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A method for identifying conflict relations between business process subjects based on paired correlations of mutual assessments

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Abstract

In this paper, a method of identifying conflict relations between the subjects of business processes is presented. The proposed solution seems quite important due to the high sensitivity of modern high-tech enterprises' business processes to negative factors, as well as the need to develop correct management decisions in conflict situations. A company's ability to identify internal conflicts and to take them into account during management decision-making is a feature of an effective business process. Modern methods of conflict detection that are available for practical use are able to identify conflict situations only at the stage of open conflict. In this case, the impact of the conflict on the business process is already material and may lead to deterioration in the company's performance. Unfortunately, existing methods have a significant disadvantage: they are not able to identify conflicts at an early stage, when the impact of the situation on the business process is not noticeable. An innovative approach based on analytical processing of survey-based data is proposed. This approach is able to identify hidden conflicts among employees of the enterprise. Identifying a conflict situation at an early stage makes it possible to manage conflict and reduce subsequent financial loss.

Keywords: conflict situation, survey-based data analysis, personnel conflict management, hidden conflict

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Introduction

A distinctive feature of high-tech companies is high concentration of human intellectual resources. Business processes of modern high-tech enterprises are determined (among other things) by the absence of contradictions among employees regarding their interests, goals, views, etc., that is, by the absence of conflict situations. The relevance of identifying conflicts among employees is only increasing [1]. This article presents a data analysis method for implementing a new approach for identification of hidden conflict situations. We will consider a conflict situation as not only the demonstrations of disagreement, contradictions in opinions, but also as a deviation from usual relationships among employees in the business process. Risk management describes such deviations as risks that lead to financial losses in the business process [2]. Of course, such financial losses reduce the company's profit.

Companies do not have many tools to identify conflict situations among employees. There are technical tools used for individual psychophysiological studies, also called a "polygraph" or "lie detectors." The advantages of the "polygraph" include the possibility of detecting conflicts among employees at a hidden stage [3, 4]. However, the significant cost of such studies does not allow them to be applied on a massive scale throughout the enterprise. Modern statistical methods of conflict detection are suitable for mass use. However, they have a significant disadvantage due to the inability to identify conflict situations at the stage of hidden conflict, i.e. when the risks of conflicts have not yet been fully realized and the losses from them are insignificant [5]. This means that the methods of conflict detection used so far do not allow us to minimize the cost of risky losses and lead to deterioration of a company's economic indicators. Modern methods applicable for identifying conflict situations are based on the survey data – assessment of an employee by his colleagues. However, this approach does not make it possible to identify conflict situations at an early stage of the conflict development.

1. The aim and objectives of the study

The aim of this study was to develop a method for identifying conflict situations among personnel at an early stage. The objective of the research was to develop a method that is able to identify conflict situations between subjects of business processes at an early stage (i.e., even during their hidden phase) in order to reduce risks to business processes associated with employees' relationships and thereby to reduce financial losses.

The method should identify conflict relations between certain pairs of participants, preventing the extension of a conflict situation, the involvement of other participants and the growth of the conflict into the open stage associated with financial losses.

2. Current state of the problem

Modern conflict researchers have identified as essential the role of conflicts both at the level of the production process and at the level of the

nation. Antsupov [6] justifies the thesis that at the country level, social and intrapersonal conflicts represent one of the main implicit factors of state defeats. Thus, he makes a conclusion regarding the importance of a comprehensive study of conflicts to ensure Russia's security.

The authors of [7] formulated the problem in this way: on the one hand, there is a need to manage conflicts among staff, and, on the other hand, personnel and social methods and technologies for their prevention are not effective enough. According to the study [8], 32% of employees of industrial enterprises reported that conflict situations periodically arise in their companies.

Moreover, interpersonal conflict is perceived as a situation of confrontation and a tangible psychological problem [9].

An important aspect is segmentation of conflicts into life cycle stages. In [10], the following stages are formulated: latent, the beginning of open conflict interaction, escalation of open conflict and conflict resolution. In our opinion, prevention of open conflict, i.e. its identification at the latent stage and its resolution, is a promising direction. Let us pay attention to the fact that during the latent period, a conflict situation arises and develops without explicit awareness by future participants, as well as without recognition of the conflict situation by at least one of the participants. It should be noted that the pace of identifying a conflict situation even in the phase of occurrence (i.e. without explicit awareness by the participants) is of paramount importance for making management decisions.

