



METHODOLOGY FOR MEASURING THE QUALITY OF HUMAN CAPITAL IN THE CHEMICAL INDUSTRY USING THE EXAMPLE OF ENTERPRISE JSC KAZNITROGEN

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ABSTRACT

This article proposes a methodology of measuring the quality of human capital in the chemical industry using the example of JSCKazNitrogen. This methodology will help to assess the quality of the human enterprise in the enterprise. It is an assessment of human capital by means of a methodic of weighted average block factors affecting the formation of human capital in an enterprise. This methodic can be useful in identifying weaknesses in the formation of human capital in the enterprise and eliminating these weak sides. It can also be used not only in the chemical industry, but also in any industry.

KEY WORDS: *human capital, R & D, qualification, secondary vocational education.*

Introduction

The problem shown in the article covers issues related to the methodology of measuring the quality of human capital in an enterprise in the chemical industry. There are many methods, but the problem is that it is necessary to find the optimal method that can help to determine the quality of human capital and identify weaknesses in this enterprise.

Literary review

The origin of human capital dates from the late 18th century, when the British economist and philosopher A.Smit published his work "The Wealth of Nations." In his publication A. Smit suggested that people are productive capital, which is invested in economic growth and development of the country [1].

However, the theory of human capital was not as widely 19 until the end of the 19th century. In 1891, the English economist I. Fischer received his PhD degree from Yale University and was the first economist to distinguish between real and nominal interest rates.

I.Fisher has developed a theory of capital, investment, and interest rates that relate as people and organizations that invest different types of capital that are based on expected return rates. His theory, which is widely applied today, considers human capital as an investment in future earnings [2].

In 1960, economists at the University of Chicago began analyzing how human capital could be improved. 2 prominent economists and Nobel Prize winners M. Fridman and T. Schulz were largely responsible for the revival of human capital theory. T. Shulz and M. Fridman tried to define the relationship between human capital and the country 's economic growth. T. Schulz 's main theoretical discovery was to expand the meaning of investments that improve an employee 's skills and



productivity. Schultz believed that human capital includes direct expenses, such as lost income and loss of free time in obtaining human capital itself [3].

There are many definitions of human capital in the economic environment. Let's consider the most known.

Thus, Andrea Keller Pfunder, Professor of the Institute of Business Economics Studies at the University of Zurich, defined human capital as the existence of basic production capabilities in humans [4].

The Soviet economist M.M. Kritsky believed that human capital is a form of the economy of human activity and the result that society receives from the historical society to the modern state [5, p. 32].

Methods of measuring the quality of human capital are large. The human capital is understood as set of physical, mental, enterprise capacities of the person, his knowledge, ability, the skills, professionalism, and experience used in production of goods and services and providing income in the future [4]. This formulation of the notion of human capital covers most aspects of human opportunity, the use of which can generate income and contribute to the formation of human capital. The method of assessing human capital will allow determining more real patterns of formation of human capital in the enterprise. Enterprises should be interested in developing the abilities of the employee, as this can generate large revenues in the future.

A very unique contribution to the formation of the theory of human capital was made by Y.Korchagyn. He believed that the human capital is the deep culture of the people, traditions, mentality, culture of the main mass of the population [6].

He also refers to human capital as its quality, education, vocational and entrepreneurial level, management, health of the population, degree of freedom, movement of labor.

That is, according to Y. Korchagin, human capital is all that is connected in the economy directly with human opportunities, which allow showing the abilities both creative, entrepreneurial and managerial [6, p. 31].

The functional designation of human capital was given by scientist Dyatlov S.A. This approach requires taking into account the specific application. That is, thanks to this principle, it is possible to characterize this phenomenon not only in terms of its internal structure, but also in terms of its functional purpose, taking into account its intended using [7].

Dyatlov S.A. believed that human capital is not just a collection of skills, knowledge, abilities that man possesses. So [7, page 34]:

- First, it is about the saved-up stock of skills, abilities, knowledge which is possessed by the person.
- Secondly, it is a stock of skills, knowledge, which is useful for a person.
- Third, the result of such expedient use is an increase in the employee's income.
- Fourthly, the growth of income encourages the interest of a person to increase the stock of skills, knowledge and motivations in order to use it again effectively in the future.

Russian scientist Kapelyushnikov I.V. gives such a definition of human capital - it is a kind of a certain stock of knowledge, human abilities and motivations of a certain person. On the one hand it requires certain investments, and on the other it is future sources of human earnings [8].

The academician NAN RK, Dr. Econ. Sci., professor K.A. Sagadiyev defines the human capital as «set of knowledge, skills, abilities and abilities, embodied in people and allowing them to create personal, social and public welfare»[9].

As for the micro-level of the enterprise itself: we believe that all the above-mentioned designations of human capital also fit our topic. But we give our own interpretation of the formation of human capital in the chemical and petrochemical industry - it is a set of individual, social, physical, professional capabilities of an employee with knowledge in chemistry, petrochemicals, the application of which ensures high efficiency of the industry.

