Politechnika Częstochowska
Wydział Zarządzania

Zeszyty Naukowe Politechniki Częstochowskiej. Zarządzanie
Research Reviews of Czestochowa University of Technology. Management

No 53 (2024), pp. 188-203, ISSN: 2083-1560
DOI: 10.17512/znpcz.2024.1.14, https://znz.pcz.pl/

Received: 25.12.2023; Revised: 20.02.2024;
Accepted: 23.02.2024; Published: 31.03.2024.

# INTERGROUP CONSENSUS AMONG EXPERT TEAMS IN THE SELECTION OF PROJECTS TO ENHANCE THE INTERNATIONAL COMPETITIVENESS OF SOLAR ENERGY INDUSTRY

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**Abstract:** The premise for undertaking the research is the need for an intergroup consensus of assessments by teams of international experts when choosing international investment projects in the field of solar energy for their adequacy and validity. The aim of this article is to provide theoretical and methodological justification for ensuring intergroup consensus among teams of international experts in selecting projects that are aimed to enhance the international competitiveness of the solar energy industry. Research results: The study decomposed the concept of 'intergroup consensus among teams of international experts' and verified its presence through one-factor regression analysis. Additionally, the study conducted a rating assessment of the efficiency of project implementation to enhance the international competitiveness of Ukraine's solar energy industry under conditions of uncertainty using the taxonomy method. Conclusions: The collaboration of international experts in teams has ensured comparability and adequacy of evaluations, leading to the possibility of selecting an effective project for enhancing the international competitiveness of Ukraine's solar energy industry under conditions of uncertainty.

**Keywords:** intergroup consensus of opinions, intergroup concordance, international competitiveness, risks in conditions of uncertainty, solar energy projects

**JEL Classification:** C12, C25, C83, D81, Q42

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## Introduction

The use of alternative energy sources is of paramount importance for enhancing the international competitiveness of the energy sector in the global market and ensuring sustainable development of the country. One way to achieve this is through the implementation of solar energy projects in the field of alternative energy.

We found out that due to the large number of potential energy projects available to investors, including international ones, there arises a challenge of selecting an energy project based on its implementation efficiency parameters. Our approach to this is based on the estimation of the integral efficiency parameter using a taxonomic method.

The problem with the research is that, consequently, there is a need to engage teams of international experts to evaluate the significance levels of these parameters and check the presence of concordance and consensus in their assessments. Our approach to this is based on the use of univariate regression analysis and variance analysis.

Furthermore, we are aware that the implementation of projects in the energy sector is associated with numerous risks arising from uncertain conditions, particularly the full-scale war in Ukraine, which can impact the international competitiveness of its energy sector. This further necessitates the involvement of teams of international experts to assess the degrees of these negative impacts. The prerequisite for assembling experts into teams is the need to accumulate their knowledge and experience and achieve consensus through close communication.

The research problem is important, as ensuring intergroup consensus among teams of international experts in selecting solar energy projects is crucial to effective decision-making and successful project implementation. Research results can be valuable for the implementation of solar energy projects and the development of strategies to enhance the international competitiveness of the Ukrainian solar energy industry.

This research expanded the knowledge of the problem, showing that the qualitative dimension of the concept of intergroup consensus of international experts' opinions requires further investigation. Its essence is disclosed not through a system of quantitative concordance indicators but through specific verbal-logical criteria. This helps provide a comprehensive and integrated definition of this concept, taking into account both its qualitative (non-formalized) and quantitative (formalized) dimensions. It will facilitate a better understanding of the essence of the phenomenon it describes and, from a research perspective, will lead to the discovery of new methodological approaches to its systematic analysis and evaluation.

The object of this article is the intergroup consistency of opinions of international experts in project selection. The research hypotheses of the article are the following: the intergroup consistency of teams of international experts can be assessed using univariate regression analysis and variance analysis; the presence of intergroup consistency of experts' assessments is a condition for their relevance and validity, which is extremely important when choosing business projects aimed at increasing the international competitiveness of the industry.

The purpose of the article is to evaluate the effectiveness level of implementing projects to enhance the international competitiveness of Ukraine's solar energy industry via intergroup consensus assessments of groups of experts. To achieve the goal, the following tasks need to be addressed:

1. to decompose the concept of “intergroup consensus among teams of international experts”.
2. to identify the advantages and disadvantages of forming teams of international experts.
3. to examine the characteristics and classify the competency profiles of international experts within the team.
4. to develop and distribute a questionnaire to experts for assessing the weightage of selected performance parameters and the degree of negative impact of risks in uncertain conditions for the selection of a solar power plant construction project.
5. to use a univariate regression analysis to test the existence of intergroup consensus among teams of international experts based on their assigned ratings.
6. to conduct a ranking evaluation of the effectiveness level of implementing projects to enhance the international competitiveness of Ukraine's solar energy industry in conditions of uncertainty using the taxonomic method.