Among the founders of classical studies in the field of interpersonal relations, we can mention Jacob Moreno [11], who formed a new direction of knowledge – sociometry. This direction allows quick and technically simple quantitative assessment of the main characteristics of a group of interpersonal relationships. Sociometry is actively used to study relationships in sports teams [12], where a conflict-free psychological atmosphere is a prerequisite for successful performance at competitions. Among the methods used, the evaluation of teammates method and the method of selecting the most preferred partners are widely used.

The sociometric methodology is a base for the modular methodology of diagnosing interpersonal conflicts [13]. According to this methodology, the attitude towards employees from each of their colleagues is evaluated. Comparison of the responses forms a list of the most and least conflicting participants. Meanwhile, formation of the conflict index in a pair is based on the addition of evaluation points.

On the one hand, modern conditions of informatization form new circumstances and prerequisites for conflicts to arise and escalate. On the other hand, informatization makes it possible to use modern information technologies to study conflicts and accelerate the development of conflictology.

Among the approaches in the field of experimental data processing, it is worth mentioning the Analytical Hierarchy Process (AHP) method, proposed in the 1980s by Thomas Saaty [14]. The author developed a scientifically justified decision-making method based on hierarchical structures and making judgments. Saaty considers it reasonable to use scales of absolute values that reflect the superiority level of one element over another.

According to Saaty [14], selection of weights and criteria for formation of final rating is an important task. The development of reasonable management solution should be segmented into the following stages:

- formulating the task and determining the type of data required;
- establishing the aim construction of appropriate decision hierarchy through intermediate levels (criteria on which subsequent elements depend) to the lowest level;

- construction of a set of pairwise comparison matrices, where each element in the upper level is used to compare elements at the level directly below with respect to it;
- calculation of weights for each element, as a result of comparisons.

It is important to choose a measurement scale that demonstrates the predominance of one element over another regarding the criterion selected. For example, Saaty demonstrates a scale for comparing the relative consumption of beverages in the United States and considers it appropriate to use the inverse value of the parameter. The results of using the AHP method allowed him to discover preferences in consumption of beverages and provided reliable information for management decisions when planning procurement volumes.

Saaty also applied his method in making management decisions in the field of employment. The result of his research was selecting the direction of activity after obtaining a scientific degree – working in corporate business or teaching at school or university. In Saaty's works, it is also shown that using the geometric mean rather than the frequently used arithmetic mean is more appropriate in such models. Saaty justifies this by the fact that the survey subjects (in fact, experts) are not always ready to formulate their judgments, but are only ready to present the final results obtained by their own hierarchies. For such cases, the geometric mean of the final results should be used. Since the survey subjects have different subjective priorities regarding parameters importance, the results of their judgments should take into account the subjective priority, and after that the geometric mean is formed. Consideration of the relationship between events using the AHP model was carried out by Saaty in another paper [15], where the authors examined the mutual influence of gains and losses. A pairwise comparison of events was carried out, and they proved the need of using correlation dependencies in the AHP model. Comparison of the model results and actual data showed a high coincidence (85.10%) [15].

In fact, the model [14, 15] already uses correlation dependencies. However, the model [14] does not make it possible to identify conflicting pairs of subjects of a survey.

The AHP method was developed in the study of Nishizawa [16], where the author proposes to expand the pairwise comparisons of the AHP analytical hierarchy process and points out the limitations of traditional AHP. The author explains that there are limitations in traditional AHP, such as the reciprocity property of elements in the pairwise comparison matrix. Based on the matrix of non-reciprocal evaluation by mutual evaluation, Nishizawa proposes a method for solving the evaluation matrix to obtain a perfectly consistent eigenvector. In this method, the values of the resulting eigenvector are greater even if the smaller value of the estimate is more important. In addition, for making a management decision, a final evaluation vector is presented, combining the results of a well-conditioned vector and a poorly conditioned vector. One example is mutual evaluations of students' work. The assessment was carried out according to 10 criteria, and the total maximum score was 50 points. The assessment of each student was executed by his fellow students. In this paper, the method of mutual evaluation with comparison in AHP is considered. The proposed method was built on the basis of the author's previous research [16].

