

# Management Risks of Dependence on Key Employees: Identification of Personnel

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## Abstract

The approach to the realization of one of the most essential stages of information technology risk management in the personnel security system of the company was studied. Information technology aims to ensure the sustainability and success of the company by anticipating, exploiting the benefits, and minimizing vulnerabilities to potential threats to work with such categories of personnel as key employees. The stage that is the subject of the study is related to the identification of personnel. It is carried out on the basis of the analysis of conformity of possibilities of the respondent to requirements to various groups of competencies defined by the profile of key employees formed in the company. In this study, the stage of identification of key employees is considered as a human-machine toolkit, built on a system-linked base of peer review models using modern capabilities of decision support systems in a weak process structuring and conceptual uncertainty. Its information result - an indicator of identification and a database of diverse assessments of employee competence - is considered as one of the basic in assessing potential threats to company assets, their vulnerabilities, expected costs, finding ways to minimize them in the next stages of information technology risk management of key employees.

## Keywords

Key employee, profile and identification of personnel, risk of dependence, index of authentication, group and criteria of competencies, weight of criteria.

## 1. Introduction

The main task of skilled safety to the company is providing maximal stability of work, prevention, and removal of threats and risks that is related to the human factor—work of personnel.

According to resource conception of business management, which formed the theoretical basis of a ground of behavior of company on modern markets, set one of major having special-purpose options is possession and management application of unique resources of a different type, that needed for the realization of its strategies. It gives the company special value, uniqueness, and competitiveness. To their number the taken and human resources. The professionalism of the worker, his knowledge, skills, structural flexibility, thinking level determine the key competencies of an organization, stipulate its uniqueness and value. In these terms to the important questions of improvement of the system of safety of the company, there is providing of firmness of its work with foresight and use of possible advantages and potential problems with such categories of personnel as key employees.

Subjects of improvement of skilled safety in sense of managing risks as dependence on key employees especially actual in spheres in those business successes, first of all, depend on an intellectual human capital. In these terms the role of key employees rises as a base constituent of the

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success of the company, and, the second party, the level of risks that arise up the independence of success of the company on key employees rises. The measure of expenditures for compensating risks is varied and depends on different factors. The first factor is the loss of key employees as an important human asset of the company. For example, is unforeseen liberation of key employees. It can lead to substantial expenditures that connected with the inevitability of postponement of possibilities of implementation of strategic plans of the company, the loss of connections in the state authorities, logistic companies, in an informative environment, with the decline of the skilled potential of the company, to require additional charges on the preparation of skilled replacement. The second factor is related to the actions of the key employee as the real or potential source of realization of threats - work on a competitor during work in the company or after liberation, creation of the personal company—a competitor with bringing in and use of resources of company—technologies, workers, information and others like that.

Therefore, for today one of the actual tasks of skilled security of company service, there is the determination of problems and analysis of risks that is related to dependence on key employees.

## 2. Analysis of Literary Data, Raising of Problem, Aim, and Research Tasks

At this time among theoretical and practically-oriented publications, there is a far of works that examine the problems of management key employees in sense of differentiation of personnel depending on their payments in development of business and companies on the whole [1-5], there are materials of empiric researches that is executed within the framework of international research projects and work round table [6, 7]. In works certain interpretation of term “key employee,” investigational approaches to forming of the profile of key employee that determines typical quality properties of personnel, the different variants of the structure of quality properties (criteria of competence) of the profile, accordance of employee are argued to his requirements and the offered methodologies of identification of this accordance. They are based on the methods of the questionnaire, expert discussion without formalization or partial formalization of these procedures. The worked-out algorithmic charts of estimation of payment of key employee are in the development of company taking into account weight of criteria of competence. The number of publications that examine the problem of increase of skilled strength security due to management risks grew lately, that the dependences related to the factor are on key employees [7–11]. In the problem of dependence is substantially justified and relevance of further works of it solving is defined, the partly formalized vehicle of determination of the expected threats and approach to risks and potential charges is offered.

The conducted researches allowed the authors to draw conclusions basing necessity on managing risks that connected with dependence on key employees, on the generated scientific ideas, accumulated experience, and practical recommendations of many both home and foreign scientists and researchers in the industry of analysis of risks and counteraction to their threats [12–14]. At this time the great number of various methods and models that are sent to the determination of constituents of the mathematical vehicle of estimation of risks in the conditions of incomplete definiteness of data on the basis of methods of expert evaluation is used [8, 9, 15]. They foresee the evaluation of the level of losses and probability of realization of risk on a quality scale, as a rule, without her quantitative interpretation. It was drawn the conclusion that by the substantial lever of increase of efficiency of management risks, that the dependences related to the factors are on key employees, in the real terms of weak structurization of processes of management and conceptual vagueness, there will be passing to the application of information technology that is based on possibilities and advantages of the modern systems of support of making the decision (SSMD). The base of models of SSMD must include the aggregate of statistical methods and methods of expert evaluation [16, 17] and to be sent to the determination of the risk of dependence of company from key employees.