## Literature review

Kraemer (1981) was one of the first to investigate the issue of intergroup consistency of experts' opinions. This author first proposed a coefficient of intergroup concordance for estimating the intergroup consistency of experts' opinions, which is based on Kendall's coefficient of concordance. Among modern researchers who used this econometric indicator in assessing the consistency of opinions of respondents during the survey, we can mention Aasland, Filippova & Deineko (2023). However, the approach to combining respondents into consensus groups also has its drawbacks compared to the survey of individuals, which is emphasized by Song (2009). The author refers to these shortcomings as less reciprocity among members of the consensus group and lower psychological trust. However, according to this author's research, such groups have higher behavioral trust, which is especially important for surveying expert-professional environments where behavioral competencies are more important than psychological ones. Carter et al. (2020) in their study put forward the hypothesis that the presence of a leader in each team of experts is an important factor in achieving their intergroup agreement (concordance). After all, leaders are the main communicators between teams. Park & DeShon (2018) in their work highlight the phenomenon of competition during intergroup interaction of experts, which is also one of the factors influencing the concordance of their assessments. Dekle et al. (2008) proposed to use the theory of permutations in assessing the intergroup agreement of opinions based on the concordance coefficient, taking into account the agreement of opinions within each of the groups.

The scientific work of Voitko & Hrinko (2022) is devoted to the issue of revealing the essence of the concept of intergroup consensus of opinions of teams of international experts. In this collective monograph, intergroup consensus of expert teams is described through criteria such as a shared understanding of the situation and team goals among expert teams, characteristics of the effectiveness of work and interaction among experts within teams, and the absence of conflicting views in decision-making. In this work, the system of indicators for assessing consensus of expert opinions is referred to as concordance. From this statement, we can conclude that the intergroup consensus of opinions among teams of international experts is effectively described by a system of indicators called intergroup concordance of international experts. Based on this scientific work, we can say that intergroup concordance of international experts can be described through a certain function of independent variables (factors). If there are multiple variables, such a function is multifactorial. The factors of expert concordance in the investigated scientific work include the level of effectiveness of the expert selection system based on criteria of shared knowledge and competence in the problem domain; the presence of flexible, adaptive, and effective methods (with an emphasis on economic-mathematical methods, which are precise and more objective) for evaluating and verifying the level of justification and argumentation of expert opinions (in the form of subjective verbal-logical reasoning and formal assessments: absolute, relative, rating scales, etc.); the effectiveness of the diagnostic and control system for the reliability of expert assessments; the level of absence of discrepancies among the conclusions of experts.

The thesis from the work by Voitko & Hrinko (2022) that intergroup consensus of expert opinions is essentially intergroup concordance of experts, described by a system of indicators, is also confirmed in the educational manual by Hrabovetskyy (2000). The indicators listed in the work by Voitko & Hrinko (2022) are also presented with formulas for their calculation in the work by Hrabovetskyy (2000). Scientific works by Hrinko (2022), Yashkina (2013) are also dedicated to the question of methodological approaches to assessing the consensus of expert opinions (particularly intergroup consensus among international experts) through a system of concordance indicators. It is also worth mentioning the collective monograph by authors: Havrysh, Dovhan, Kreydych et al. (2017) on personnel management technologies, the results of which, based on the deduction method, can be applied in the study of expert team management technologies. It is necessary to agree with the thesis of Raku (2016) that "expertise solves the tasks assigned to it and produces unified, collectively accepted and agreed-upon decisions that correspond to the real state of affairs". This statement emphasizes the importance of a high level of consensus among experts' opinions. The possibility of using the term "intergroup concordance of experts" is also justified by the fact that the term "intragroup concordance" (consensus) of experts is used in the scientific article by Klymenko (2020) regarding expert opinions within the framework of a questionnaire.

The thesis that the quantifiable agreement of expert opinions is concordance is also formulated in the scientific article by Hluh & Svishcho (2012) et al.: "Of particular interest is the indicator of agreement of each individual expert's opinions with the opinions of each of the other experts (concordance coefficient)". From this, we can assume that the intergroup consensus of expert opinions is a dependent variable of the intragroup consensus of expert opinions, and the latter should also be considered when assessing the former through a system of concordance indicators.

