EVALUATION OF FACTORS OF RISKS OF INVESTMENT IN THE DEVELOPMENT OF PERSONNEL IN IT SECTOR

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Abstract. *In this paper, we examine key factors that influence the risks of investment in the development of human capital of a firm in the Ukrainian IT sector and estimate their weight in the overall risk. Particularly, we single out the risk of premature voluntary termination of an employee, risk of ineffective training, and the risk of firm's incorrect employee development strategy. Risk of non-investment was also characterized and analyzed. Moreover, to support management of the mentioned kinds of risks, we enumerate the factors that influence them and classify those factors into three main groups: related to the employee, related to the firm, and related to the external environment. Based on this division, we build a model for estimation of the risks of investment in the development of personnel using the Analytic Hierarchy Process (AHP). Using data from Ukrainian IT firms we calculated the weights of each factor for very big, big, medium and small firms. This gives a base for further research in this field and allows for a creation of a practical framework for making decisions regarding the personnel development strategy and specific employees' development plans for the HR departments.*

Key words: *Analytic hierarchy process, AHP, investment, personnel development, risk of investment, risk factor.*

1. Introduction

According to the modern economic theory, human capital became one of the main production factors and the most promising direction of investment, as such investment provides opportunity of obtaining high and long-term economic and social effects. Informational technology (IT) sector is the representative of this new economy which is most dependent on human capital as the main competitive factor. In the last decades, IT sector grew dramatically and nowadays, IT is integrated in almost every part of life, and it is apparent that this tendency will continue in the future. This trend explains the high level of demand for IT specialists globally.

In this paper we aim to concentrate on the micro level and study a firm as a contributor to human capital enrichment. Development of personnel requires investment the results of which are unpredictable due to many internal and external factors. Thus, investment in the human capital of a firm is associated with risks. The necessity to find the balance between potential gain, benefits and risk on the one hand, and to build a complex method for the risk estimation on the other explains the actuality of this research.

There are many scientific works exploring the concept and role of human capital starting from Adam Smith, who in the work “The Wealth of Nations” (1776) formulated the basis of what was later to become the science of human capital and the first classical economist, who included this kind of capital in his definition of capital. Further, such well known economists as Mincer [1], Becker [2], Schultz [3] contributed significantly to study of investment in human capital. Barro [4], Riddell [5], Hanushek [6] explored the economic effect of education. Grishnova [7], Oluwatobi and Ogunrinola[8], Sarra, Benabou and Tabeti [9] studied the role of government in human capital development. And such economists as Dobrynin, Dyatlov and Tsyrenova [10], Christiansen, Joensen and Nielsen [11], Zaklekta-Berestovenko [12], Bhattacharya and Wright [13], Koerselman and Uusitalo [14] examined the ROI of investment in human capital. In addition, there are a lot of studies regarding the development and training of personnel, its positive and negative aspects, its effect on the firm's performance: Collins and Clark [15], Wall and Wood [16], Aguinis and Kraiger [17], Aragón, Jiménez and Valle [18]. Fitz-enz who is considered to be the father of human capital benchmarking and performance assessment with his book “The ROI of human capital” provided a

methodology for measuring the bottom-line effect of employee performance [19].During the last years, Zakharova [20] contributed significantly to the topic of evaluating the factor of risk that occurs if a firm invests in the development of its personnel in her monograph "Management of investment in human capital: methodology, estimation, planning". On the other hand, there are a lot of scientific researches related to risk estimation in general terms, namely in the field of investment risk assessment. So, the fundamentals of investment were described by Sharp [21] and Blank [22]. Vitlinskiy [23], Kaminskiy [24] examined and deeply explored the general risk determination and econometric approaches to its evaluation. Nevertheless, there is still a gap in theory and its application for the determination, classification and estimation of risks of investment in human capital of a firm in general terms and especially related to human capital in the IT sector.