Will describe the general going near the construction of information technology of managing the risks of dependence on key employees. In Fig. 1 its stages are certain. The informative ground of work of this technology (1) and summarizing mathematical model of risk  $KR_i$  (2) assessment it is suggested to describe next correlations:

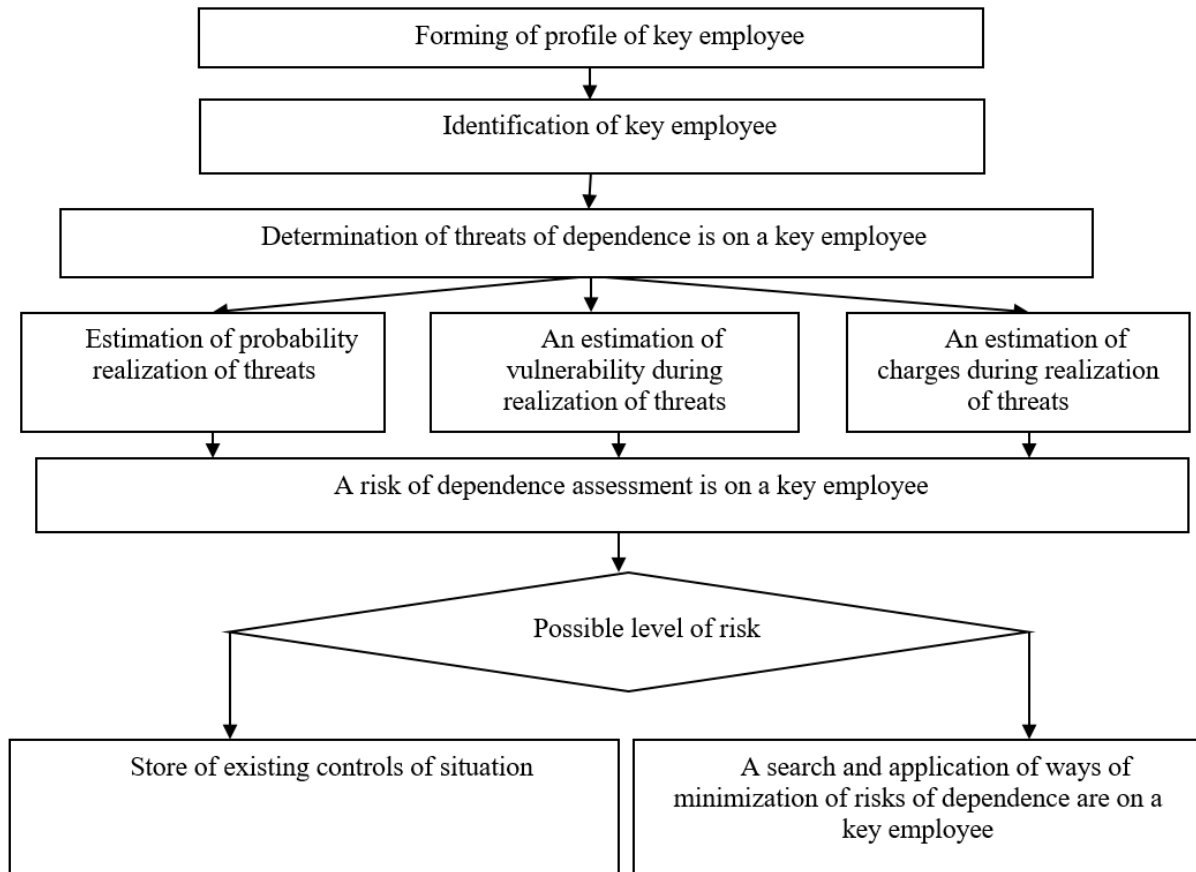
$$KR_i = \{ (V_i; \overline{R_{ij}}; \overline{B_{ij}}; \overline{P_{ij}}) | i \in I, j = \overline{1, n} \}, \quad (1)$$

$$KR_i = V_I \times \sum_{j=1}^n R_{ij} \times B_{ij} \times P_{ij}, \quad (2)$$

Where  $V_I$  is an index of identification of key specialists that is determined in a range  $[0.5 \div 1]$ ;  $R_{ij}$  is the probability of realization of the offensive of  $j^{\text{th}}$  threat of dependence is on key employees that are determined in a range  $[0 \div 1]$ ;  $\sum_{j=1}^n R_{ij} = 1$ ;

$B_{ij}$  is the vulnerability of company is during realization of the offensive of  $j^{\text{th}}$  threat of dependence on key employees that is determined in a range  $[0 \div 1]$ ;

$P_{ij}$  is multivariable charges that are expected during realization of  $j^{\text{th}}$  threat of dependence on key employees, determined in the set scale of measuring.



**Figure 1:** Information technology of managing the risks of dependence is on key employees

Becomes separated from authors for considered one of the substantial stages of information technology, that related to identification of key employee, and the task of presentation of it results is put as a corresponding quantitative index of authentication  $V_I$ . To represent the setting measure of accordance of  $i^{\text{th}}$  respondent to the requirements of the profile of key specialist both complex and from the point of view of his separate properties. They got the value of this index and database of identification formed in the system become the informative basis of realization of the further stages of management to the risks of dependence on key employees.

The aim of the research of authors is a search and analysis of ways of the decision of compromise task that requires, from one side, to provide the evaluation system taking into account variety of requirements to the competence of specialist, distribution of measure of formalization of processes and improving on the other hand, taking into account the discrepancy between the real conditions of the unstructured problem of decision-making and conceptual uncertainty. An attempt to assist the partial decision of this problem will be realized in this research.