There are many different methods and approaches to assessing human capital in the economic literature. In determining the value of human capital, both natural (temporal) and cost methods of measuring human capital are used. Temporal methods suggest that the estimation of human capital in man-years of learning: the higher the level of education, the larger the amount of human capital an individual possesses.

Among the cost methods, approaches such as earnings capitalization (W. Petty, W. Farr), production price (E. Engel), combined method (T. Witstein) are best known. T. Witstein also proposed to estimate the cost of a person based on production costs and income [10].

That methods that are built around the idea of production costs assume that the value of the cumulative costs is measured on the basis of the cumulative costs that are associated with its formation less depreciation [11].

This approach was first adopted in 1883. E. Engel, so he tried to estimate the cost of having and raising children for their parents (Engel 1883). So it was determined by him as a total cost of maintenance of children.

According to Engel, the formation of workers as adult individuals is completed by the age of 26 in men and by women by the age of 20.

He believed that for parents belonging to different social strata, the cost of giving birth to a child would vary: if for the lower class it was estimated at 100, for the middle class at 200, and for those representing the upper class at 300 marks.

So another assumption from which he was based was that as the child's age increased, the cost of his maintenance increased annually in arithmetic progression with a step of 10% of the cost of birth. So hence the generalized formula:

$$C(x) = coi + coi \cdot [x + 0,5 \cdot k \cdot x(x+1)] \quad (1)$$

Where $C_i(x)$ is the social cost of keeping a child up to the age of x by parents belonging to the first social class; coi - expenses of its birth; $coi \cdot k$ - pitch progression at $k = 0.1$ [11].

2) Another cost-based representative of the approach was Theodore Witstein [11].

He viewed people as core funds, and he used approaches to the valuation of human capital that W. Farr and E. Engel developed (the price of production).

Thus, T. Witstein's interest in the concept of human capital formation was formed under the influence of the consumer sphere of life insurance and the need to develop reference tables, which are used to calculate the values of claims for compensation for loss of life [11].

He believed that the amount of earnings of an individual's life was equal to the costs of maintaining it plus the costs of education.

This approach produces human assessments that will inevitably be 0 at the time of birth.

He brought out the following formulas:

$$C^1_{n=aRo} = \frac{Lo \cdot rn}{Ln} - aRn \quad (2)$$

$$C^2_{m=XRn} = \frac{LN}{Ln} \times P^{N-n} - aRn \quad (3)$$

Where a are annual consumption costs, which include education per adult of a certain profession;

$R = (1 + i)$, where i - market interest rate;

$P=1/r$; L_n is the number of people of age n in the life table;
The R_n value of a person of age n that he receives at the time of birth (for a given r);
 X - the amount of future income per person of a certain profession;
 N - the age at which a person enters into work.

The following formulas are derived from Witstein:

$$V_0 = \sum_{x=0}^{\infty} V^x \cdot P_x (Y_x \cdot E_x - C_x) \quad (4)$$

Where is the V_0 value of a person at the time of birth;

$$V^x = \frac{1}{(1+i)^x} \quad (5)$$

The value at the moment of one dollar to be received in x years;
 P_x -probability that a person will survive to age x ;
 U_x -annual human earnings from the moment x to $x+1$;
 E_x -share of people employed in the workplace between the ages of x and $x+1$.
 C_x - value of costs in production at age x to $x+1$.

To determine the monetary value of a person at a certain age (for example, age a), the formula will be:

$$V_a = \frac{P_0}{P} \sum_{x=0}^{\infty} \frac{P_0}{P} \cdot V^{x-a} P_x (Y_x \cdot E_x - C_x) \quad (6)$$

This method of capitalizing the income of the human population less consumption costs gives an estimate for many people.

Scientists L. Dublin and A. Lotka offered their own monetary valuation of human capital. One of the founders of the theory of human capital G. Becker proposed to estimate human capital taking into account the difference between the total income and the part of income that can be obtained as a result of work activity taking into account the age at which the active work activity of the individual has been ended[10].

Thus, for example, the economic value of a person for his family is calculated, which was a goal for Dublin and Lotka.

Thus, the cost of producing (raising) a person of age a - S_a for Dublin is equal to [11]:

$$C_a = \frac{1}{P^a} \left[\sum_{x=0}^{a-1} V^{x-a} P_x (C_x - Y_x E_x) \right] \quad (7)$$

This formula can be simplified to the following form:

$$C_a = V_a - \frac{1}{P^a \cdot V^a} \cdot V_0 \quad (8)$$

Therefore, the cost of producing a person before age $a =$ is equal to the difference between their value at age a and the value at their birth multiplied by

$$Ca = \frac{(1+i)^a}{Pa} \quad (9)$$

At the moment, this method has a number of disadvantages:

With this approach, the value of capital is actually measured according to its production costs. Value is determined entirely on the supply side without any involvement of demand factors.

