dispersion of the specific value of the considered projects, and the off-diagonal elements characterize the covariances between the specific value of the considered projects. According to the obtained results, we see that the largest deviations of the values of variable specific values from the mathematical expectation were observed for projects No. 2 and No. 3 and were, respectively, $V_{R_{ni2}^m} = 25.15$ EUR/ton and $V_{R_{i3}^m} = 24.65$ EUR/ton. It was for these projects of harvesting raw materials from corn waste that the largest deviations of the obtained values were characteristic, and they are the riskiest for investors. From a risk perspective, they should be the last to be included in technologically integrated "European Green Deal" projects for the production of ecologically clean energy from corn waste.

The obtained correlation matrix of the specific values of projects (Figure 6) shows that a strong relationship according to the specified criterion was observed between projects No. 7 and No. 5 ($r_{75} = 0.83$), and the correlation coefficient between projects No. 7 and No. 6 was $r_{76} = 0.79$. It was established that project #7 had the largest cost relationships with projects on the production of environmentally clean energy from corn waste.

5. Discussion of Research Results

According to the obtained results, we see that the largest deviations of the values of the variable specific value from the mathematical expectation were observed for projects No. 2 and No. 3 and were, respectively, $V_{R^m_{ni2}} = 25.15$ EUR/ton and $V_{R^m_{i3}} = 24.65$ EUR/ton. It was for these projects that the procurement of raw materials from corn waste was characterized by the largest deviations of the obtained value, and they are the riskiest for investors. From the point of view of risk, they should be included last in technologically integrated "European Green Deal" projects for the production of environmentally friendly energy from corn waste.

In addition, we conducted a rank correlation between the specific value of the considered projects of the procurement of raw materials from corn waste, the results of which are presented in Figure 5. The obtained correlation matrix of the specific value of projects indicates that a strong relationship according to this criterion was observed between projects No. 7 and No. 5, for which the correlation coefficient was $r_{75} = 0.83$, and between projects No. 7 and No. 6, for which the correlation coefficient was $r_{76} = 0.79$. This shows that the No. 7 project had the greatest value relationships in the technologically integrated "European Green Deal" projects for the production of clean energy from corn waste.

Balancing the technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste made it possible to establish priority projects, that were ranked according to their specific value and risks in ascending order (Table 2).

Table 2. Results of ranking of projects of procurement of raw materials from corn waste by their specific value and risks.

Indicator	Project No.						
	7	**1**	**4**	**5**	**6**	**3**	**2**
Fraction values, %	37.65	36.67	12.96	7.46	1.94	1.7	1.6

As a result of the research, it was established that for a given design environment (conditions of Lutsk Agrarian Company LLC, Volyn region, Ukraine), technologically integrated "European Green Deal" projects for clean energy production from corn waste should be formed in the sequence shown in Table 2. At the same time, the total value of the implementation of technologically integrated projects of harvesting raw materials from corn waste was taken as 100%. Among the projects under consideration, projects No. 7 and No. 1 were prioritized, which provided them the opportunity to obtain the greatest values, which were 37.6% and 36.6% of the projects under consideration, respectively.

The number of corn waste projects to be included in the European Green Deal was selected from condition (4) and depended on the scale and configuration of the clean energy project in the region.

This research allowed the development of a method and a computer program that make it possible to speed up and ensure the accuracy of the process of coordinating the configurations of technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste in the territory of the given region. The specified projects were considered as separate organizational and technical systems, which made it possible to take into account their peculiarities and the peculiarities of their project environment. The peculiarity of the developed method is that it involves the modeling of individual projects to determine their value indicators under a given implementation scenario, which ensures the balancing of their configurations according to the value criterion. This ensures accurate results. The performed verification of the adequacy of the computer program for coordinating the configurations of technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste confirmed the specified accuracy, as the obtained value $V_{R^m_{ij}}$ of the projects

of harvesting raw materials from corn waste deviated from the real one within insignificant limits—1.6 . . . 4.9%. The possibility of the practical use of the developed toolkit was confirmed by the obtained results of the coordination of the configurations of technologically integrated "European Green Deal" projects for the production of environmentally clean energy from agricultural waste for the conditions of LLC "Lutsk Agrarian Company" of the Volyn region (Ukraine). At the same time, it was established that the value and risks of individual projects for the production of ecologically clean energy from agricultural waste are distinguished within fairly wide limits. This confirms the expediency of using the developed method and computer program to coordinate the configurations of technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste, which will make it possible to avoid making erroneous decisions regarding the selection of appropriate projects. Further research should be conducted regarding the coordination of the configurations of technologically integrated "European Green Deal" projects for the production of ecologically clean energy from agricultural waste for other types of raw materials and regions characterizing the project environment. This will provide an opportunity to create relevant knowledge needed by project managers when coordinating the configurations of technologically integrated projects for the production of ecologically clean energy from agricultural waste.

6. Conclusions

The proposed method of coordinating the configurations of technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste involves the implementation of five stages. These stages take into account the specific project environment for each region, the type of agricultural raw materials for energy production, as well as modeling projects, which allow the determination of their value for each of the existing organizational and technical systems. On the basis of the ranking of projects by their maximum value for stakeholders and the possibility of risk minimization, the balancing of technologically integrated "European Green Deal" projects for the production of clean energy from agricultural waste was performed.

With the use of a computer program developed at the Department of Information Technology of Lviv National University of Nature Management, on the basis of the proposed method, the configurations of the technologically integrated "European Green Deal" projects for clean energy from agricultural waste for a given project environment (conditions Lutsk Agricultural Company, "Volyn region, Ukraine) were determined.

This made it possible to establish numerical characteristics and models of distributions of the predicted specific value ($V_{R_{i1}^m}$) for individual projects of harvesting raw materials from corn waste: the estimation of mathematical expectation—EUR 9/ton; dispersion—EUR 25/ton; the estimation of root mean square deviation—EUR 5/ton. On the basis of the obtained data, covariance and correlation matrices were constructed between the predicted specific value of the individual projects under consideration. The largest deviations of the values of variable specific values from the mathematical expectation were observed for projects #2 and #3 and were, respectively, $V_{R_{i2}^m} = 25.15$ EUR/ton and $V_{R_{i3}^m} = 24.65$ EUR/ton. It was for these projects of harvesting raw materials from corn waste that the largest deviations of the obtained value were characteristic, and they are the riskiest for investors. The ranking of projects by their specific value and risks was carried out, which ensured the identification of priority projects No. 7 and No. 1, which provide the opportunity to obtain the greatest values, which were 37.6% and 36.6% of the projects under consideration, respectively.

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