The article aims to analyze the approach of realization of the stage of identification of key employees on the basis of system linked bases of models of expert evaluation with the use of modern possibilities of the systems of support of making the decision. For gaining end such tasks were put: to

define the base of models of identification of key employee; to conduct research of base models and methods of their realization.

### **3. Base of Models of Identification of Key Employee**

#### **3.1. Principles of Construction of the Base of Models**

Forming of the base of models is conducted on the basis of analysis of steps of realization of the stage of identification and research of possibilities of existent methods of solving tasks of such class. At forming of the base of models, following the having a special purpose setting of achievement of desirable levels of authenticity and validity of results of authentication, to realize the gradual removal of problems of conceptual vagueness due to basing on next principles:

Forming of human-machine technology of expert evaluation is on the basis of the set base of models of SSMD.

Realization of the idea of system coordination of vehicle of formalization, mathematical providing, and rules of receipt of quality information is from a person, that makes the decision (PMD), and experts. As PMD and expert's certain guidance companies are examined representatives of skilled security and management a personnel service.

Use of methods of qualitative analysis with its interpretation in the quantitative measuring.

Account of efficiency of "human factor"—making the decision must be based on professionalism, being informed, intuition, the intellect of PMD and experts, that is why reasonable requirements must be certain in the complement of the expert group.

Application of the method of individual questioning is on the basis of the absence of exchange information between experts. Every expert must have an individual password of access to the server for implementation of expert evaluation and receipt of initial information about the object of evaluation, but can't exchange information with other experts. Dependence of evaluation results is eliminated these on prevailing of opinions of the most active and authoritative specialists and "anonymity" of opinions of experts is provided.

Providing is at a concordance and grouping of end-point of the real compromise taking into account ideas and level of competence of every expert.

Application of vehicle of the unclear questioning is with a grant to the possibility to conduct the expert questioning with an orientation on the interpretation of interval of vagueness as a structure of his scale.

To take into the accountability of man to recognize and form the estimations within the framework of the recommended limitations of the number of Miller ( $7 \pm 2$ ) at the construction of structures of evaluation scales.

An acceptance of final decision is the prerogative of man—to the collective of specialists, accountable for the policy of the company that is the initiators of development and interested in the achievement of a quality result.

To the base of models, it is suggested to include:

Model 1. Profile of key employees.

Model 2. Estimation of the weight of criteria of competence of different levels of the hierarchy of profile of key employees.

Model 3. Establishment of values of criteria of competence of key employees.

Model 4. Control of coordination of opinions of experts.

Model 5. Generalization of evaluation results.

Model 6. Determination of index of identification of key employees.

The base of models is divided into two component groups that are certain as two components of the spiral approach of creation of the system:

a group of models, that will realize the processes of work of separate experts (models 1–3, model 5), is the first iteration of the development of the system;

a group of models, that will realize the processes of generalization of opinions of different experts (model 3, model 4), is the second iteration of development.

Within the framework of the article the put task of research of models of the first group.

### 3.2. Model of the Profile of Key Employee

The model of the profile of key specialist prepares by PMD—the corresponding structures of personnel management and the system of company safety. At forming the profile of PMD we will consider two hypostases of dependence on key employees. From one side, an employee is examined as a valuable asset of the company (human resource) of the present time and taking into account the terms of long-term development of the company, from another party, as a possible source of the potential threat that determines the risk of dependence. Clear that profile of key employee this empiric set concept, he must be built depending on the reality of terms of work of the corresponding company, and to guarantee his model possibility of varying of the profile structure. Stopped up the hierarchical model of the profile of key employees, rich in content authenticity of that is reasonable in-process [5]. She is built on the basis of results of questioning of experts that work in intellectually capacious companies and have an experience both for authentications of key employees and application of these results at a management risks by the unformalized or partly formalized way. At the first level of hierarchy certain groups of competencies of key employees, on the second are criteria of competence for every group (Table 1, columns 1,2).

**Table 1.**  
Profile of key employee

Groups and criteria of competencies of key employees		Weight of groups of competencies and their criteria		
Code	Name	$\beta_g$	$\beta_{gm}$	$\beta_{gm}^R$
1.	<b>Group of competence “Ability to learning”</b>	0.2	—	—
1.1	The permanent personal interest is in the acquisition of new knowledge		0.1152	0.0230
1.2	Analysis of aim and maintenance of studies		0.1531	0.0307
1.3	Ability to apply new knowledge in practice		0.2234	0.0447
1.4	Ability to use stranger experience for own development		0.1453	0.0290
1.5	Ability independently to determine why it is necessary to learn for the best implementation of work		0.2630	0.0526
1.6	Permanent perfection of abilities and skills		0.1000	0.0200
	<b>All on a group 1</b>	0.2	1.0	0.2
2	<b>Group of competence “Professionalism”</b>	0.4	—	—
2.1	Owens unique knowledge		0.1751	0.0700
2.2	Really manages the business, company		0.1462	0.0584
2.3	Locks on itself the acceptance of important administrative decisions		0.1223	0.0489
2.4	Owens unique skills, technologies		0.0790	0.0317
2.5	Able quickly to get along at the put tasks.		0.0790	0.0317
2.6	Ability to decide difficult tasks.		0.0790	0.0317
2.7	Ability to make a decision in the situation of vagueness		0.3194	0.1276
	<b>All on a group 2</b>	0.4	1.0	0.4
3	<b>Group of competence “Integration”</b>	0.2	—	—
3.1	Contacts with key clients		0.2501	0.0500
3.2	Turned out a copula in state structures		0.2501	0.0500
3.3	It is an informal leader		0.1002	0.0200
3.4	Ability to create and support confidence relations		0.0923	0.0181
3.5	Ability to forecast the most credible reactions of man		0.1133	0.0221
3.6	Ability for the decision of any task, quickly to find and		0.1240	0.0248