The practice of using correlation and mutual assessments is considered to be a modern approach to increase the level of objectivity and accuracy of processing survey data. In the reviewed works of leading experts in this field [14–16], no solution is proposed to identify conflict pairs. So, the task formulated, as well as approaches to its solution, have a certain scientific novelty and the possibility of further development.

The method considered is based on mutual assessments of survey subjects– cross-correlations. The scoring approach in the evaluation system is a traditional approach and reflects only the subjective opinion of a particular subject by other subjects. To identify a conflict, the difference between a specific parameter value and the average among other subjects must be significant, otherwise it will not be fixed. To increase the accuracy of the model, it seems appropriate to increase the number of respondents, i.e. the subjects making the assessment. However, this measure will not lead to an increase in the model sensitivity, rather the opposite. An increase of the survey subjects sample size will affect only the accuracy of the conflict level, but not the sensitivity of the model to availability of hidden conflicts. Such an approach may be considered as traditional in the field of personnel evaluation, but it does not allow us to answer the question, which pairs of subjects are in conflict due to the fact that the evaluation of one subject among all his colleagues will not be distinguishable.

To increase the sensitivity of the model to the existence of a conflict situation, it is necessary to develop criteria that will reflect the level of conflict between two certain subjects. This parameter seems the most important one, because it characterizes the ability of the model to detect a conflict situation at its early stage. The question of choosing a criterion for evaluation is fundamental [14]. We will formulate a number of requirements for criteria to identify hidden conflicts based on data of surveys conducted among employees. The first requirement is that the criteria must be objective, i.e. formed on the basis of survey data. Secondly, the criteria should have a high sensitivity to the conflict pair, i.e. distinguish it from all possible combinations. The third requirement is that the criteria should not to be influenced by strong deviations (errors) in the survey data.

3. Description of the method proposed

The basis for the study is an array of data of mutual assessments of the business process subjects. This means that each subject evaluates all other subjects, and a two-dimensional array of data is formed according to the number of subjects. The resulting matrix $A = \{a_{ij}\}$ represents the survey result. Any rank scale can be used for the evaluation model (selection of the scale for the model is an additional task that is not examined in the current paper).

For a conflict situation to arise, the presence of at least two participants is necessary. This condition of conflict occurrence will be used for creation of a new approach. We consider it reasonable to use cross-correlation criteria, i.e. criteria that characterize distinctive features of the relationship between subjects in a particular pair. We also assume that the value of a criterion for assessing the participants in the conflict significantly differs from all other assessments of the subjects, thereby allowing us to identify even minor deviations in the relationship between two subjects. It becomes possible to identify a "hidden conflict" when the level of confrontation between the two subjects is not significant yet.

Let a_{ij} be the value of estimates of the i-th subject by the j-th subject, and $a_{ij} \in [0,1]$, $i, j = 1, ..., n$, where n is the number of subjects.

As was mentioned above, different scales may be used for mutual evaluation of the subjects, thereby simplifying or complicating the level of the evaluation stage. For example, when using the simplest binary rating system (1 or 0), subjects should form their opinions at the level of "positive or negative" ("like/dislike"). However, this approach excludes from consideration various intermediate values of opinions and, despite its simplicity, is not applicable in this case. We consider it reasonable to use at least five assessment levels. Further on, we will consider the estimates in a normalized form (using the [0, 1] range).

Following the requirement of the need to estimate the relationship between the two particular subjects, we form criteria based on a simple multiplication of the values a_{ij} and a_{ji}. Alternatively, we may use values $(1 - a_{ij})$ and $(1 - a_{ji})$ to represent the level of negativity between two subjects.

The level of conflict between two subjects based on their mutual assessments can be determined by the following formula:

$$R_{ij}^{(1)} = a_{ij} a_{ji}. \quad (1)$$

Low values of the function $R_{ij}^{(1)}$ indicate a mutually low assessment of the subjects and may be considered as an indicator of a conflict situation between them. Choosing a functional for $R_{ij}^{(1)}$ as a simple multiplication meets the above mentioned requirements to the model: the objectivity of the criterion and high sensitivity. This dependence makes a significant difference in the case of mutual negative assessments. This form allows us to avoid mistakes in the case when one subject evaluates another at a low level, while the reverse evaluation is neutral.

