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BUILDING A MATRIX OF POSITIONING IT-PROFESSIONALS

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Abstract

Introduction. Nowadays, information technology is the key area in the labor market in Ukraine. The development of information technology is gaining more and more momentum and holds a leading position. The IT sphere is dynamically integrated into all sectors of the world economy, and thus affects the overall growth of economic and social indicators of enterprises and organizations. The importance of IT professionals leads to a steady increase in the demand for their work.

Purpose. The article is aimed at researching the tendencies of the Ukrainian IT labor market, analyzing the tendencies of the professions observed in the IT market in Ukraine, identifying the main characteristics of the work of IT specialists, and also the features of positioning IT specialists in the specialty.

Results. To achieve the goals and objectives in the article, the idea of the method of factor analysis is used to determine the factors that influence the observed variables. A dot chart was created which gives an opportunity to see scattering of points in two indicators - wages and hh.index, and shows the connection of wages with competition to the position and trends of professions. Professional groups have been selected and their main characteristics are considered taking into account the position on the IT market.

Conclusions. Achievement of the main goal is possible only in a state of stable economic development. During the research, the stable state of development and demand of IT specialists in the labor market has been proved. A factor analysis was conducted and a dot chart of positioning of IT specialists in the specialty was constructed. Distinguished professional groups in the IT field. Further research requires the regulation of the work of IT professionals, and the development and successful performance of IT companies directly depends on the qualifications of IT specialists, their ability and desire to work productively.

Keywords: factor analysis, IT-market, positioning of IT specialists, professional groups, hh-index.

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ПОБУДОВА МАТРИЦІ ПОЗИЦІОНУВАННЯ ІТ-СПЕЦІАЛІСТІВ

Анотація

Вступ. На сьогодні ключовою областю на ринку праці в Україні являються інформаційні технології. Розвиток інформаційних технологій набирає усе більших обертів та займає провідні позиції. ІТ-сфера динамічно інтегрується у всі галузі світової економіки, і

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тим самим впливає на загальне зростання економічних та соціальних показників підприємств і організацій. Важливість ІТ-спеціалістів, призводить до стійкого зростання попиту на їх працю.

Метою статті є дослідження тенденцій українського ІТ-ринку праці, аналіз тенденції професій, які спостерігаються на ринку ІТ в Україні, виявлення основних характеристик праці ІТ-фахівців, а також особливостей позиціонування ІТ-спеціалістів за фахом.

Результати. Для досягнення цілей та завдань у статті використано ідею методу факторного аналізу для встановлення факторів, що впливають на спостережувані зміни. Побудовано точкову діаграму, яка дає можливість побачити розсіювання точок за двома показниками – заробітною платою та *h_h* індексом, та показує зв'язок заробітної плати з конкуренцією на посаду та тенденції професій. Виділено фахові групи та розглянуто їх основні характеристики з урахуванням позиції на ІТ-ринку.

Висновки. Досягнення основної мети можливе лише в стані стабільного розвитку економіки. У процесі дослідження доведено стабільний стан розвитку та затребуваність ІТ-фахівців на ринку праці. Проведено факторний аналіз та побудовано точкову діаграму позиціонування ІТ-спеціалістів за фахом. Виділено фахові групи в ІТ-сфері. Подальші дослідження потребують регламентації праці ІТ-фахівців, а розвиток та успішна діяльність ІТ-компаній безпосередньо залежать від кваліфікації ІТ-спеціалістів, їх уміння і бажання продуктивно працювати.

Ключові слова: факторний аналіз, ІТ-ринок, позиціонування ІТ-спеціалістів, фахові групи, *h_h* індекс.

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Introduction

For today, the development of information technology is becoming more popular and holds leading positions. The IT sphere is dynamically integrated into all sectors of the world economy, and thus affects on the overall growth of economic and social indicators of enterprises and organizations. Understanding the importance of IT professionals leads to a steady demand for their work.