	attract necessary people			
3.7	Ability it easily to set new business contacts		0.0350	0.0070
3.8	Ability to coordinate interests of different people		0.0350	0.0070
	<b>All on a group 3</b>	0.2	1.0	0.2
4	<b>Group of competence "Reflection"</b>	0.1	—	—
4.1	Ability critically to analyze an eigenstate and behavior		0.1541	0.0154
	Ability to critically analyze one's condition and behavior			
4.2	Ability to acknowledge the errors		0.1242	0.0124
4.3	Ability to use previous experience for the decision of new tasks		0.3024	0.0303
4.4	Ability to ask for feedback from colleagues and guidance in relation to own actions		0.1243	0.0124
4.5	Ability to find out essence and reasons of the phenomena and processes		0.1541	0.0154
4.6	Possessing the realized aims		0.1409	0.0141
	<b>All on a group 4</b>		1.0	0.1
5	<b>Group of competence "Creation of new knowledge"</b>	0.1	—	—
5.1	Ability to work with the unstructured data		0.2000	0.0200
5.2	Ability for the decision of tasks to apply interdisciplinary knowledge		0.3002	0.0300
5.3	Ability to systematize information		0.1023	0.0103
5.4	Ability to analyze the large arrays of data		0.0921	0.0092
5.5	Ability to offer a non-standard solution of tasks		0.1140	0.0114
5.6	Ability to perceive a new, be not afraid of changes		0.1223	0.0122
5.7	Ability to actualize the knowledge		0.0691	0.0069
	<b>All on a group 5</b>	0.1	1.0	0.1
	<b>All</b>	1.0	5.0	1.0

### 3.3. Estimation Model of the Weight of Criteria of Competence of Different Levels of Hierarchy

Application of this model gives the formalized mathematical vehicle of transformation of quality estimations of the expert of comparative meaningfulness of criteria in the quantitative expression of their weight. An estimation is formed for two levels of the hierarchy of profile model: at the level of groups of competence  $\{(\overline{\beta_g}) | g = 1, \dots, G\}$ , of criteria of competence of every group  $\{(\beta_{gm}) | g \in G; m = \overline{1, M}\}$  and for determining the weight of the generalized influence of every criterion of competence on the large-sized index of identification of key specialist  $\{(\beta_{gm}^R) | g \in G; m = \overline{1, M}\}$  (see Table 1, columns 3–5).

The construction of the model is based on the application of possibilities of the method of analysis of hierarchies (MAH) [18–21]. According to this method, an expert gradually carries out the comparative estimation of meaningfulness of groups of competencies and criteria of every group based on the recommended scale of estimation of advantages. An estimation that is conducted by an expert in verbal and grows into a model in the quantitative description. The expediency of application of MAI a base tool of construction of the model was grounded by the next possibilities of the method, that substantially influence on authenticity of evaluation results.

The flexible hierarchical structure of presentation of objects of evaluation that gives the possibility to the user, in accordance with the situational terms of work of the company, to make alteration both in the complement of groups of competence, criteria of their evaluation and levels of decomposition of criteria.

Expansion of evaluation interval. If most methods of expert comparative evaluation (for example, pair comparisons and ranging) give the possibility to the expert to set only the fact of advantage of one object above other, MAI allows taking into account the different levels of advantages.

Assumes violation of condition of complete co-ordination of estimations of expert, that in the conditions of implementation of the set limitations, distributes an evaluation scale and specifies the results of estimations.

On the set profile in our example as a result of the questioning of experts, it must be six matrices of pair comparisons are built. One for comparison of the weight of groups of competence, five—for comparison of weight criteria of every group of competences. A typical view of these matrices is driven to Table 2.

**Table 2.**  
Matrix of pair comparisons

Group of criteria of competence	Group of criteria of competence				
	$S_1$	...	$S_q$	...	$S_n$
$S_1$	$a_{11}$	...	$a_{1q}$	...	$a_{1n}$
...	...	...	...	...	...
$S_m$	$a_{m1}$	...	$a_{mq}$	...	$a_{mn}$
...	...	...	...	...	...
$S_n$	$A_{n1}$	...	$A_{nq}$	...	$A_{nn}$

The results of the verbal questioning of experts about the advantages of evaluation objects grow into a numerical presentation on the basis of the classic scale of MAH. She has 5 base levels (recommended a minimum of the number of Miller) and 9 levels at the application of terms of intermediate evaluation (recommended a maximum of number of Miller): 1 does not advantage (criteria are identically important); 3 is a weak advantage (the first criteria has an insignificant advantage as compared to the second); 5 is a substantial advantage (the first criteria is substantially major than second); 7 is a very strong advantage (the first criteria is considerably major than second); 9 is an absolute advantage (the first criteria are absolutely major than second); 2.4.6.8 are intermediate estimations of levels of advantage.