As a result of the analysis of the aforementioned scientific works, it has been established that most of them focus on elucidating the essence of concordance as a system of indicators for assessing the agreement of expert opinions. The application of these indicators depends on the choice of a specific methodological approach, taking into account the specificity of the selected research problem. On the other hand, this focus has led to the conclusion that intergroup consensus of international experts' opinions in its quantitative dimension can be considered as intergroup concordance of international experts.

## Research methodology

The empirical base was obtained by collecting closed data directly at the enterprise, which is engaged in the creation and implementation of international investment projects for the construction of solar power plants. These data refer to the technical, economic, production and financial performance parameters of three such projects in three different regions of Ukraine.

According to the proposed research methodology, in the first stage, competence profiles, fields of activity, and the number of teams of international experts are determined. When forming teams (groups) of international experts, we propose selecting those who have the following types of competence profiles:

1. the first competence profile – an expert in causal relationships, a problem expert;
2. the second competence profile – a methodological expert;
3. the third competence profile – a driver/communicator expert.

In the second stage, data collection is carried out for the parameters of the effectiveness of implementing the selected solar power plant construction projects.

In the third stage, teams of international experts fill out a questionnaire in Google Forms. The description of the questionnaire is as follows:

- Project #1: Address: Zaporizhzhia Oblast, Vasilivskyi District; the size of the solar power plant: large.
- Project #2: Address: Khmelnytskyi Oblast, Shepetivskyi District; the size of the solar power plant: medium.
- Project #3: Address: Cherkasy Oblast, Umanskyi District; the size of the solar power plant: small.

Section 1:

1. “Provide your full name”
2. “Indicate which team of international experts you belong to”:
   a) International investors;
   b) Managers;
   c) Engineers;
   d) Scientists.
3. “Which country do you represent?”

Section 2: “Rate the degrees of importance (1-10) of implementation efficiency parameters for each of the specified projects for the construction of a solar power plant (Table 1)”. In the second section, experts need to assign degrees of importance for each of the 16 parameters for each project. Therefore, a total of 48 ratings should be provided.

Section 3: “Evaluate the degree of negative impact (from 1 to 10) of the listed risks under conditions of uncertainty on the effectiveness of implementing solar power plant construction projects (Table 1) as a whole (average expert rating)”.

In the fourth stage, the intergroup consensus of opinions among the teams of international experts is evaluated using the methodology of single-factor regression analysis X = f(Y) (Hrinko, 2022). In substage 4.1, we will calculate the average values of the assessed degrees of importance of implementation parameters for each of the projects and the degrees of negative impact of risks on each of the risk projects under conditions of uncertainty using the formula (1).

$$\overline{X_Y}=\frac{1}{n}\left(\sum_1^n X_{ij}\right) \quad (1)$$

where $X_{ij}$ is a dependent variable (the rating of the i-th international expert in the j-th team, X = 1, 10); Y is an independent variable (the number of the j-th team of international experts, Y = 1, 4); $\overline{X_Y}$ – is the average value of the rating of n international experts in the j-th team, calculated separately for each team number j of experts, i = 1, n; j = 1, 4); n is the number of international experts in the team.

After that, in substage 4.2, we will calculate the overall average ratings for all teams of international experts using the following formula (2):

$$\overline{X}=\frac{1}{N}\left(\sum_1^n X_{i1}+\sum_1^k X_{i2}+\sum_1^c X_{i3}+\sum_1^f X_{i4}\right) \quad (2)$$

Where the value N indicates the total number of experts in the four teams (N = n + k + c + f); i represents the i-th expert in the j-th team, i = 1, {n when j = 1; k when j = 2; c when j = 3; f when j = 4}; j = 1, 4. In our case, the number of experts in each team is the same: n = k = c = f = 3. Therefore, the total number of experts N = 12.

Substage 4.3 involves decomposing the total (expanded) variation $SS_X$ of the dependent variable (X: rating of the i-th expert in the j-th team, X = 1, 10) into:

- between-group (between-team, SSY) variation between categories of the independent variable Y (team number j, Y = 1, 4);
- within-group (within-team, SSerror) variation of X within each team of experts.

$$SS_x = SS_y + SS_{error} \quad (3)$$

where:

$$SS_X=\sum_1^n(X_{i1}-\overline{X})^2+\sum_1^k(X_{i2}-\overline{X})^2+\sum_1^c(X_{i3}-\overline{X})^2+\sum_1^f(X_{i4}-\overline{X})^2, \quad (4)$$

$$SS_Y=n(\bar{X}_1-\overline{X})^2+k(\bar{X}_2-\overline{X})^2+c(\bar{X}_3-\overline{X})^2+f(\bar{X}_4-\overline{X})^2, \quad (5)$$

$$SS_{error}=\sum_1^n(X_{i1}-\overline{X}_1)^2+\sum_1^k(X_{i2}-\overline{X}_2)^2+\sum_1^c(X_{i3}-\overline{X}_3)^2+\sum_1^f(X_{i4}-\overline{X})^2, \quad (6)$$