Today, about three thousand new vacancies are published by Ukrainian IT companies on a monthly basis. According to the results of the poll DOU.ua, the salary of the programmer at the entry level is more than the average salary in Ukraine, so software development is perhaps the most attractive area of activity [1].

Information technology is a key area in the labor market in Ukraine. Programmers, developers, system administrators today are the most sought after specialists. In some specialties, up to 5 open vacancies can fit into one specialist [2].

Many scientists contributed significantly to the development of theoretical and applied problems of innovative development of countries and IT spheres: J. Sachs, M. Porter, M. Porata, A. Maslov, S. Pyrig, D. Bogunya, O. Grishnova and others. However, in our opinion, systematic studies concerning the positioning of IT specialists in the specialty and characteristics of the work of IT specialists in Ukraine are not enough.

Formulating the goals of the article

The main objectives of the article are to study the trends of the Ukrainian IT market, to identify the main characteristics of the work of IT specialists, as well as the positioning of IT specialist in the specialty, to allocate professionals' groups in the IT area based on the developed positioning matrix.

Presentation of the main research material

Management of the formation and use of information technology and innovation work is associated with the establishment and description of internal regularities on the enterprise. Today, the domestic information technology market is in the stage of active growth. The computerization market of enterprises is expanding, the network of Internet access is expanding, the tangible increase in the export of Ukrainian software products and technological services has been fixed [3].

In our work, the idea of the method of factor analysis is used to determine the factors influencing on the observed variables. Factor analysis is aimed at "compressing" the information of many indicators that are being investigated into a small number of significant variables. In this way, the problem of finding objective regularities can be solved. If we can briefly describe a large array of numbers, then we can assume that in this case some internal objective regularity has been revealed, which conditioned the possibility of such an integral description. The advantage of factor analysis, in comparison with other methods of analysis, is the effectiveness of its application with a large number of variables, the absence of a requirement for the distribution of variables on dependent and independent. This is especially important when the causes of the phenomenon are not clear [4].

Factor analysis is used to identify the interconnection between variables, the main component method (MCM) is also used in case of need to reduce the dimension of the data. Main components method refers to the methods of multivariate statistical analysis. Although this method was proposed by Pearson at the beginning of the twentieth century, a lot of the modern publications of domestic and foreign scientists are devoted to his research [5].

We will try to evaluate the main components that will serve as the defining characteristics of the work of IT professionals (X1 - wages, X2 - the number of vacancies, X3 - the number of CVs, X4 - experience).

The method of the main components will allow us:

- to reduce the number of initial data, carry out reduction of data;
- to identify the structure of relationships between the features, give their quantitative assessment and economic interpretation;
- to assign the ranks to the objects under study and classify them by the size of the detected latent indicators.

For the study will be used the following data (table 1).

Mathematical processing of data in the application of the method of the main components was carried out using software, namely in the system STATISTICA.

To determine the optimal number of factors, it is expedient to use a stony oscillation graph. According to this method, it is necessary to find such place on the chart, where the decrease in the values of factors is sharply slowing down.

It is assumed that to the right of this point (this is the second or third point) there is only a "factorial oscillation", that is, those indicators that have no determinative influence on the investigated process.

To justify the optimal number of factors, the percentage of the explained dispersion is used, that is, the cumulative percentage of dispersion by the number of factors should be greater than or equal to 75%. In this case, it would be logical to select two factors (according to calculations, the cumulative percentage of dispersion is 78.74%) (table 2).

In the column "Own values", the dispersion of each factor is given, in the column "Share of total dispersion" is the percentage of the total dispersion for each factor. In this case, the first factor explains about 42% dispersion, and the second - 37%. The "Cumulative Value" column contains accumulated or cumulative dispersion of the selected factors, the column "Cumulative dispersion" is the accumulated percentage of the total dispersion.

The matrix of factor loads is shown in fig. 1 and in table 3.

