

Formation of Supply and Demand for IT Specialists on the Base of Competency Model

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Abstract— The possibilities of intelligent management of the processes of formation and interaction of supply and demand in the market of IT specialists are studied. A model of professional competence, which takes into account the actual industry requirements of the specialists, is proposed as a tool for the formalization of supply and demand in the labor market. A formal statement of the problem of the correspondence of supply and demand in the market of IT specialists is given.

Keywords— the market of IT specialists; intelligent management of supply and demand; competency model; the balance of supply and demand

I. INTRODUCTION

Currently, the problems of planning of human resources development in accordance with the demand in the labor market; bringing the proposal to specialists in accordance with the demand for them both quantitatively and qualitatively in various sectors of national economy, including in the information technology segment are quite relevant. The main difficulty on the way of solving the problem of the correspondence of supply and demand for professionals is a high degree of dynamism and diversification in the requirements of specific enterprises and organizations (employers) to Human Resources. According to the international experience, the only way out of the situation seems to create a tool to formalize the processes of formation of supply and demand in the labor market and the development of an effective mechanism to manage these processes. The major tool of formalization of supply and demand in the labor market is a model of professional competence, integrating professional knowledge, abilities and skills necessary to perform specific professional tasks, i.e. which takes into account the real demands of industry for the proper specialists. In this context, there is a promising approach to the description of labor market as an intellectual environment, basing on the knowledge, abilities and skills, in the framework of which the processes of the interaction of supply and demand for specialists in terms of assessing their professional competencies are functioning.

The aim of the given paper is to study the interaction of supply and demand for IT specialists from the standpoint of the concept of intellectual environment of competence management in the IT labor market.

Supply and Demand in the Labor Market

In the traditional sense, the labor market can be defined as a place (environment or procedure), reflecting the interaction and balance of the interests between its subjects achieved for the given period: 1) employers, forming a demand in the labor market, basing on the needs of labor force, 2) employees, i.e. human resources determining the supply of the labor market and 3) state and intermediary institutions (employment services, labor exchanges, etc.), regulatory processes and the effective employment. The labor market requires cooperation and coordination of supply and demand for labor in the formation of a certain price for labor, the state of the labor market in the correlation of supply and demand. Commodity in the labor market is the amount of labor which can be purchased at a specified price within a certain time.

In quantitative terms, the magnitude of demand for labor is determined by a set of job vacancies in existing and reoperated enterprises, companies, firms and a number of jobs occupied by the employees not satisfying the employers who seek their substitution. Demand, in terms of its quality characteristics, is determined by a set of requirements to labor force, possessing certain professional and qualifying characteristics for a specific job vacancy.

Labor force supply in the labor market is the number of labor resources with specific professional qualification characteristics, which has chosen wage labor by the manifestation of its economic activity. It should be noted, that the supply and demand for labor force are inextricably linked and interdependent, however their contents are completely different. Relationship and dependence between supply and demand for labor force is an external expression of the relationship and dependence between an employer and an employee.

II. COMPETENCY MODEL

Demand for professionals (employees), their qualitative parameters, their qualification requirements are formed by the labor market. The latter one is the starting point, from which the employer must proceed in search of a specialist with qualification necessary for those conditions which he is able to provide. To create an effective management system of supply and demand in the labor market, it is necessary to formalize the processes of formation of supply and demand in the labor market. Changing paradigms in the management of demand and supply, highlighting qualitative characteristics as key requirements to the professionals, which also take into account personality peculiarities among professional characteristics,

are stipulating the development of new approaches to solving the problem of management of supply and demand in the labor market. A competency approach, which became one of the leading innovation in the modernization processes of human resource management, acts as an integrative tool, aggregating professional characteristics, individual experience, personal qualities and other characteristics of a specialist. Currently, there exist different interpretations of the notion of "competency" [1-4]. In this paper, the term "competency" means a set of required characteristics (qualities) of an employee, which he displays in real activities to successfully achieve the given goals in certain terms. Competencies include the knowledge, ability and skills, and personal characteristics. A competency model represents a full set of competencies (knowledge, abilities, skills) and personal characteristics, including indicators of behavior.

III. THE CONCEPTUAL MODEL FOR MANAGING SUPPLY AND DEMAND IT SPECIALISTS

In the concept of approach to the labor market as an intellectual environment, the entities and resources of the labor market, the mechanism of functioning of the latter is based on the following assumptions:

1. Competencies are considered as a commodity in the labor market (the set of knowledge, abilities and skills, as well as personal characteristics of IT specialist).
2. The key entities interacting in the labor market are:
 - companies and organizations on behalf of the employer (competency consumer), which form the demand for IT specialists of a particular structure and quality;
 - IT specialists, which form supply for the labor force of a certain quality (sellers);
 - state and intermediary institutions, which regulate the processes of employment and employment;—
 - educational institutions as a producer (supplier) of labor force.
3. Interaction of key entities can take place either through an intermediary - recruitment agencies – or directly (without intermediary).
4. To achieve the aims of interaction of the entities, a flexible and integrated system is needed for assessment of both knowledge, ability and skills (of the goods), and the entities of the labor market themselves.
5. Information about the entities, their interaction, the objectives and results of the interactions is poorly structured and poorly formalizable by the databases.

Conceptual approach to the labor market of IT specialists as an intellectual environment provides an opportunity to formalize relations between supply and demand in the IT job market and to simulate the processes of management of supply and demand through the interaction of the following information models:

- vacancy model (demand for IT specialists with specific competencies);
- specialist model (supply and demand for IT specialists);
- employment model;

- the model of correspondence of supply and demand for IT specialists with specific competencies.