In the current research, we consider that a firm invests in its human capital and assume that a selected strategy will lead to risks. We define risks of investment in the development of personnel of a firm as both objective and subjective category of the firm's activity that constitutes the probability of receiving additional competitive benefits and economic gain, as well as the likelihood of partial or complete loss of invested resources, depending on how effective is the company's management of the factors of uncertainty. We adhere to the positive approach to the phenomenon of risk which emphasizes the opposite side of risk – the potential success of entrepreneurial activity as a result of effective human resource and firm management and favorable external conditions. The sources for the transition from threats to opportunities in this direction comprise the new methods and approaches to management, effective training and development policy, improvement in the corporate culture, deep and considerate market analysis and adequate planning according to it. We assume that exploring the factors of risk, beside their quantitative results, provides a wide range of information about many aspects of internal and external situation.

In the framework of the general economic theory, investment in the development of personnel of a firm is the process of employee's knowledge and skills improvement realized in work adaptation, professional learning, training, work assessment, and career planing.

In particular, analyzing risks of investment in the development of personnel of a firm, we singled out three main categories of factors that influence them: related to an employee, related to a firm, related to external factors.

Moreover, we singled out four main risks of investment in the development of personnel of a firm:

1. Risk of premature voluntary termination – a risk that an employee trained by the enterprise will leave it before the invested resources are recovered.

2. Risk of ineffective training – a risk that personnel of a firm will not reach the target results of training**.** Typically, the reason in this case is insufficient level of learning skills, competencies, and motivation of employees. Although, it also can be caused by poor HR training or external provider performance.

3. Risk of wrong development strategy– a risk that a firm will choose the inappropriate employee development plan, which will have only short-term effect or will not give competitive advantages. We consider two factors that influence this kind of risk: 1) consistency in general firm's strategy and HR policy – development program should comply with a general goal and strategy that the firm has; 2) correspondence of personnel development plan to employees' real needs based on the results of their assessment.

4. Risk of non-investment – a risk that a firm can loose valuable employees, reputation as a employer, quality of produced goods and services if it will not invest in the development of its personnel.

This risk is very actual for IT sector because it operates in the rapid change of technologies and business models, so for the IT sector development of its personnel is essential.

2. The Model

One of the distinctive features of investment in human capital of a firm is that unlike the human capital of a country, for which almost every kind of investment brings general positive effect, the benefits for the enterprise are determined by the relative utility of it in the limited economical spheres, as well as by the possibility of employees' movement in the labor market [7].

The main problem and difficulty of quantitative estimation of risks of investment in the development of personnel of a firm and its forecasting is the human factor. Human behavior is often unpredictable and complex, so it requires specific approaches and methods of assessment.

There are a number of classic methods of estimation of the effectiveness of investment in a personnel on which we emphasized in our previous works, but in this paper we will focus on providing actual model and the results of our research.

In this research, we will consider risks from the perspective of the factors that are the source of those risks: originating from the personnel, from the firm or from the external environment. The basic formula of estimation of risks of investment in human capital of enterprise can be presented as the following:

$$R=Q_1R_1+Q_2R_2+Q_3R_3 \quad (1)$$

where $\boldsymbol{R}$ is the value of the general risk of investment results.

$\boldsymbol{R_1}$ (risk caused by the employee) – the likelihood that employee behavior will lead to negative results of investment or the employee will leave the firm before the resources invested in him/her will be recovered.

$\boldsymbol{R_2}$ (risk caused by the firm) – the likelihood that a firm will not perform optimally in the area of employee development: training programs will not be selected according to real needs of employees and firm strategy; hired employees will not suit perfectly the respective positions and share the firm's values; external training providers and products selected by the HR division will be not reliable and qualitative enough.

$\boldsymbol{R_3}$ (risk caused by external conditions) – the likelihood that economic situation, labor market conditions, and competitor's actions will influence negatively the investment results.

$\boldsymbol{Q_1}$, $\boldsymbol{Q_2}$, $\boldsymbol{Q_3}$ – respective weights of each group of risks calculated as a result of pairwise comparisons.

It should be emphasized that each highlighted factor and sub-factor that can influence the investment results has to be evaluated in the view of possibility to impact negatively, i.e. lead to undesired outcome. Avoiding inconsistency in evaluation of "positive" and "negative" factors is the necessary condition of receiving the correct index. For example, evaluating competencies we will generally assign minimum risk to the employee who has the highest level of competencies and maximum to the one whose competencies are lowest compared to the others.