Table 1. Initial data for the MCM (summarized by the author according to the site dou.ua [6])

Indicators	Wages, dollars	Number of vacancies, %	Number of CVs, %	Experience, years
	X ₁	X ₂	X ₃	X ₄
Director of Information Technology	4700	2,0	5,0	15,0
Head of the development department	4400	4,0	4,0	10,0
System architect	4300	9,0	9,0	7,0
Head of IT department	4500	3,0	5,0	8,0
Head of software implementation department	3400	3,0	4,0	7,0
SAP Implementation Consultant	2300	3,0	2,0	7,0
Head of Testing Department	2100	3,0	3,0	5,0
Leading Java Programmer	2950	6,0	4,0	4,0
Leading Oracle Programmer	2800	3,0	3,0	4,0
Leading programmer 1C	2730	5,0	1,0	4,0
Leading PHP programmer	2740	3,0	3,0	4,0
Programmer C #	2500	3,0	1,0	4,0
Leading C ++ programmer	2450	3,0	1,0	4,0
Programmer Java	2500	5,0	5,0	3,0
Programmer Oracle	2400	3,0	3,0	3,0
Programmer C ++	2000	5,0	4,0	3,0
Android Developer	2550	5,0	4,0	3,0
Web developer	2500	12,0	8,0	5,0
Information Security Specialist	1500	1,0	4,0	10,0
Windows system administrator	650	8,0	9,0	8,0
Technical support specialist	550	5,0	5,0	4,0
Software tester	570	5,0	12,0	2,0
Others	1000	1,0	1,0	2,0

Table 2. Own values of factors

Factors	Own values	The share of total dispersion, %	Cumulative actual value	Cumulative dispersion, %
Factor 1	1,665752	41,64380	1,665752	41,64380
Factor 2	1,483889	37,09722	3,149641	78,74103

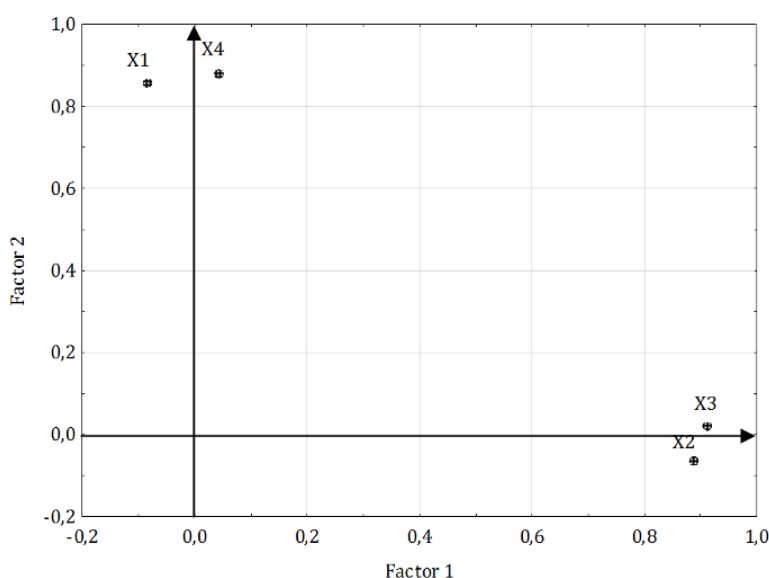


Fig. 1. Graph of the matrix of factor loads

The following indicators are important for analysis:
the accumulated percentage of the dispersion of both factors (78,74%), which determines how fully it was possible to describe an array of data with the help of the selected fac-

tors. The higher this indicator, the greater part of the data array managed to factorize;

the percentage of total dispersion for each factor, indicating the significance of this factor. The greater the percentage load of the dispersion explains the factor, so it is more significant and the more variables it includes in itself. In our case, the first factor explains 41,6% of the dispersion, and the second – 37,1%. Together, they describe 78,74% of the dispersion, that is, the significant part of the data array. Factorization in this case can be considered complete.