However, low value of a_{ij} score may reflect both the negative attitude of subject *i* to subject *j* and be considered as an indicator of the general state of the subject i regarding the criterion being evaluated. It means that the function (1) will be subject to error, which is formed relying on the general condition of one of the subjects of the pair examined.

To identify a negative attitude, let's consider the mechanism of underestimation:

$$L_i^{(j)} = \begin{cases} A_i - a_{ij}, \text{ if } a_{ij} < A_i \\ 0, \text{ if } a_{ij} \geq A_i, \end{cases} \quad (2)$$

where A_i is the average assessment of the subject by other participants of the business process:

$$A_i = \frac{1}{n-1} \cdot \sum_{l=1, l \neq i}^{n} a_{il}, \quad (3)$$

Then the conflict level can be determined on the basis of underestimation of estimates:

$$R_{ij}^{\prime(1)} = L_i^{(j)} L_j^{(i)}. \quad (4)$$

Both indexes and numerical values can be used as arguments of the model. Formation of the evaluation scale is a special task (this aspect may be studied in subsequent research).

For further considerations, it is necessary to determine threshold values of the criterion.

4. Results (by the illustrative example)

The method proposed was tested as a part of a study to identify conflicts among third year students. We assume that over the years of study in the university, a group under consideration formed certain relations, including cases of latent conflicts [17]. The initial survey data can be presented in various scales and ranges. In our survey, we used a scale from one to ten, where 1 point means the most negative attitude to the evaluated person, while 10 points – the most positive attitude.

Let's convert all numerical estimates into a range of [0, 1] (*Table 1*).

Calculation of cross-correlation coefficients for conflicting pairs (*Table 1*) in accordance with the equation (1) showed that the coefficients values lies in the range from 0.18 to 1.

Identification of conflicting pairs was performed using a simple comparison rule: $R < \gamma$, where R is the criterion used, $\gamma \in (0,1)$ is the threshold applied. In this case, latent conflict pairs were attributed to pairs for which the condition $R_{ij}^{(1)} < 0.25$ is fulfilled. Selection of the conflict boundaries is an another separate task determined by the user of the model relying on expert estimates or on previously observed precedents (it is the task of determining threshold values [18]).

The sample corresponding to the condition $R_{ij}^{(1)} < 0.25$ included 19 pairs of respondents. For

Table 1.

Example of survey data within the conflict management model after conversion

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	0.2	1	1	0.5	0.7	0.8	0.5	0.5	0.7	0.8	0.9	0.7	1	0.7	0.6
2	0.4	0.8	0.5	0.3	0.1	0.9	1	0.6	0.5	0.6	0.7	0.8	1	0.5	0.5	0.8
3	0.9	0.5	0.9	0.8	0.7	0.7	0.9	0.8	1	1	0.8	0.8	0.7	0.7	0.6	0.6
4	0.8	0.6	0.7	0.7	0.5	0.6	0.7	0.5	0.7	0.7	0.7	0.8	0.7	0.8	0.7	0.7
5	0.5	1	0.6	0.5	0.7	0.8	0.7	1	0.6	0.8	0.5	0.6	0.6	0.4	0.7	0.2
6	0.6	0.7	0.3	0.6	0.5	1	0.8	0.8	0.7	0.8	0.6	0.8	0.7	0.8	0.7	0.6
7	0.8	0.7	0.5	0.8	0.5	0.7	1	0.7	0.5	0.6	0.7	0.8	0.8	0.8	0.8	0.7
8	0.7	0.2	0.4	0.4	0.9	0.9	0.7	0.9	0.8	0.7	0.7	0.7	0.9	0.7	0.6	0.4
9	0.6	0.6	1	0.6	0.7	1	0.8	0.8	1	1	0.8	0.6	0.8	0.7	0.7	0.7
10	0.7	0.5	1	0.9	0.7	0.7	0.7	0.6	0.9	1	0.8	0.7	0.6	0.8	0.7	0.5
11	0.6	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.5	0.5	0.4	0.5	0.4
12	1	0.5	0.7	1	0.5	0.8	0.8	0.7	0.7	0.7	0.7	1	0.7	1	0.7	0.7
13	0.5	1	0.4	0.6	0.7	0.7	0.9	0.7	0.8	0.6	0.4	0.9	0.7	0.8	0.5	1
14	1	0.7	0.8	1	0.5	0.6	0.6	0.6	0.8	0.8	0.8	1	0.9	1	0.9	0.9
15	0.8	0.5	0.5	0.8	0.3	0.8	0.9	0.2	0.7	0.6	0.8	0.7	0.7	0.8	1	0.7
16	0.3	0.8	0.4	0.5	0.4	0.4	0.6	0.6	0.7	0.6	0.7	0.6	1	0.7	0.7	0.9