Risks related to the employee – this is the main group of risks associated with greatest unpredictability. In the previous section, we have described the factors that influence this kind of risk. In this section, we will estimate respective weighs of each factor and focus on possible outcomes related to employee behavior. To evaluate $\boldsymbol{R_1}$, we use the following formula:

$$R_1=W_1X_1+W_2X_2+W_3X_3+W_4X_4 \quad (2)$$

where $\boldsymbol{W_1}$, $\boldsymbol{W_2}$, $\boldsymbol{W_3}$, $\boldsymbol{W_4}$ are the respective weights of each kind of risk calculated as a result of pairwise comparisons.

$\boldsymbol{X_1}$– investment results can be influenced by the motivation of employee.

$\boldsymbol{X_2}$ – investment results can be influenced by the performance of an employee.

$\boldsymbol{X_3}$ – investment results can be influenced by the level of employee's competencies.

$\boldsymbol{X_4}$ – investment results can be influenced by personal reasons of an employee.

To evaluate risks related to the firm we suggest to use the following formula:

$$R_2=S_1Y_1+S_2Y_2+S_3Y_3+S_4Y_4+S_5Y_5+S_6Y_6+S_7Y_7 \quad (3)$$

where

$\boldsymbol{Y_1}$ – factor of staff development plan;

$\boldsymbol{Y_2}$– consistency of strategies;

$\boldsymbol{Y_3}$– salary;

$\boldsymbol{Y_4}$ – corporate culture;

$\boldsymbol{Y_5}$ – interesting work and projects;

$\boldsymbol{Y_6}$ – team;

Y_7 – career opportunities.
$S_1, ..., S_n$– coefficients of weight (importance) of these factors, n=1,7.

Risks related to macroeconomic situation and labor market conditions are defined as external factors in the "firm-employee" relationship. Some of them are the same for the whole sector or economy. In the framework of our research to estimate P_3, we will focus on the following factors:

$R_3 = T_1Z_1 + T_2Z_2 + T_3Z_3 + T_4Z_4 + T_5Z_5 + T_6Z_6$ where
Z_1 – economic and political situation;
Z_2 – labor market situation;
Z_3 – competitors' actions;
Z_4 – training market situation;
Z_5 – political changes;
Z_6 – technological changes.
$T_1, T_2, \ldots, T_n$– coefficients of weight (importance) of these factors, n=1,6.

To build a comprehensive method for estimation the main factors that influence the risks of investment in the development of a personnel, we decided to use the method of Analytic Hierarchy Process (AHP) that initially was created and developed by Saati in 1976 [28]. The Analytic Hierarchy Process is a structured technique for dealing with complex decisions. A hierarchy is a system of ranking and organizing people, things, ideas, etc., where each element of the system except for the top one is subordinate to one or more other elements. Based on mathematics and psychology in 80's, it has been extensively studied and refined since then. In our research, we use the AHP because it helps capture both subjective and objective evaluation measures providing a useful mechanism for checking the consistency of the evaluation measures and alternatives suggested by the team thus reducing bias in decision-making. Moreover, the AHP provides a comprehensive and rational framework for structuring the problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. In the field of strategic human resource management, the AHP analysis helps to determinate and study different factors that influence personnel motivation and performance.

Users of the AHP first decompose their decision problem into a hierarchy of more easily comprehended subproblems each of which can be analyzed independently. It consists of the overall goal, the group of options or alternatives for reaching the goal, and the group of factors or criteria that relate the alternatives to the goal. The criteria can be further broken down into sub-criteria, sub-sub-criteria and so on in as many levels as the problem requires.

Once the hierarchy is built, the experts systematically evaluate its various elements by pairwise comparison. What is applicable to estimation of the importance of the factors that influence the risks of investment in the development of a personnel that in making the comparisons both objective data and judgments of experts may be used. The AHP converts these evaluations to numerical values that can be processed and compared. In the final step of the process, numerical priorities are calculated for each of the decision alternatives. These numbers represent the alternatives' relative ability to achieve the decision goal, so they allow a straightforward consideration of the various courses of action.