Table 3. Matrix of factor loads

Features	Factor 1	Factor 2
X1	-0,083730	0,858720
X2	0,889060	-0,063697
X3	0,912387	0,021755
X4	0,042861	0,880900
Own numbers λ_j	1,631725	1,517916
Weight of factors, %	0,407931	0,379479

Consequently, factor 1 with a load of 42% includes indicators such as: the number of vacancies and the number of CVs for a particular post.

The combination of these components into a single indicator becomes possible due to the use of the so-called hh.index, which shows the ratio of the number of active resumes (CVs) to the number of vacancies (or the number of resume for the vacancy). The hh.index was developed by the company of Internet recruitment HeadHuntehh.ua.

The higher the hh.index, the more discrepancies between the number of resumes and vacancies, the greater the competition in the IT market. If the index is one, then the number of vacancies is equal to the number of CVs.

The second factor, with a load of 37%, includes wages and experience, that is, traditional labor indicators that affect on welfare and quality of life. Taking into account the economic nature of these indicators, the second factor can be interpreted as a motivational or salary component.

Using of data resulting from the calculations allows us to solve a very important task of positioning IT specialists by specialty using a matrix.

To construct a matrix, it is expedient to use the so-called dot chart (or scatter diagram), which is a graphical representation of the set of data representing the connection between two different variables.

Dot chart depicts the relationship between numerical values in several rows and represents the series of points in the coordinates of the XY.

Mathematical processing of data in the process of constructing the matrix was conducted using software in the system EXCEL.

To construct a dot chart, first of all, a collection is made in the form of a table. Output data for constructing a dot chart is given in the table 4.

Each row in the data table is represented by a marker whose position depends on the values in the columns given on the X and Y axes. A dot chart is convenient to demonstrate the connection between data in different rows. They can be shown in the form of one sequence of points [5].

The chart (diagram) is constructed in the following order: on the horizontal axis, indicators of measuring the values of one variable are plotted, and in the vertical one another variable (fig. 3).

The dot chart has two data axes: the abscissa axis (X) - the wage and the ordinate axis (Y) - hh.index. These values are combined into single points and displayed in irregular intervals, or clusters.

Construction of a dot chart gives an opportunity to see scattering of points in two indices - wages and hh.index.

Table 4. Initial data for constructing a dot chart

Indicators	Wages, dollars	hh.индекс	Symbolic designation
Director of Information Technology	4700	3,00	A
Head of the development department	4400	1,90	B
System architect	4300	1,00	C
Head of IT department	4500	2,67	D
Head of software implementation department	3400	1,33	E
SAP Implementation Consultant	2300	0,67	F
Head of Testing Department	2100	1,00	G
Leading Java Programmer	2950	0,67	H
Leading Oracle Programmer	2800	1,00	I
Leading programmer 1C	2730	1,40	J
Leading PHP programmer	2740	1,25	K
Programmer C #	2500	0,33	L
Leading C ++ programmer	2450	1,40	M
Programmer Java	2500	1,00	N
Programmer Oracle	2400	1,00	O
Programmer C ++	2000	0,80	P
Android Developer	2550	0,80	Q
Web developer	2500	0,67	R
Information Security Specialist	1500	4,00	S
Windows system administrator	650	3,30	T
Technical support specialist	550	1,00	U
Software tester	570	2,40	V
Others	1000	1,00	W
General Director of Agency	5500	4,00	X
Median	2700		
Average		1,47	

Each of the marker points means a special IT specialist. The calculation and application of the median (X axis) and the average value (Y axis) allows more accurately to delimit the data obtained and use the diagram as a matrix for positioning IT specialists in their specialty. The chart shows the concentration of individual groups of markers or clusters.

Consider the resulting groupings in more detail.

We have four quadrants of the matrix that differ in the level of wages (low and high) and the level of the hh.index (or competition for the position) (low or high). The positions of specialists are improved as they move on the matrix from the left side to the right (increase in wages) and from top to bottom (reducing competition for the position).