Scientist M. Friedman understood under human capital a certain fund, which provides the employee with permanent (continuous) income [10, p.119]. The latter refers to the weighted average of expected cash flows in the future. M. Friedman also claims that permanent income acts as total income from five types of property: money, bonds, shares, non-expendable items and human capital. All the above models make it possible to estimate the human capital of only one employee. However, total human capital can only be estimated on the condition that we are able to determine the indicator of each employee.

L.Turow paid great attention to the analysis of human capital production [10, p.119]. He believed that every individual had their own special opportunities to produce their intellectual capital. So Turow believed that the processes of human capital production were different for individual workers. He recognized that the productivity of human capital already available could depend very much on the economic capacity of the individual. They used the Cobb-Douglas production function to model human capital. J. Ben-Poret believed that the stock of human capital "produces services in standard units and is thus identical to machines in the structure of real capital" [10, p.119]. In his model, the amount of human capital produced depends on the factor of the ability to increase human capital, part of the available stock of human capital.

We hypothesize that the amount of human capital produced by an employee may increase from the amount invested in R & D in an enterprise. Also, the ratio of the ability to increase human capital in the enterprise may increase from the level of qualification of the employees themselves and the level of advanced training of retraining of the employees. But also the quality of human capital also depends on the number of personnel with higher education, secondary vocational education.

On the basis of this, we have developed a methodology for measuring the quality of human capital.

The following factors can be used to build a human quality assessment model for your enterprise [12]:

- X1-Share of internal R & D expenditure,%
- X2-Proportion of staff advanced,%
- X3-Proportion of personnel with higher education,%
- X4-Proportion of staff with secondary vocational education.

Step.1. Since. Key figures have different units of measure (percentages, fractions, quantities in pieces, and other ones need to be normalized. The most commonly used linear conversion on a ten-point scale is applicable:

$$y(x) = 10 [x-x(min)] / [x(max)-x(min)] \quad (10)$$

Where x is the value of the indicator, y is the normalized value for x .



Assuming that an increase in x describes both an increase in the expression of quality A and a decrease in degree B, the normalized measure of quality B can be simply the difference $Y = 1 - y$.

Now it is necessary to correctly determine the minimum and maximum for indicators. For x1-minimum will be = 0, the maximum should be taken from the value of the average value of this factor in developed countries, for example 2.5%. (For example, in the United States = 2.74%, in South Korea-4.24%, in China-2.12%).

For x2, the minimum value is 0 and the maximum value is 20% (this takes into account the requirement that advanced training take place at least 1 times every 5 years).

For x3-minimum value = 0, and for maximum average value of this indicator in developed countries = 60%. It should be noted that these data correspond to innovative enterprises of developed countries, which should include chemical and petrochemical industries of Kazakhstan.

We will calculate the quality model of human capital formation for JSCKazNitrogen.
 Step 1- Use the following data to build a model

Table 1- Model Data

	Share of internal R & D costs, %	Proportion of staff trained, %	Proportion of personnel with higher education, %	Proportion of staff with secondary vocational education, %
	y1	y2	y3	y4
KazNitrogen	4	9,5	8,50	7,33
min	0	0	0	0
max	2,5	20	40	60

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Step 2. Estimate the weight of each indicator or block. Let's estimate the weight of indicators. For example, let their preferences be the same as they are located in the table, i.e.

$$X1 > X2 > X3 > X4 >$$

We build a matrix of paired comparisons to estimate the weight of the indicators.

Table 2- Matrix of paired comparisons for evaluation of weight of indicators

Factors	x1	x2	x3	x4	Sum	Weight	Weight of factor
x1	1	1	1	1	4	0,4000	v1
x2		1	1	1	3	0,3000	v2
x3			1	1	2	0,2000	v3
x4				1	1	0,1000	v4

Step 3. Calculation of personnel quality evaluation at KazNitrogen enterprise

$$RI = Y1 * v1 + Y2 * v2 + \dots + Y4 * v4 = 4 * 0,4 + 9,5 * 0,3 + 8,5 * 0,2 + 7,33 * 0,1 = 6,88 \quad (11)$$



Conclusion

Thus, the assessment of personnel quality at KaNitrogen enterprise according to the ten-point estimate is only 6.88. The weakest point of this enterprise is R & D, as well as qualification of the middle professional level. It should be noted that the construction of quality assessment in the enterprise is complex and comparative. Thus, it can be said that in this enterprise it is necessary to increase the costs in R & D and increase the number of average professional workers. Thus, the methodology of measuring the quality of human capital in the enterprise JSCKazNitrogen revealed insufficient financing of R & D and a small number of average professional workers and thus showed that these factors are the most vulnerable to the construction of quality human capital in the enterprise.

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