The AHP uses the set of formulas and established scales which gives opportunity to receive weights of factors and check consistency of the results.

3.Empirical Results

To gather data for our research, we conducted a survey among the specialists in development of personnel in IT and they played the role of experts for the AHP method. The survey was performed in the form of a questionnaire in which experts had to compare factors of risks of investment in the development of personnel of a firm. The population of the current study is 32 IT firms and distributed as following: 53% firms under 80 employees, 12% firms from 80 to 200 employees, 19% firms from 201 to 800 employees, and 16% firms with more than 800 employees.

In the framework of this research we aim to determinate which kind of factor that influence the risks of investment in the development of a personnel is the most dangerous for the IT sector. To

do this using the AHP method, we constructed the matrices for the factor's pairwise comparison.

As it seen from the Figure 1 the biggest weights in the category of “All” IT firms has the group of factors that relate to the internal factors, to a firm. Although the weights of “Employee” group is also high in all categories of firms ranged by size. The influence of the group of “Employee” factors is high for small firms and relatively small for big and medium. It can be explained by fact that there are many small firms in the sample and on the Ukrainian IT market as well, so the competition among them is high and they significantly depend on the situation in the IT sector.

Figure 2 demonstrates the weights of importance of the risk of investment in the development of a personnel. The weight of the risk of non-investment is high among all firms, especially for medium-sized firms. The risk of premature leaving has a relatively small weights in all size groups.

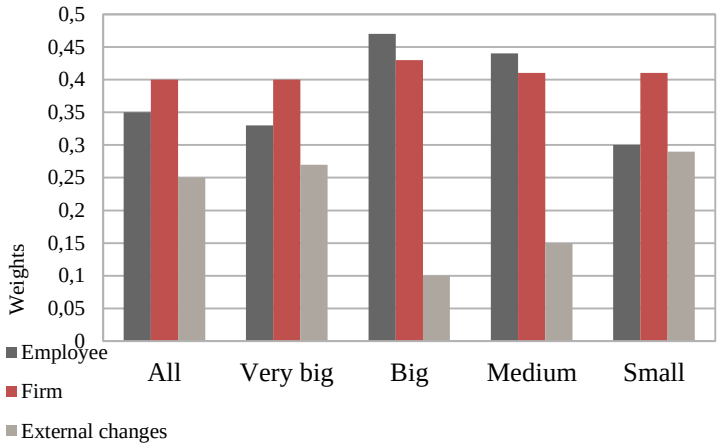

Figure 1. Weights of importance of groups of factors depending on the size of IT firm.

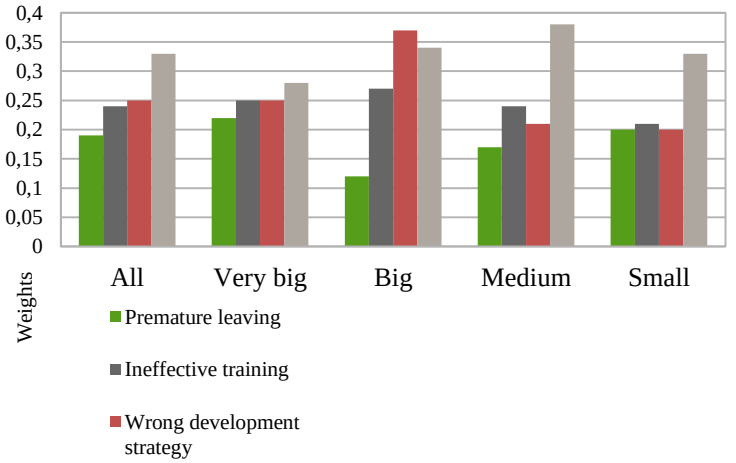

Figure 2.Weights of importance of risks of investment in the development of IT personnel.

It becomes evident that the Figure 2 proves the output of the Figure 1 and points out on the importance of effective management of investment in a personnel, namely in the directions of developing, implementation and support of personnel development strategy and its consistency with

the general firm's strategy and needs. Moreover, according to the results, it worth to put a stress on the quality of training programs as well.