four pairs $0.08 < R_{ij}^{(1)} < 0.1$, three pairs fell into the range $0.13 < R_{ij}^{(1)} < 0.18$, and the remaining 12 pairs lied within the range $0.19 < R_{ij}^{(1)} < 0.25$.

It should be highlighted that for some conflicting pairs, the criterion $R_{ij}^{(1)}$ is not unambiguous. For example, $R_{ij}^{(1)}$ for pairs 5/2 and 16/5 shows an unambiguously conflicting situation: the values of cross-correlation coefficients are 0.10 and 0.08, respectively. Let's consider the initial data for these pairs (*Table 1*). The estimates for these pairs (1 and 0.1 for 5/2, and 0.4 and 0.2 for 16/5) are not unambiguous. We mean that the relationship in a pair of 16/5 can definitely interpreted as a conflict, while in a pair of 5/2 it is too premature to make such a conclusion because mutual scores of 1 and 0.1 do not indicate the existence of a latent conflict. Hence, there is a need to take into account uniformity of the assessments between subjects.

Among simple solutions of nonlinear optimization problems, there is use of so-called penalty functions [19]. Penalty functions allow us

to transform the initial task by introduction of certain restrictions. The idea of the restriction in question is to use a penalty to the original function in such a way that violation of the imposed restriction leads to a change in the function and becomes unprofitable from the point of view of the problem of unconditional optimization.

In the case examined, it is necessary to introduce a function excluding couples from the set of conflicting ones with a significant unevenness:

$$M_{ij} = (a_{ij} - a_{ji})^2, \quad (5)$$

where $(a_{ij} - a_{ji})$ represents the unevenness of estimates.

Application of a penalty M_{ij} can increase the values of the cross-correlation functions $R_{ij}^{(1)}$ of pairs whose mutual estimates are significantly unequal. Increasing the cross-correlation functions value $R_{ij}^{(1)}$ can remove a specific pair from the group of those in conflict.

Taking into account (5), we apply a criterion that takes into account the penalty:

$$R_{ij}^{(2)} = a_{ij} a_{ji} + M_{ij}, \quad (6)$$

$$\text{or } R_{ij}^{(2)} = a_{ij} a_{ji} + (a_{ij} - a_{ji})^2. \quad (7)$$

Application of this criterion to certain data is presented *in Table 2.*

Table 2.

Cross-correlation coefficients for conflicting pairs $R_{ij}^{(2)}$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00	0.12	0.91	0.84	0.25	0.43	0.64	0.39	0.31	0.49	0.52	0.91	0.39	1.00	0.57	0.27
2		0.64	0.26	0.27	0.91	0.59	0.79	0.28	0.31	0.31	0.39	0.49	1.00	0.39	0.50	0.64
3			0.81	0.57	0.43	0.37	0.61	0.48	1.00	1.00	0.48	0.57	0.37	0.57	0.51	0.28
4				0.49	0.25	0.36	0.57	0.21	0.43	0.67	0.37	0.84	0.43	0.84	0.81	0.39
5					0.49	0.49	0.39	0.91	0.43	0.57	0.25	0.31	0.43	0.21	0.37	0.12
6						1.00	0.57	0.73	0.79	0.57	0.31	0.64	0.49	0.52	0.57	0.28
7							1.00	0.49	0.49	0.43	0.39	0.56	0.73	0.52	1.08	0.43
8								0.82	0.64	0.43	0.39	0.49	0.67	0.43	0.28	0.28
9									1.00	0.91	0.49	0.43	0.64	0.57	0.49	0.49
10										1.00	0.49	0.49	0.36	0.64	0.43	0.31
11											0.49	0.39	0.21	0.48	0.49	0.37
12												1.00	0.67	1.00	0.49	0.43
13													0.49	0.73	0.39	1.00
14														1.00	0.73	0.67
15															1.00	0.49
16																0.90

In *Table 2*, the 0.25 boundary is used to distinguish conflict and non-conflict pairs, as in *Table 1*.