If the criteria of  $m$  prevail above  $q$ , then the cage of column  $m$ , filled by a reverse to his number (by a shot). If the criteria of  $m$  do not prevail above  $q$ , then there is a reverse. If it is considered that criteria of  $m$  and  $q$  are identically important, then the unit belongs in both positions. This matrix must own the property of reverse symmetry:  $a_{mq}=1/a_{qm}$ .

Principles of construction of matrix and rule of her treatment are identical for every matrix. Will illustrate the stated on the basis of construction and processing of data of comparative estimation the expert of meaningfulness of criteria of a group of competence “Professionalism” (Table 3).

**Table 3.**  
Matrix of comparative estimation by the expert of the weight of criteria of the group of competence “Professionalism”

Criteria of group “Professionalism”	2.1	2.2	2.3	2.4	2.5	2.6	2.7	Weight of criteria $\beta_{gm}$
2.1. Owns unique knowledge	1	2	2	2	2	2	1/3	0.1751
2.2. Really manages business, company	1/2	1	2	2	2	2	1/3	0.1462
2.3. Locks on itself the acceptance of important administrative decisions	1/2	1/2	1	2	2	2	1/3	0.1223
2.4. Owns unique skills, technologies	1/2	1/2	1/2	1	1	1	1/3	0.0790
2.5. Able quickly to get along at the put	1/2	1/2	1/2	1	1	1	1/3	0.0790

tasks								
2.6. Able to decide difficult tasks	1/2	1/2	1/2	1	1	1	1/3	0.0790
2.7. Able to make decision in the situation of vagueness	3	3	3	3	3	3	1	0.3194
All	6,5	8	9,5	12	12	12	3	1.0

The further processing of data of matrix consists in the estimation of the weight of criteria on the basis of determination of values of the personal vector of the matrix:

$$a_{gm} = \sqrt[n]{\prod_{q=1}^n a_{mq}} \quad (3)$$

Size is determined on the basis of normalization of values of the personal vector and equals:

$$\beta_{gm} = \frac{a_{gm}}{\sum_{m=1}^n a_{gm}} \quad (4)$$

An analogical method is determining the weight of every group of criteria of competence:

$$a_g = \sqrt[n]{\prod_{q=1}^n a_g} \quad (5)$$

$$\beta_g = \frac{a_g}{\sum_{g=1}^G a_g} \quad (6)$$

The weight of the generalized influence of every criterion of competence on the index of identification of employees is determined as follows:

$$\beta_{gm}^R = \beta_g \times \beta_{gm} \quad (7)$$

At a construction to the model, the next situational terms of realization are taken into account.

Canvassing of experts can be realized in the asynchronous mode (in comfortable for an expert time) and the conditions of the asynchronous questioning as means of the organization of the group meeting with the parallel analysis of PMD of results questioning, to their discussions and realization of iterations of improvement.

Canvassing can be organized both for the exposure of all spectrum of groups and criteria of competence and gradually with the limitation for to the groups of competencies or for to the levels of hierarchy.

For pair comparisons to the expert possibility of the use of two modes of evaluation is given:

1. To apply the chain of comparative evaluation of criteria of the first diagonal of the matrix. This approach allows to bring down a volume to estimate an evaluation and to annul the risk of errors in the coordination of estimations of the expert. Application of corresponding algorithm taking into account transitive dependence of  $a_{mq} \cdot a_{sk} = a_{mk}$  evaluations give the possibility of filling of all matrix, the sign of complete co-ordination of matrix is here kept and guaranteed logic of results:

$$a_{mq} = \beta_m / \beta_q \quad (8)$$

2. To apply the comparative pair-wise evaluation of all criteria of the reverse-symmetric matrix. From one side, this approach has a risk to bring  $\kappa$  over to the impermissible change of co-ordination of estimations of expert but, on the other hand, and to render the large preference of additional compensation of terms of conceptual vagueness - an expert in the change of the estimations can take into account the additional nuances of comparative estimation and conduct them quality clarification. So in an example that is given in Table 3, the questioning of expert passed in the second mode. An expert at questioning identically estimated insignificant advantage of criteria 2.2 (really manages business, company) above criteria 2.3 (locks on itself the acceptance of important administrative decisions) and estimated it  $a_{2.2.2.3} = 2$ . Advantage of criteria 2.1 (owns unique knowledge) above criteria 2.4 (owns unique skills, technologies) he also estimated  $a_{2.1.2.4} = 2$ . Treatment of results of estimation finds a violation of the integrity of full co-ordination of matrix:

$$a_{2.2.2.3} \neq \beta_{2.2} / \beta_{2.3} = \frac{0.1462}{0.1223} = 1,19 \text{ and}$$

$$a_{2.1.2.4} \neq \beta_{2.1} / \beta_{2.4} = \frac{0.1751}{0.079} = 2,216, \text{ that is } a_{2.2.2.3} \neq a_{2.1.2.4}$$



But this “negative” result can work on the improvement of results, namely - clarification of advantages of expert. In the first comparison, the estimation of the advantage of the first criteria is corrected and certainly less than 2, in the second—any more. In a model, a mathematical vehicle is used for diagnostics of cause and effects of the inconsistency of estimations of experts and control of admission of results [21]. Verification confirmed the possible level of “anomaly” of estimations of experts in our example. In the opposite case evaluation results are spoiled, reasons are determined and the new iteration of evaluation is conducted.