The first quadrant of the matrix ("prestigious") is characterized by high wages, which is associated with high hh.index, that is, competition for the position. It included high management positions and senior management positions:

- Director of Information Technology (A);
- Head of the development department (B);
- Head of IT department (D);
- General Director of Agency (X).

However, it should be noted that there is a shortage of senior managerial staff associated with the rapid growth of companies and the emergence of a large number of relevant vacancies. Such positions require leadership and communication skills, perseverance and knowledge of a foreign language.

The second quadrant of the matrix ("attractive") is characterized by high wages and, at the same time, low hh.index, which is due to the shortage of individual specialties. It has the following positions which requiring high qualifications, special knowledge and certain experience:

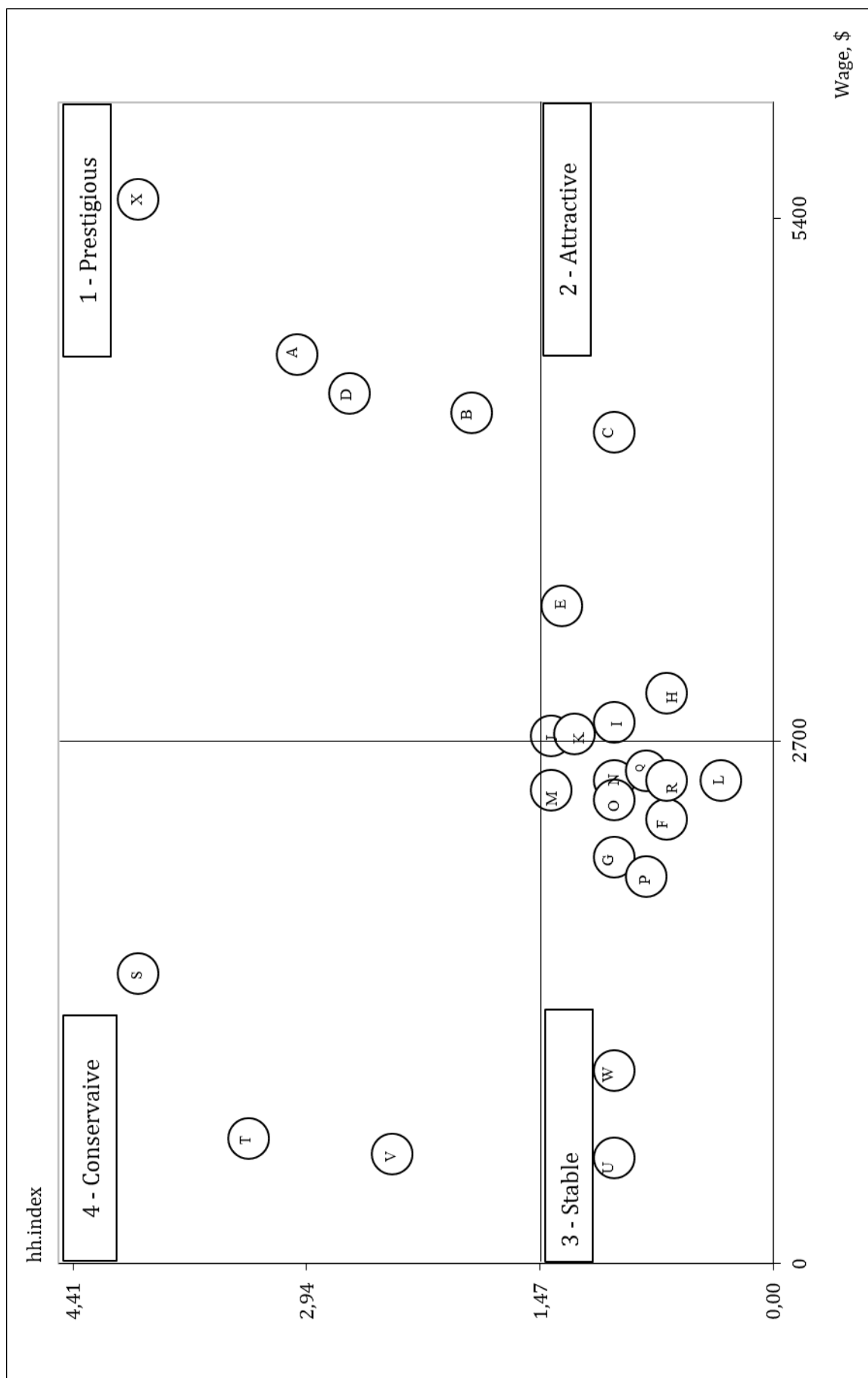


Fig. 3. Dot chart "Matrix of positioning IT-professionals in the specialty"
**Developed by the author*

System architect (C);
Head of software implementation department (E);
Leading Oracle Programmer (I);
Leading programmer 1C (J);
Leading PHP programmer (K);
Leading Java Programmer (H).

It can be argued that the wages of highly skilled leading programmers in Ukraine are gradually catching up with the Western (adjusted for the cost of living), and their level of income is significantly higher than that of engineers in other sectors of the Ukrainian economy.

The third quadrant of the matrix ("stable") is characterized by a relatively low or average wage for the industry and, accordingly, a low hh.index. That is, at relatively low competition, wages for these jobs are lower than the average due to the limited availability of "narrow" programmers working with only one programming language and their widespread distribution. This quadrant include the following positions:

Programmer C # (L);
Leading C ++ programmer (M);
Programmer Java (N);
Programmer Oracle (O);
Programmer C ++ (P);
Android Developer (Q);
Web developer (R);
Technical support specialist (U).

However, the position of most of them is quite attractive, because it is next to the average value.

The fourth quadrant of the matrix ("conservative") is characterized by a relatively low salary for the industry and, at the same time, a high hh index, due to the presence of a large number of those who wish to occupy these positions in a various reasons. This quadrant include:

Information Security Specialist (S);
Windows system administrator (T);
Software tester (V).