Substage 4.4. We will measure the effect of between-group (between-team) variation ($SS_Y$) on the total variation ($SS_X$) using formula (7):

$$\eta^2 = \frac{SS_Y}{SS_X} \tag{7}$$

Substage 4.5 – testing the significance of the null hypothesis ($H_0$) that the means of the expert teams should be equal in their general population, i.e., $\overline{X_1} = \overline{X_2} = \overline{X_3} = \overline{X_4}$, using the F-statistic with formula (5):

$$F = \frac{SS_Y/(y-1)}{SS_{error}/(N-y)} = \frac{SS_Y/3}{SS_{error}/(N-4)} \tag{8}$$

where y is the number of expert teams (4), N is the number of evaluations.

The null hypothesis ($H_0$) will be rejected when $F_{statistics} > F_{critical}$.

In the fifth stage, using taxonomic methodology, the integrated indicator of the effectiveness of implementing solar power plant construction projects is calculated. We calculate the standardized coefficients by first determining the maximum and minimum values within each parameter. These values are substituted into the normalization formula. The normalization of criteria that are maximized is performed using formula (9):

$$L_{ji} = \frac{x_i - x_{min}}{x_{max}, - x_{min}} \tag{9}$$

Normalization of the minimized criteria is carried out according to formula (10):

$$L_{ji} = \frac{x_{max} - x_i}{x_{max} - x_{min}} \tag{10}$$

where $L_{ji}$ is the normalized evaluation of the *j*-th criterion of the *i* -th project; $x_i$ is a parameter value of the *i*-th project; $x_{\max_i}$, $x_{\min_i}$ are the maximum and minimum parameter values of the *i*-th project.

Then, we square the obtained normalized parameters. Next, we normalize the degrees of importance obtained from Table 2 and convert them to a fraction of 100. We multiply the obtained weight coefficients by the normalized parameters. Then, using formula (11), we generate a rating assessment of international investment projects (Naraievskyi, 2019).

$$R_j = \sqrt{k_1 x_1^2 + k_2 x_2^2 + \ldots + k_n x_n^2} \tag{11}$$

where $x_1, x_2, x_3, \ldots x_n$ – parameters of the effectiveness of the implementation of international projects; $k_1, k_2, k_3, \ldots k_n$ – weight coefficients of the importance of the *i*-th parameter of the international project, $i = 1, \ldots n$.

## Research results

Before proceeding to the actual definition of intergroup concordance of the opinions of teams of international experts, let us analyze the essence of this concept using the method of scientific decomposition (Figure 1).

Next, let us define the competency profiles of experts. Based on the analysis of the usage of this term in the textbook by Voitko & Hrinko (2022), we propose the following definition: a competency profile of an international expert is a list of competencies that a professional expert needs for effective work in an international context.

In turn, according to the Explanatory Dictionary of the Ukrainian Language (1970-1980), "competence" can be defined as:

1) "good knowledge or awareness of something";
2) "the range of authority of an organization, institution, or person".