### 3.4. Model of the Establishment of Values of Criteria of Competence of Key Employees

A model is built with an aim to give to the expert of the possibility of application of the formalized mathematical vehicle of identification of employee on the basis of determination of index  $v_{igm}$ , that represents the measure of accordance of  $i^{\text{th}}$  respondent to the requirements of the profile of specialist on  $m^{\text{th}}$  criteria of  $g^{\text{th}}$  group of competences. At an evaluation, an expert follows existing in the company of information about respondent, that answers the criteria of competence that is examined, by the personal impressions from the real his job performances, by the results of intuitional analysis his potential possibilities. The last is determined on the basis of unformalized interview, interviewing, intuitional generalization of the impressions—that is, appears the unstructured problem of making the decision of estimation of the employee in the conditions of conceptual vagueness. In these terms the mathematical vehicle of model it is suggested to build on the basis of rules of unclear evaluation with the establishment of the interval of vagueness [22], which is examined as a substantial lever of increase of clearness and authenticity of estimations, and the following provides for:

An expert gets the possibility to define a result, not on the basis of synonymous estimation of accordance of the respondent of competence (for example, answers the requirements of criteria “owns unique knowledge”—or does not answer), but to take into account at an evaluation, at what level (as far as) he answers these requirements, following existent divergences of the personal impressions. It is suggested to apply five levels (minimum value of the number of Miller) of estimation of accordance of the respondent to the certain criteria of competence on the basis of such correlations:

$$v_{igm} = \{ \overline{v_{igm_w}} \mid i \in I; m \in M; g \in G; w = \overline{1, W} \}. \quad (9)$$

Where  $v_{igm_w}$  determines the result of the evaluation of a measure of accordance of  $i^{\text{th}}$  respondent an expert to the requirements of the profile of specialist on  $m^{\text{th}}$  criteria of  $g^{\text{th}}$  group of competences on  $w$ -level of accordances. The results of the evaluation of expert it is suggested to examine as discrete distribution of the casual size of evaluation.

The scale of classification levels of accordance is given in Table 4 (columns 1–4).

**Table 4.**

Examples of estimation by the expert of index  $v_{i_2_2}$ , that represents the measure of accordance of  $i^{\text{th}}$  respondent to the requirements of the profile of specialist on a criteria 1 “Owns unique knowledge” of the group of competences of 2 “Professionalism”

A scale is the classification of values of evaluation				Estimations of expert		The expected is given	
Level of accordance	Quality scale of levels of accordance	Range of values of the numeral scale of levels of accordance		Probability of truth of estimation	Degree of confidence in an estimation	Probability of compensati on of level of evaluation	Base index of accordance
		$V_m^{\min}$	$V_m^{\max}$				
						$\gamma_{igm_w}$	
1	2	3	4	5	7	8	9
W1	Very high	0.9	1	0.9	1	0.392	1

W2	High	0.8	0.9	1	0.9	0.434	0.81
W3	Middle	0.7	0.8	0.4	0.95	0.174	0.75
W4	Subzero	0.6	0.7	0	1	0	0.7
W5	Very subzero	0.5	0.6	0	1	0	0.6

An expert gets the possibility of further specification the estimation (the estimation) within the framework of the set range of evaluation on the basis of the next correlation:

$$v_{i_{gm_w}} = \left\{ \left( v_{g_{m_w}}^{max} ; Y_{i_{gm_w}} \right) \mid i \in I; m \in M; g \in G; w = \overline{1, W} \right\}. \quad (10)$$

Where  $Y_{i_{gm_w}}$  is a degree of confidence of expert in his estimation,  $0.9 \leq Y_{i_{gm_w}} \leq 1$  (see Table 4, column 7):

1 means the complete confidence of an expert, that accordance of  $i^{\text{th}}$  respondent to the requirements to  $m^{\text{th}}$  criteria of  $g^{\text{th}}$  group of competence at the level of  $w$  answers to the maximal value in the range of evaluation, 0.9 is on a verge the set level and answers a minimum value. A base for further calculations value  $v_{i_{gm_w}}$  is determined within the framework of certain intervals (Table 4, column 9):

$$v_{i_{gm_w}} = v_{g_{m_w}}^{max} \times Y_{i_{gm_w}}. \quad (11)$$

Taking into account, that the results of estimation of the expert of size  $v_{i_{gm_w}}$  are examined as discrete distribution of casual size further treatment of evaluation results it is suggested to conduct on the basis of next correlations:

$$v_{i_{gm_w}} = \left\{ \left( \bar{v}_{i_{gm_w}} ; \bar{\vartheta}_{i_{gm_w}} ; \bar{\gamma}_{i_{gm_w}} \right) \mid i \in I; m \in M; g \in G; w = \overline{1, W} \right\}. \quad (12)$$

Where  $\vartheta_{i_{gm_w}}$  is certainly an expert probability of the truth of his estimation of accordance of  $i^{\text{th}}$  respondent  $m^{\text{th}}$  criteria of  $g^{\text{th}}$  group of competence at the level of  $w$  (Table 4, column 5). Certainly, remains probability of  $1 - \vartheta_{i_{gm_w}}$ , that a truth value is outside his estimation. For example, in the truth of the estimation of separate precedents of the very high level of competence he is sure with probability 0.9, and at middle level - 0.4).