Thus, according to the developed positioning matrix, the following specialist groups can be identified in the IT sphere:

senior executives and top managers ("prestigious" quadrant, characterized by high levels of competition and highest wages);

leading specialists and high-level specialists (leading programmers) ("attractive" quadrant, characterized by low level of competition and high wages);

High-skilled professionals (programmers and developers) ("stable" quadrant, characterized by low levels of competition and relatively low and average wages);

other specialists ("conservative" quadrant, characterized by high level of competition at relatively low wages).

Conclusions and perspectives of the further research

In the course of the study, a stable state and demand of IT specialists in the marketplace has been proved. Further research requires the regulation of the labour of IT professionals.

The development of the IT sphere and the success of IT companies depend on the skills of IT specialists, their ability and desire to work productively, so the issue of regulation of work in the IT sphere should be one of the main positions in the IT development strategy of Ukraine (reduction of disproportion in demand and supply of highly skilled specialists, stop their possible outflow abroad, etc.).

Using of factor analysis, namely the method of the main components, has allowed to identify the interconnection between variables, which are defining characteristics of the work of IT specialists (wages, number of vacancies, number of resumes, experience). Mathematical processing of data in the application of the method of the main components was carried out using software, in the system STATISTICA.

The use of the resulting calculations of indicators allowed to solve an important task regarding the positioning of IT specialists by specialty using a matrix. Construction of a dot chart gives us an opportunity to see scattering of points in two indices - wages and hh.index. The chart shows the concentration of individual groups of markers or clusters. There are four quadrants of matrix that are distinguished by the level of wages (low and high) and the level of the hh.index (or competition for the position) (low or high).

In accordance with the developed positioning matrix, in the IT sphere there were identified professional groups: senior executives and top managers ("prestigious" quadrant); leading specialists and highly skilled specialists (leading programmers) ("attractive" quadrant); High-skilled professionals (programmers and developers) ("stable" quadrant); other specialists ("conservative" quadrant).

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