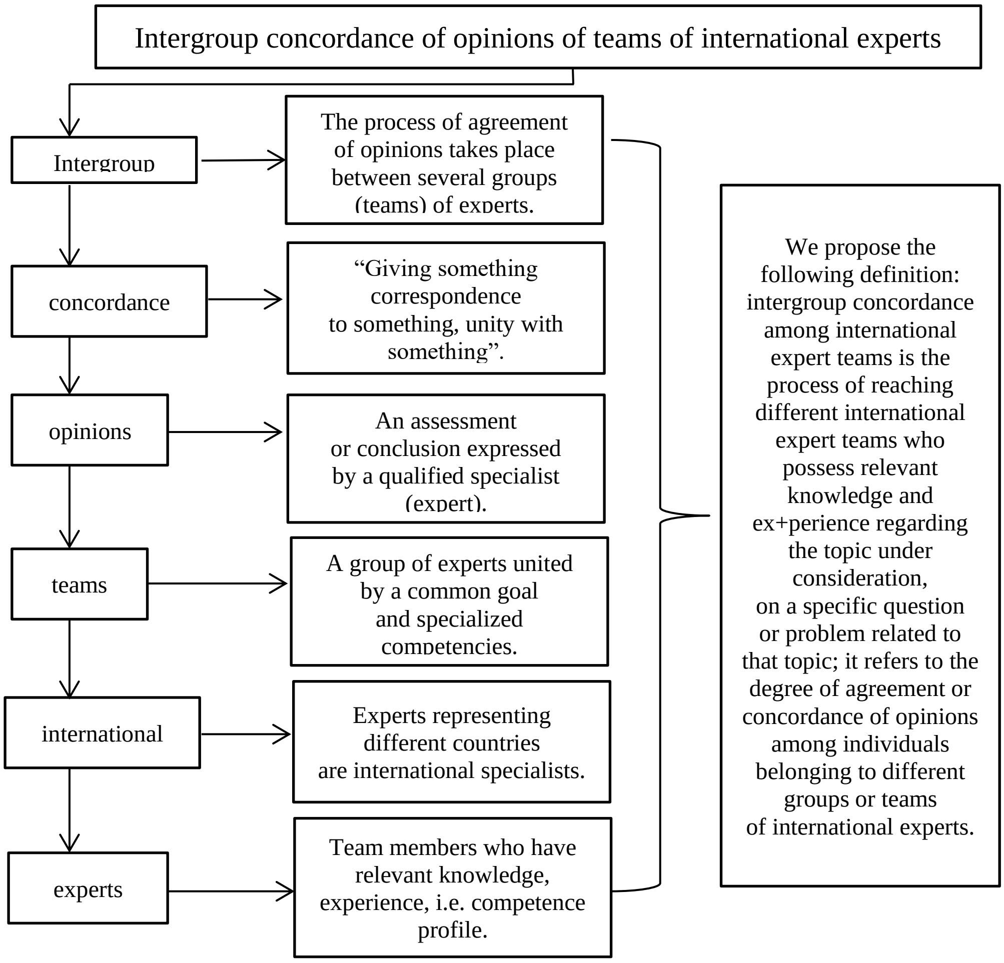


**Figure 1. Decomposition of the concept of the intergroup concordance of opinions of teams of international experts**

Sources: (Aasland et al., 2023; Kraemer, 1981)

The justification of theoretical problems provides grounds for proposing practical results. In Table 1 there are values of efficiency parameters for each of the projects for the construction of a solar power plant. We systematize the following results of indicators of the one-factor variance analysis, calculated according to formulas (1-8) in Tables 2-3. We obtained the results on the calculations of the efficiency of solar power plant construction projects using the taxonomic method due to formulas (9-11) (Table 4). We have formed a list of risks under uncertainty conditions.

1. Risk of the global energy crisis (mega-economic uncertainty).
2. Risks of increasing the NBU interest rate.
3. Risks of the inflation rate.
4. Risks of decreasing the financial support of the state for the energy sector due to the growth of the budget deficit (under conditions of macroeconomic uncertainty).
5. Risk of increasing inefficiency of functioning state-legal institutions (under conditions of political and legal uncertainty).
6. Risk of a decrease in the supply of specialists in the energy sector (under conditions of social uncertainty).
7. Risk of a decline in the attractiveness of the investment of the energy sector (under conditions of sectoral uncertainty).
8. Risk of errors in decision-making by managers and investors (under conditions of intra-corporate uncertainty).
9. Risk of the destruction of energy infrastructure in the location area of the power plant within the project (under conditions of technological uncertainty).
10. Risk of worsening the ecological and climatic situation in the country (under conditions of ecological uncertainty).

**Table 1. Data on the efficiency parameters of solar power plant construction projects**

| № | Parameters of Project Implementation Efficiency | Unit | Solar power plant construction projects | | |
|---|---|---|---|---|---|
| | | | Project No. 1 Zaporizhzhya Oblast, Vasylivsky District | Project No. 2 Khmelnytskyi Oblast, Shepetivskyi District | Project No. 3 Cherkasy Oblast, Umansky District |
| 1 | Array global power | kWp | 31 010 | 12 928 | 3 536 |
| 2 | Performance ratio | % | 86.50 | 89.33 | 87.45 |
| 3 | Produced Energy | MWh/year | 41 143 | 14 524 | 4 282 |
| 4 | Green Tariff | euro/kWh | 0.127712589 | 0.127712589 | 0.127712589 |
| 5 | Power loss coefficient | % | 3.35 | 1.36 | 1.63 |
| 6 | Capital intensity of the project | thsnd USD | 24 903 | 11 376 | 3 145 |
| 7 | Annual sales volume | thsnd UAH | 210179.2 | 74195.9 | 21874.6 |
| 8 | Specific cost of electricity without VAT | UAH/kWh | 1.0925 | 1.2112 | 1.3333 |
| 9 | Full annual cost without VAT | thsnd UAH | 44948.7 | 17591.0 | 5709.0 |