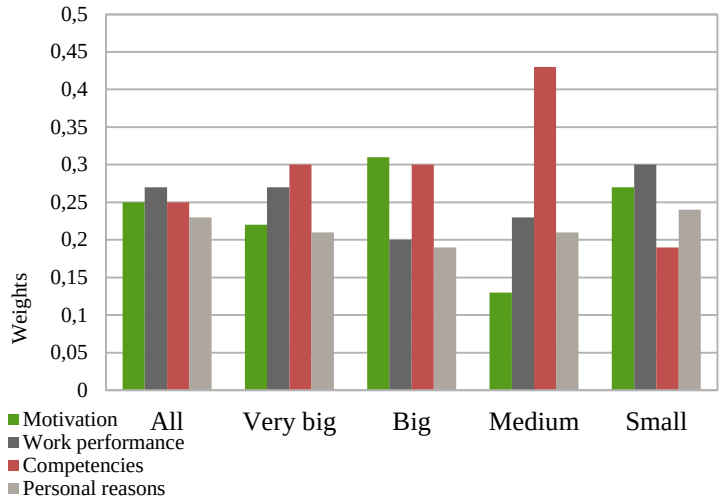

Figure 3. Weights of importance of factors related to an employee depending on the size of IT firm.

Figure 3 illustrates the nearly equal distribution of weights of importance of factors related to an employee. Regarding the group of factors related to a firm it should be emphasized the big weight of the factor of interesting work & projects. IT personnel is the representative of a group of creative profession which require inspiration and the strong interest in what they are doing. In addition, the role of consistency of strategies and team is also high. Ability to perform and communicate with highly professional and motivated personnel creates opportunity to achieve high goal and create quality and unique product and services, raise loyalty of the employees and thus lower the risks of investment in the development of a personnel.

In the framework of factors related to external situation it worth to mention that the factors of IT sector situation, technology development and competitors and have a relatively the same weights for all-sized firms of importance, 0.23. 0.23and 0.21 points respectively. In addition, the high weight of economic and political situation can be explained by the severe crises in Ukraine during 2014-2015.

Table 2

Weights of importance of factors related to an employee depending on the size of IT firm

Factors related to a firm	**Size of a firm**					**Factors related to external situation**	**Size of a firm**				
	All	*Very big*	*Big*	*Medium*	*Small*		*All*	*Very big*	*Big*	*Medium*	*Small*
Personnel development system	0.08	0.06	0.05	0.08	0.09	Economic & Political situation	0.18	0.18	0.09	0.46	0.11
Consistency of strategies	0.17	0.09	0.07	0.18	0.20	World changes	0.08	0.09	0.03	0.10	0.08
Compensation and benefits	0.14	0.26	0.12	0.09	0.13	Competitors	0.21	0.22	0.29	0.20	0.19
Corporate culture	0.10	0.10	0.17	0.08	0.09	IT sector situation	0.23	0.25	0.16	0.08	0.27
Interesting work & projects	0.21	0.21	0.23	0.28	0.19	Training sector situation	0.08	0.11	0.03	0.09	0.08
Team	0.16	0.17	0.20	0.14	0.16	Technology development	0.23	0.16	0.41	0.07	0.28
Career opportunities	0.13	0.11	0.17	0.16	0.13						

4. Conclusions

The presented method allows to take into consideration all main factors that affect the risk of investment in human capital of a company. This gives a base for further research in this field and allows for the creation of a practical framework for making decisions regarding the personnel development strategy and specific employees' development plans for the HR departments.

The results show that IT companies mostly invest in the development of their workers, although several choose the strategy of hiring only already qualified personnel. Moreover, according to the survey, he risk of non-investment has a relatively high level (0.33 points), which underlines the importance of wise and accurate investments in the staff development.

The survey also showed the difference in the results depending the size of a firm.

The main advantage of the presented method is a possibility to conduct a quantitative measurement of risk. It significantly differs the method from other existing theoretical approaches. Furthermore, evaluating factors that influence the risk can assist in deep analysis of firm's performance in human resource function.

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