Analysis of the criterion $R_{ij}^{(2)}$ for conflicting pairs shows a significant difference in values from those obtained from other pairs of subjects. Reasonable application of the criterion $R_{ij}^{(2)}$ leads not only to a difference in the number of conflicting pairs from $R_{ij}^{(1)}$. It is important to note the qualitative difference between $R_{ij}^{(2)}$ and $R_{ij}^{(1)}$ due to the ability of $R_{ij}^{(2)}$ to exclude an "inferior conflict," where one of the subjects does not demonstrate any evident hostility to the counterparty. This means that for conflicting pairs of subjects the value of the criterion $R_{ij}^{(2)}$ is meaningful and reasonable.

Figure 1 shows a comparison of the criteria $R_{ij}^{(1)}$ and $R_{ij}^{(2)}$. The criterion $R_{ij}^{(2)}$ is the criterion taking into account the penalty, and it allows us to identify unique pairs of conflicting subjects, i.e. those points that are located below the horizontal line "boundary of non-conflict, equal to 0.25".

Pairs of subjects are lexicographically ordered according to the following principle: (1, 2), (1, 3), ..., (1, n), (2, 3), (2, 4), ..., (n – 1, n), where n is the number of subjects.

The ordinate axis is the value of the criteria, the abscissa axis is the ordinal numbers of k pairs (i, j), which are calculated as follows:

$$k = j + (i-1)n - \frac{i(i+1)}{2}, \qquad (8)$$

where j and i are the numbers of columns and rows of subjects in the array.

The criterion $R_{ij}^{(2)}$ demonstrates good identification capabilities and does not react to situations when one of the subjects evaluates the other one negatively, and the other subject, in turn, evaluates him positively. For example, the subjects of the 2/5 pair evaluate each other's