| № | Parameters of Project Implementation Efficiency | Unit | Solar power plant construction projects | | |
|---|---|---|---|---|---|
| | | | Project No. 1 Zaporizhzhya Oblast, Vasylivsky District | Project No. 2 Khmelnytskyi Oblast, Shepetivskyi District | Project No. 3 Cherkasy Oblast, Umansky District |
| 10 | Financial result before taxation | thsnd UAH | 165230.4 | 56604.9 | 16165.6 |
| 11 | Payback period | year | 5.4 | 7.2 | 7.0 |
| 12 | ROE | % | 18.4 | 13.8 | 14.3 |
| 13 | The amount of fixed assets | thsnd UAH | 851682.6 | 384963.8 | 105294.6 |
| 14 | Fund return | UAH/UAH | 0.247 | 0.193 | 0.208 |
| 15 | Term of operation | year | 15 | 15 | 15 |
| 16 | Annual rate of depreciation of fixed assets (straight-line method) | % | 6.67 | 6.67 | 6.67 |

Source: Calculated on the basis of closed data of one of the Ukrainian energy enterprises

**Table 2. General average values of assessments by teams of international experts of degrees of importance of parameters X and degrees of negative impact of risks R under conditions of uncertainty**

| № | Parameters of Project Implementation Efficiency | Medium degrees of severity (1-10) | | | Risks in conditions of uncertainty | Average degrees of negative impact (1-10) | | |
|---|---|---|---|---|---|---|---|---|
| | | Project No. 1 | Project No. 2 | Project No. 3 | | Project No. 1 | Project No. 2 | Project No. 3 |
| 1 | X1 | 10 | 9 | 9 | R1 | 8 | 8 | 7 |
| 2 | X2 | 9 | 10 | 8 | R2 | 7 | 8 | 9 |
| 3 | X3 | 8 | 9 | 10 | R3 | 8 | 8 | 10 |
| 4 | X4 | 9 | 8 | 8 | R4 | 7 | 7 | 9 |
| 5 | X5 | 7 | 7 | 8 | R5 | 5 | 5 | 6 |
| 6 | X6 | 8 | 7 | 7 | R6 | 5 | 5 | 5 |
| 7 | X7 | 5 | 6 | 5 | R7 | 8 | 7 | 9 |
| 8 | X8 | 2 | 1 | 2 | R8 | 7 | 5 | 3 |
| 9 | X9 | 1 | 3 | 2 | R9 | 8 | 5 | 5 |
| 10 | X10 | 6 | 5 | 4 | R10 | 7 | 2 | 4 |
| 11 | X11 | 4 | 3 | 6 | Total level of negative impact of risks (1-100) | 70 | 60 | 67 |
| 12 | X12 | 9 | 8 | 8 | | | | |
| 13 | X13 | 4 | 3 | 4 | | | | |
| 14 | X14 | 9 | 7 | 8 | | | | |
| 15 | X15 | 2 | 2 | 1 | | | | |
| 16 | X16 | 3 | 3 | 1 | | | | |

Source: Calculated by the author

**Table 3. Results of a univariate analysis of variance for agreement of opinions of international experts**

| | | | | |
|---|---|---|---|---|
| **F – statistics** | *Notation* | F | | |
| | *Value* | 3.2 | | |
| **Fisher F –criteria** | *Notation* | F-critical | | |
| | *Value* | 3.5 | | |
| **Effect size** | *Notation* | η2 | | |
| | *Value* | 0,5 | | |
| **Source of variance** | | Intergroup/ interteam | Intragroup/ intrateam | Total |
| **Sum of squares** | *Notation* | SSY | SSerror | SSx |
| | *Value* | 12 | 24 | 36 |
| **Degrees of freedom** | | 3 | 8 | 11 |

Source: Calculated by the author

**Table 4. Results of calculations of the efficiency of solar power plant construction projects**

| **Project** | **Int. Rating** | | **Total Risk Impact Degree** | **Discounted Integrated Rating** |
|---|---|---|---|---|
| | **0-1** | **0-100** | | |
| No. 1, Zaporizhia region, Vasylivsky district | 0.828 | 82.791 | 61.583 | 1.344 |
| No. 2, Khmelnytsky region, Shepetivsky district | 0.619 | 61.942 | 45.500 | 1.361 |
| No. 3, Cherkasy region, Uman district | 0.608 | 60.807 | 53.000 | 1.147 |

Source: Calculated by the author

## Discussion

Thus, based on the decomposition, semantic analysis, analysis of recent research and publications conducted, the definition of the concept of "intergroup consensus among teams of international experts" is proposed in Figure 1. In turn, it is suggested to consider concordance as the process of achieving agreement or consensus among different researchers, experts, or groups on a certain problem or issue. Intergroup consensus of opinions is one of the important elements of concordance. To achieve concordance, different groups (teams) of experts need to have a shared understanding of the issue studied and reach an agreement on the decision or conclusion. This can be achieved through the use of methods that promote intergroup consensus, such as discussions, debates, voting, or compromise.