$\gamma_{i_{gm_w}}$  is the probability of serving of every level of evaluation that is determined on the basis of correlation:

$$\gamma_{i_{gm_w}} = \frac{\vartheta_{i_{gm_w}}}{\sum_{w=1}^W \vartheta_{i_{gm_w}}}. \quad (13)$$

An index  $v_{i_{gm}}$  is considered as the justified unbiased estimation for general average meaning, that is determined as a mathematical expectation of this value, where a value  $v_{i_{gm_w}}$  is defined as casual, for what probabilities of compensation  $\gamma_{i_{gm_w}}$  are set:

$$v_{i_{gm}} = \sum_{w=1}^W v_{i_{gm_w}} \times \gamma_{i_{gm_w}}. \quad (14)$$

Will give an example application of model at an estimation the expert of index  $v_{i_{2_2}}$ , that represents the measure of accordance of  $i^{\text{th}}$  respondent to the requirements of the profile of specialist on a criteria 1 "owns unique knowledge" of the group of competence 2 "Professionalism" (see Table 4). Will comment on the data of this table. An expert-defined that an employee had answered requirements to the criteria that determine possessing unique knowledge on different levels: there are precedents of confirmation of the very high level of knowledge of the respondent, an expert determines the truth of the estimation (probability of truth)—0.9, feet of confidence of expert in that an employee answers the maximal value of this level—1; there are precedents of the high level of accordance, an expert fully reposes in it to the estimation (probability of truth)—1, degree of confidence of expert in that an employee answers maximal value of this level—0.9; there are precedents of the middle level of accordance, the confidence of expert in it to the estimation (probability of truth)—1, degree of confidence of expert in that an employee answers maximal value of this level—0.95.

Based on the formula (11) the values of the base index  $v_{i_{gm_w}}$  are determined for every level of accordance:  $v_{i_{2_1}} = 1$ ;  $v_{i_{2_2}} = 0.81$ ;  $v_{i_{2_3}} = 0.75$ , on basis (f.13) probability of serving of

evaluation level is determined:  $\gamma_{i2_{11}} = 0.392$ ;  $\gamma_{i2_{12}} = 0.434$ ;  $\gamma_{i2_{13}} = 0.174$ ; based on the formula (14) is set an index  $v_{i_{gm}}$  that represents the measure of accordance of  $i^{\text{th}}$  respondent to the requirements of the profile of specialist on a criteria 1 “owns unique knowledge” of the group of competencies 2 “Professionalism:”

$$v_{i_{2_1}} = 1 \times 0.392 + 0.81 \times 0.434 + 0.75 \times 0.174 = 0.87404.$$

### 3.5. Model of Determination of the Index of Identification of Key Employee

Decision-making about the identification of respondents as key employees is the prerogative of PMD. A model that is examined is built with the aim of the grant of the help of PMD in making the decision on the basis of the formalized tool. He is based on the mathematical vehicle of identification of key employees on the basis of determination of index that represents the measure of accordance of  $i^{\text{th}}$  respondent to the requirements of the profile of specialist and is used as one of the base estimations at a risk of dependence (1) assessment. In a model is used scales of classification of levels of accordance that is certain in Table 4 (columns 1–4). By the formalized sign. conforming to the requirements of key employees are that the value of the index belongs to the level of  $w_1$  or  $w_2$ . A determination in a model taken into account:

- analysis of the measure of accordance of the worker to all complex of requirements to the different groups of competence taking into account their comparative meaningfulness;
- analysis of the measure of possessing a respondent by unique properties from the point of view of the concrete group of competence or separate criteria.

It is suggested to define an index  $V_i$  on the basis of the next correlation:

$$V_i = V_i^C \times \delta_C + V_i^{Max}(g) \times \delta_{max}. \quad (15)$$

Where  $V_i^C V_i^C$  is a complex index of identification that determines accordance of the respondent to all complex of requirements to the different groups of competence;

$\delta_C$  is coefficient that determines the measure of the personal interest of PMD in the complex estimation of respondent  $0 \leq \delta_C \leq 1$ . If  $\delta_C = 1$ , it means that PMD is interested only in the scalene estimation of the respondent in accordance with the requirements of the profile, if, it means that PMD examines at an estimation only the aspects of competence, that have maximal values and prevailing unique possibilities determine him.

$\delta_{max}$  is coefficient that determines the measure of the personal interest of PMD in the estimation of the respondent from the point of view of competencies, that have a maximal value and unique properties determine it,  $0 \leq \delta_{max} \leq 1$ ,  $\delta_{max} = 1 - \delta_C$ .

$V_i^{Max}(g)$ - index of identification that estimates an employee from the point of view of maximal value of his competence for to the set groups.

A complex index is determined on the basis of the application of the method of linear convolution of criteria:

$$V_i^C = \sum_{g=1}^G v_{i_g} \times \beta_g. \quad (16)$$

where  $v_{i_g} v_{i_g}$  is a complex index of identification of  $i^{\text{th}}$  employee for  $g^{\text{th}}$  group of competence;

$\beta_g$  is the weight of  $g^{\text{th}}$  group of competence, see formula (6).