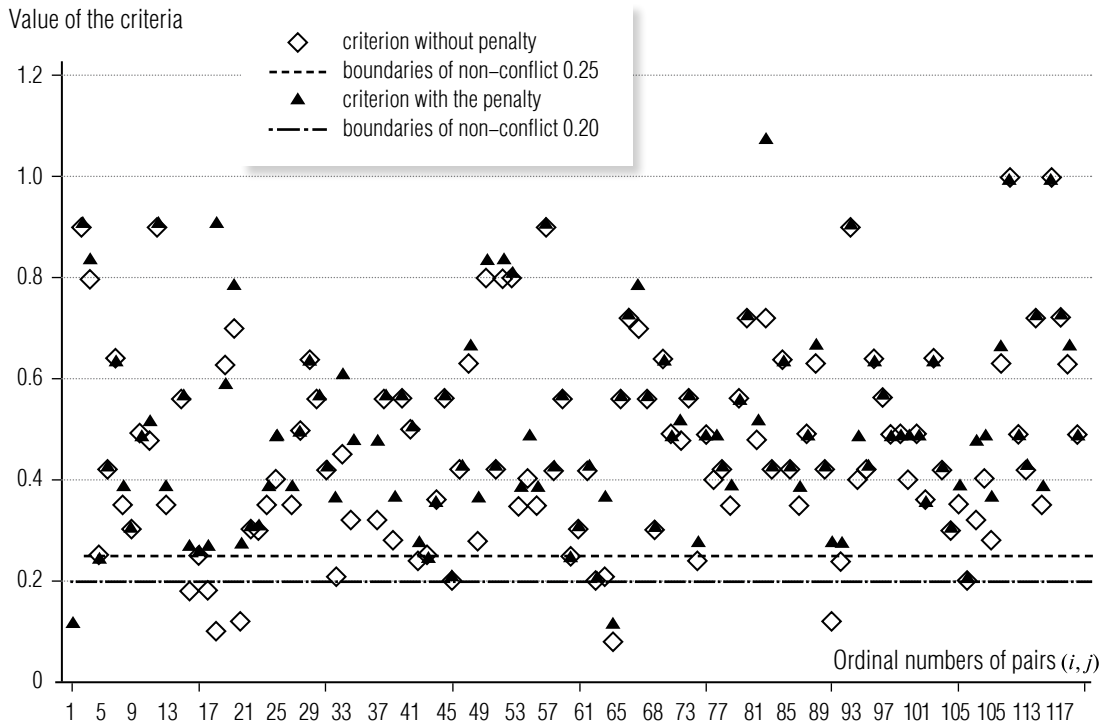

Fig. 1. Comparison of criteria (criterion without penalty) and (criterion with penalty).

conflict level as 0.1 and 1 (*Table 1*), and such a pair should be excluded from the results due to the lack of evidence of a conflict assessment from each subject.

Using the example of these conflict pairs whose level of non-conflict is below 0.25 (*Fig. 1*), there are six such conflict pairs: 1/2, 4/8, 5/11, 5/14, 5/16 and 11/13. Let's consider the mutual estimates of the identified pairs (*Table 1*): 1/2 – 0.2 and 0.4; 4/8 – 0.4 and 0.5; 5/11 – 0.5 and 0.5; 5/14 – 0.4 and 0.5; 5/16 – 0.2 and 0.4; 11/13 – 0.4 and 0.5.

In the case of applying a stronger non-conflict criterion – 0.2, there are only two such conflict pairs – 1/2 and 5/16. In *Fig. 1*, they are numbered 1 and 65 on the horizontal axis, respectively.

The method presented has one more feature – the ability to identify "conflicts of interest" between employees of the company. By conflicts of interest, we mean situations or conditions when an employee's personal interest affects the performance of their job duties. The prerequisites for such personal interest are overly positive and friendly relationships between employees. This means that by identifying extremely friendly relationships between employees, potential conflicts of interest can be identified. As an initial function, we apply the cross-correlation function already discussed above.

In the case of analysis of excessively positive attitude of the studied couples, the criterion $R_{ij}^{(1)}$ presented above can be applied. Since the criterion $R_{ij}^{(1)}$ reveals not negative, but positive mutual assessments of the subjects of the study, there is no need to apply the penalty M_{ij}.

The highest values of the cross-correlation criterion $R_{ij}^{(1)}$ demonstrate an excessively positive attitude between subjects (*Fig. 2*).

When analyzing the results of determining conflicts of interest, we pay attention to the maximum values of $R_{ij}^{(1)} = 0.5$. These values indicate that there exist excessively positive mutual relations between the subjects.