Therefore, intergroup consensus among teams of international experts means that experts from different countries and with different professional and cultural contexts can have a shared understanding of a particular question or problem. International expert teams can be an important tool to achieve intergroup consensus of opinions and to solve complex problems that involve multiple countries.

In this regard, let us define the advantages and disadvantages of forming teams of international experts, specifically in a team setting.

Therefore, the following advantages can be identified:

1. development of intercultural communication and mutual understanding, which is important in a global context;
2. international expert teams have diverse professional and cultural contexts, which promotes diversity of perspectives and ideas;
3. a team of international experts can bring together individuals with different specializations and extensive experience in their fields, allowing the team to utilize various skills and knowledge to find the best solutions.

Among the disadvantages of forming teams of international experts, the following can be mentioned:

1. language barriers: they can create obstacles in communication and limit the exchange of ideas and knowledge;
2. different methodologies and approaches among team members, which can complicate the decision-making process and consensus-building;
3. time differences and geographical distances, which can challenge coordination and collaboration between international expert teams.

As for the two definitions of the concept of "competence" given in the results of the research, then in our context, the first interpretation is more applicable. And "profile" in this context, according to the same dictionary, means "the set of main typical features characterizing a profession". Therefore, based on these definitions, we can propose the following definition for a competence profile: it is a set of main typical features that characterize good knowledge within a specific field.

We agree with Voitko & Hrinko (2022) regarding the proposed approach to classifying team members based on their competence profiles. However, we find it quite general, as it identifies profiles such as leader, idea generator, expert, harmonizer, enthusiast, tester, practitioner, and supporter, without considering the participants' specialized competencies.

It should be noted that within the scope of our research topic, which concerns a narrow professional field of selecting projects in the alternative energy sector, we suggest forming teams of participants for survey purposes to enhance the level of consensus by choosing a single profile type for all participating teams: the expert profile. In our opinion, the competence profile of an expert includes both general competencies, such as communication and intercultural skills, as well as specialized competencies in the specific field related to the research subject.

Voitko & Hrinko (2022) propose an approach to classifying expert profiles. We adapt this approach to our research topic. Therefore, we first propose that all teams consist of the same international expert profiles. In our opinion, this will increase the level of intergroup consensus (concordance) among international experts. If teams have varying numbers of profiles, it may amplify the differences in the evaluations by experts, as the opinions of experts with certain competence profiles will be considered in one team but absent in another. Thus, the uniformity of the competence profiles between different teams is one of the criteria for shared perspectives on a specific problem, a common knowledge base, and competencies that improve the level of consensus among experts.

The question of establishing an exact correlation between the homogeneity of types and the number of profiles in groups of international experts and the intergroup consensus of their opinions (concordance) requires separate research. It should be noted that conducting such a correlation analysis is challenging due to the subjectivity and abstract nature of concepts such as “competence”, “opinion”, and “evaluation”. However, to some extent, in a qualitative dimension, we can hypothesize that increasing the number of shared competencies related to the research topic among the experts in these groups would lead to an increase in the intergroup consensus of opinions.

Analyzing data on the consensus of opinions among international experts (Table 3), we conclude that, firstly, the effect size ($\eta 2$) of the influence of variable Y (expert's affiliation with a team) on variable X (expert's ratings) on the degrees of negative impact of risks is lower than the effect size of the influence of variable Y on expert ratings regarding the degrees of the parameters of importance of project execution efficiency. Hence, there is higher consensus among experts regarding the assessment of the degrees of negative impact of risks (the lowest effect size – for Project No. 3, $0.187 < 0.3$, the norm for achieving consensus). The highest effect size is 0.4 for the ratings of the importance of Project No. 3 parameters, demonstrating insufficient consensus among expert opinions. Second, the Fisher's F-test showed that the empirical F is lower than the critical F (taken from the table) for all three projects, both for ratings of importance levels and ratings of risk impact levels. Thus, according to Fisher's F-criterion, the opinions of international expert teams are consistent, and the null hypothesis (H0) is accepted.