The index of identification  $V_i^{Max}(g)$  is determined on the basis of correlations:

$$V_i^{Max}(g) = \max_g \{v_{i_g}\}, g = \overline{1, G}. \quad (17)$$

In accordance with argumentation that was applied at descriptions of going near the evaluation of index of identification (15), at an estimation  $v_{i_g}$  are taken into account the results of it complex evaluation on  $g^{\text{th}}$  group of competences  $v_{i_g}^c v_{i_g}^c$  and index  $v_{i_g}^{max}(m)$  of maximal value of criteria on the set group of competence:

$$v_{i_g} = v_{i_g}^c \times \varphi_{g_c} + v_{i_g}^{max}(m) \times \varphi_{max_g}. \quad (18)$$

Where  $\varphi_{g_c}$  a coefficient that determines the measure of the personal interest of PMD in the complex estimation of the respondent in  $g^{\text{th}}$  to the group of competencies,  $0 \leq \varphi_{g_c} \leq 1$ . If  $\varphi_{g_c} = 1$ , it means that PMD is interested only in the versatile estimation of properties of workers, if  $\varphi_{g_c} = 0$ , it means that PMD examines at an estimation only the aspects of competence, that have maximal values and determine his prevailing unique possibilities.

$\varphi_{max_g}$  is coefficient that determines the measure of the personal interest of PMD in the estimation of the respondent from the point of view of criteria of competencies, that have a maximal value and determine his unique properties  $0 \leq \varphi_{max_g} \leq 1$ ,  $\varphi_{max_g} = 1 - \varphi_{g_c}$ .

A complex index  $v_{i_g}^c$  is determined:

$$v_{i_g}^c = \sum_{m=1}^M v_{i_{g_m}} \times \beta_{g_m}. \quad (19)$$

Where  $v_{i_{g_m}}$  a value of  $m^{\text{th}}$  criteria of  $g^{\text{th}}$  group of competence of  $i^{\text{th}}$  worker, see formula (14);

$\beta_{g_m}$  is the weight of  $m^{\text{th}}$  criteria of  $g^{\text{th}}$  group of competence, see formula (4).

The index of identification is determined on the basis of correlations:

$$v_{i_g}^{max} = \max_{g_m} \{v_{i_g}^{max}\}, m = \overline{1, M}. \quad (20)$$

Possibility of consideration of results of identification with difference fluctuation of correlations of coefficients  $\delta_c$ ,  $\delta_{max}$ ,  $\varphi_{g_c}$  and  $\varphi_{max_g}$  gives PMD the vehicle of imitation design with the aim of analysis of alternative variants of evaluation of an employee from the point of view of the set aims of authentication.

#### 4. Discussion of Results of Research of Approach of Realization of the Stage of Identification of Key Employee

The got results of the research to testify that approaches, models, and methods that fold only information technology of authentication, create the effective tool of influence on the quality decision of one of the major and actual problems of minimization of risks of dependence on key employees. The universality of the built models allows lightness to apply the got tool in any organization. Taking into account the problem of conceptual vagueness and weak structured of data, that they are characterized, application of the system constrained models is offered that are based on: to the dominant role of expert opinion; principles of maximally possible formalization of processes; the validity of application and expansion of possibilities of mathematical-logical methods of expert evaluation; to the comfort for specialist interactive office hours with a tool.

The got results of experimental calculations to testify that an expert gets comfortable enough interactive tool of transformation of quality estimations in the quantitative expression of their weight. Considerably specify authenticity of estimation of e the expert of comparative meaningfulness of criteria of competence and their groups, that an expert gets the possibility to take into account the different degrees of advantage of levels that are based on the known scale of comparative estimations of the method of analysis of hierarchies. Got results of treatment of estimations of experts after offered by the system of equalizations (3)–(8) testify that determining the weight of criteria of competence and their groups (Table 3) is formalized and does not cause complications during work of the expert.

To the user, the mathematical vehicle of the establishment of values of criteria of competence of key employee that is built on the basis of rules of unclear evaluation with the establishment of the interval of vagueness was offered. He is examined as a substantial lever of increase of clearness and authenticity of results due to that possibility to conduct the evaluation of respondent an expert on the basis of existent divergences of the estimations due to application of five levels of accordance of the respondent to the certain criteria of competence (9) is given (14), gradual specification the estimations taking into account confidence in the exactness of the evaluation (10)–(11) and task probabilities of accordance of properties of respondent to every level (12)–(14).

## 5. Conclusions

The approach of realization of the stage of identification of key employees is investigational on the basis of system linked bases of models of expert evaluation with the use of modern possibilities of the systems of support of making the decision. Models that are examined, grants of the help of PMD built with an aim in making the decision on the basis of the formalized tool. It is based on the mathematical vehicle of identification of key employees on the basis of determination of index  $V_i$  that represents the measure of accordance of  $i^{\text{th}}$  respondent to the requirements of the profile of specialist and is used as one of the base estimations at risk of dependence assessment.

The got results of experimental calculations to testify that realization authentications of key employees, that is completed by determination of index, on the basis of the offered formalized vehicle does not cause inconveniences. He gives the possibility of PMD to be based in the estimations both on the analysis of the measure of accordance of the worker to all complex of requirements to the different groups of competence and to take into account or be based in the estimation only on the measure of possessing a respondent by separate unique properties.

It is necessary to mark, that herein investigational does not pay attention to the grouping of results of questioning of different experts that are the necessary component of information technology and mortgage of a considerable increase of efficiency and authenticity of results. Therefore, the question of selection of the group of experts on the basis of analysis, estimations and to the formalized account of the measure of their competence, creation of mathematical vehicle of the grouping of estimations of experts with control of sufficiency of measure of the logic of their ideas, measure of the dispersion of estimations of separate expert and accordance to the measure of co-ordination of opinions of different experts it is planned the set requirements to work at further researches.

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