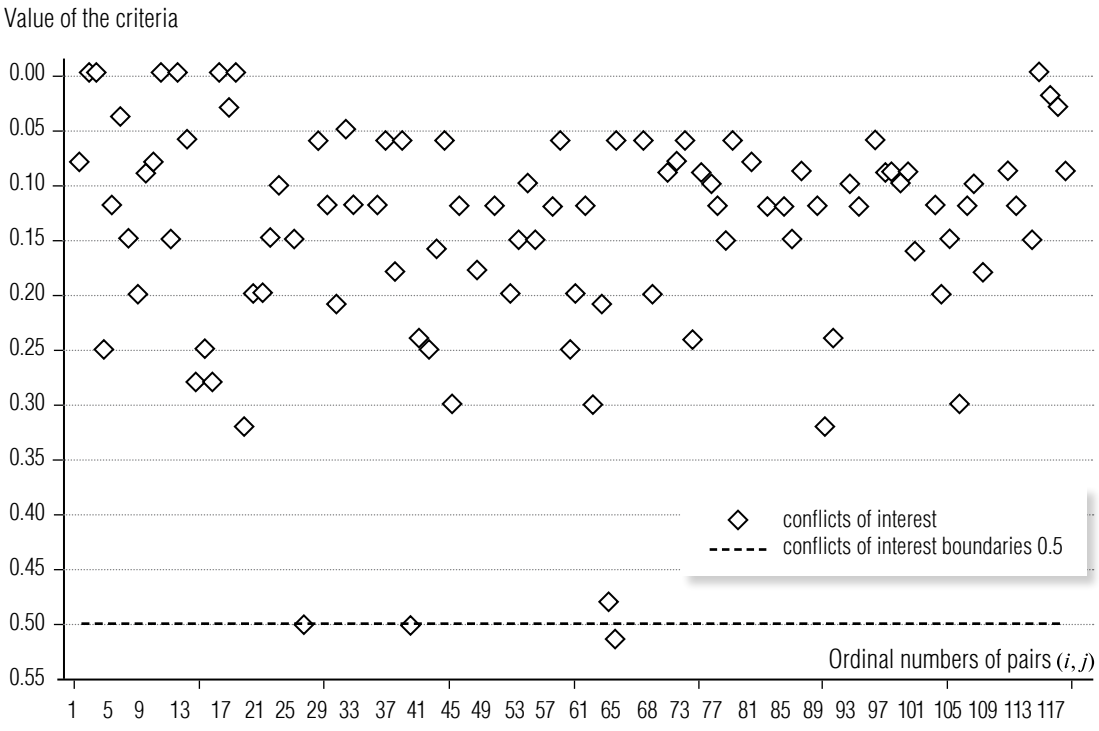

Fig. 2. Results of identifying a conflict of interest according to the criterion $R_{ij}^{(1)}$.

Thus, pairs of respondents with numbers 28 and 41 demonstrate excessively friendly relations, which also need to be taken into account when making decisions in the field of personnel management.

The method presented based on the survey data uses another, different from the traditional, level of determining the functional dependence between conflicting couples. The use of such an innovative tool significantly increases the company's ability to identify conflicts at an early stage, which makes it possible to take into account the information so obtained in the company's strategy [20–25]. By processing the survey data according to the presented model, the user company receives objective information based on up-to-date data.

Modern external conditions, such as the consequences of Covid-19, have a negative psychological impact on the level of conflict within the company. The growth of conflicts between employees of the department is not excluded [21], for which there are no effective tools for an early stage of conflicts.

5. Results and discussion

Let us analyze the results of the study according to the model presented. When determining the effectiveness of the traditional approach, consider the survey data given above (*Table 1*). The average values of each employee's ratings cannot differ noticeably, and this shows the inability of the traditional approach to identify hidden conflicts.

Let us pay attention to works in the field of data processing and analytical models. Above, we have already mentioned the work of Thomas Saaty, who introduced a new scientific method of decision-making based on hierarchical structures and making judgments – the analytical hierarchy process (AHP) [5].

The analytical hierarchy process uses the idea of developing a criterion through pairwise comparisons of data that are based on expert opinions and determining priority scales. These scales are used in relative terms for making managerial decisions.

The method presented and its approbation regarding the survey data of 3rd year students showed its effectiveness. The effectiveness of this method is understood to be the ability to unambiguously identify the most conflicting pairs in relation to which some work should be carried out. In a study of a group of 16 people, one couple was identified that is in a state of latent conflict. The functionality of the method for identifying conflicts of interest has also been confirmed. However, the study revealed certain shortcomings that should become directions for further research.

First, it is necessary to pay attention to the scale used in surveys. On the one hand, the gradation of the scale should be as clear for respondents as possible. Moreover, as a rule, this requirement leads to a reduction in the number of intervals. On the other hand, the accuracy of the study directly depends on the number of intervals, i.e. it is necessary to determine the optimal number of intervals in a survey scale.

Another problem we identified is the increased sensitivity of the method. As a result of application of the method, the most conflicting pairs should be identified. From the point of view of data analysis, the values of the cross-correlation indices for these pairs should differ significantly from the others, thereby facilitating their identification.

Research in the field under consideration shows that using correlation and mutual estimates holds certain promise for increasing the sensitivity and accuracy of models.

Conclusion

The method of conflict situations identification presented in this article uses the processing of survey data by applying cross-correlation

criteria. Such an approach is able to identify exactly conflicting pairs, even in cases when an average assessment of the conflict of a particular subject is not able to do this.

Application of the approach described in the article makes it possible to identify conflict pairs with hidden conflict at the latent stage, when the risk of damage to the business process is still insignificant. On balance, the method facilitates prompt management decisions and significantly reduces potential losses to the company. ■

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