In Table 4 in order to calculate for each project a discounted integrated assessment of its effectiveness, we multiplied this value by 100 and divided by the sum of the negative impact of risks from 1 to 100 (Table 2). Therefore, by analyzing the results of the calculations given in Tables 1-4, it is worth choosing the construction project of the solar power plant No. 2 (Khmelnytskyi region, Shepetivskyi district). Although the parameters of this project are inferior in efficiency to the larger project No. 1, its capabilities are located in the deep rear, and the level of negative impact on it of risks in the conditions of a full-scale war is lower compared to other projects. This project, due to its proximity to the western border, will allow to increase the export capacity of the Ukrainian solar energy industry and, as a result, its international competitiveness.

## Conclusions

Based on theoretical justification and practical recommendations regarding ensuring intergroup consensus among international expert teams in the selection of projects to enhance the international competitiveness of Ukraine's energy sector under conditions of uncertainty, the following conclusions have been drawn.

1. By decomposing the concept of inter-group consensus among international expert teams, the following definition has been formulated: it is the process of achieving consensus among members of different international expert teams who possess relevant knowledge and experience related to the topic under consideration regarding a specific question or problem within that topic; the degree of agreement or concordance of opinions among individuals belonging to different groups or teams of international experts.

2. Through critical analysis, it has been identified that the advantage of teaming up with experts in groups is the enhancement of opinion consensus through exchange, continuous discussion, and communication, while the disadvantage is the risk of misunderstandings and conflicts among team participants.
3. Analysis of recent research has allowed for the systematization of approaches and the proposal of a unique approach to classifying competency profiles of experts, taking into account the specificities of the energy sector.
4. By creating and distributing a survey questionnaire to international experts through Google Forms, tangible survey results in the form of expert ratings on the degrees of importance of project implementation parameters and levels of negative impact of risks in uncertain conditions have been obtained.
5. Through multi-stage single-factor regression analysis, the existence of intergroup consensus among international expert teams regarding their assigned ratings has been identified and confirmed.
6. By applying the taxonomic method, a conclusion has been drawn about the significant influence of risks in uncertain conditions on the level of project implementation effectiveness in the energy sector.

Thus, achieving intergroup consensus through the collaboration of international experts in teams has ensured the comparability and adequacy of their ratings, as well as the possibility of selecting the most effective project for enhancing the international competitiveness of Ukraine's energy sector based on those ratings under conditions of uncertainty. Prospects for further research lie in increasing both the number of teams and the number of international experts themselves.

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**Authors’ Contribution:** Oleksii Zrobok – 50%; Oleg Kinchiev – 50%.

**Conflict of Interest:** No conflict of interest.

**Acknowledgements and Financial Disclosure**: No funding for the research used in this publication.

# MIĘDZYGRUPOWY KONSENSUS ZESPOŁÓW EKSPERTÓW W WYBORZE PROJEKTÓW DLA ZWIĘKSZENIA MIĘDZYNARODOWEJ KONKURENCYJNOŚCI UKRAIŃSKIEJ ENERGETYKI W WARUNKACH NIEOKREŚLONOŚCI

**Streszczenie:** Przesłanką do podjęcia badań jest potrzeba międzygrupowego konsensusu ocen dokonywanych przez zespoły międzynarodowych ekspertów przy wyborze międzynarodowych projektów inwestycyjnych w obszarze energetyki słonecznej pod kątem ich adekwatności i zasadności. Celem artykułu jest przedstawienie teoretycznego i metodologicznego uzasadnienia zapewnienia międzygrupowego konsensusu wśród zespołów międzynarodowych ekspertów przy wyborze projektów mających na celu zwiększenie międzynarodowej konkurencyjności branży energetyki słonecznej. Wyniki badań wskazały, że koncepcja „konsensusu międzygrupowego zespołów międzynarodowych ekspertów” uległa rozkładowi; obecność konsensusu międzygrupowego wśród zespołów międzynarodowych ekspertów zwery-fikowano za pomocą analizy regresji jednoczynnikowej. Ocena ratingowa poziomu efektywności realizacji projektów zwiększających międzynarodową konkurencyjność ukraińskiej branży energetyki słonecznej w warunkach niepewności została przeprowadzona przy użyciu metody taksonomii. Wyciągnięto następujące wnioski: osiągnięcie konsensusu międzygrupowego poprzez współpracę międzynarodowych ekspertów w zespołach zapewniło porównywalność i adekwatność ocen oraz możliwość wyboru skutecznego projektu zwiększającego międzynarodową konkurencyjność ukraińskiego przemysłu energetyki słonecznej w warunkach niepewności.

**Słowa kluczowe:** międzygrupowy konsensus opinii, zgodność międzygrupowa, konkurencyj-ność międzynarodowa, ryzyka w warunkach niepewności, projekty energetyki słonecznej