IV. COMPETENCY MODEL OF AN IT SPECIALIST

The task of the correspondence of supply and demand through the prism of the requirements of the employer stipulates the development of materially innovative approaches, which are based on the competence structure of IT specialists [5-8]. Requirements of the employers to IT specialist, to a candidate for a particular vacancy, in terms of competence-based approach is expressed by a system of indicators, which provides evaluation of the development level of a professional of a specific set of competencies. This means that any IT specialist can be described by the set of criteria and indicators. Professionally important characteristics of the expert and the ability to identify these qualities, i.e. definition of the real professional competence of experts, allows us to estimate the correspondence level of the latter ones with specific requirements of the employer. In accordance with such structure, the model of IT specialist is a description of a set of competencies possessed by the latter one to perform professional obligations, and possession degree of these competencies to perform specific functions. It should be noted, that the competencies listed in the model of IT specialist are not equally important for the employer, i.e. the competencies that are relevant to one employer, may be quite uninteresting for another. At the same time, for various IT specialists, a set of competencies may vary in structure and content. Therefore, the task of developing a meaningful set of competencies for IT specialists with a wide range of specializations is quite relevant for today and doesn't have a definite solution. In the process of evaluating and selecting suitable candidates for a specific job an employer must be able to operate a set of competencies which would enable him to select an IT specialist with such qualities meeting his preferences.

In this paper, the following professional competencies of IT specialists are highlighted: 1. Functional competencies (actual professional competencies), which express professional characteristics of a specialist (education, qualifications, professional experience, knowledge, abilities and skills). The latter ones provide information about the basic professional qualities of IT specialists in the specific subject field, in this case in the field of information technology. This means that any professional can be described by a set characterizing him from different sides of the criteria and indicators. Professionally important characteristics of an expert and the ability to identify the possession level of these qualities, i.e., the definition of actual professional competencies of IT specialists, allow us to estimate the level of compliance of the latter ones with specific requirements of an employer. Professional competencies can be universal, suitable for any organization, company, industry and specific, as well. 2. Personality characteristics (qualities) of an IT specialist, describing him as a person, and expressing his moral, business, behavioral qualities necessary for employment in certain activities.

V. DEMAND (VACANCIES) MODEL IN IT LABOR MARKET

Demand in the market of IT specialists is given as a set $V = \{V_1, V_2, \dots, V_k\}$ or $V = \{V_i\}, i = \overline{1, k}$, expressed by a number of vacancies, $l = \{l_1, l_2, \dots, l_n\}$ or $l = \{l_i\}, j = \overline{1, n}$ are the set of personality characteristics, positions (jobs) are presented by the candidates to fill the vacancies (post, position, job), $c = \{c_1, c_2, \dots, c_m\}$ $c = \{c_f\}, f = \overline{1, m}$ is an open set of competencies that a candidate must have for a vacant job. Demand model $V = (l, c)$ is described by two matrixes, $V_l = \|l_{ij}\|_{k \times n}$ and $V_c = \|c_{ir}\|_{k \times m}$, where each line (V_i) is a separate vacancy in the IT labor market, the columns (l_n, c_m) are constantly expanding bases of personality characteristics and competencies, the elements (l_n, c_m) are the levels of possession of certain attributes needed to fill a vacancy. In the expanded form, the matrix has the following form

Personality characteristics of an IT specialist in terms of demand

Demand (vacancies)	l_1	l_2	...	l_n	
V_1	l_{11}	l_{12}	...	l_{1n}	$=\{l_{v1}\}$
V_2	l_{21}	l_{22}	...	l_{2n}	$=\{l_{v2}\}$
...
V_k	l_{k1}	l_{k2}	...	l_{kn}	$=\{l_{vk}\}$

Requirements for an IT Specialist Competency in terms of demand

c_1	c_2	...	c_m	
c_{11}	c_{12}	...	c_{1m}	$=\{c_{v1}\}$
c_{21}	c_{22}	...	c_{2m}	$=\{c_{v2}\}$
...
c_{k1}	c_{k2}	...	c_{km}	$=\{c_{vk}\}$

VI. SUPPLY MODEL IN THE MARKET OF IT SPECIALISTS

Supply in the market of IT specialists is given as a set $S = \{S_1, S_2, \dots, S_q\}$ of IT professionals, in search of work and applying for a particular vacancy. $l = \{l_i\}, j = \overline{1, n}$ is a set of personality characteristics, which characterizes IT specialists, $c = \{c_f\}, f = \overline{1, m}$ is a set of real competencies possessed by each individual candidate to fill the vacancy. Supply model $S = (l, c)$ is also describes by two matrixes $S_l = \|l_{ij}\|_{q \times n}$ and $S_c = \|c_{ir}\|_{q \times m}$, where each line (S_q) is a separate candidate for a job presented in the IT labor market, the columns (l_n, c_m) are constantly expanding bases of personality characteristics and competencies, the elements l_{kn}, c_{km} are the levels of possession of certain attributes

needed to fill a vacancy. In the expanded form, the matrix has the following form

Personality characteristics of an IT specialist in terms of supply

IT specialist	l_1	l_2	...	l_n	
S_1	l_{11}	l_{12}	...	l_{1n}	$=\{l_{s1}\}$
S_2	l_{21}	l_{22}	...	l_{2n}	$=\{l_{s2}\}$
...
S_q	l_{q1}	l_{q2}	...	l_{qn}	$=\{l_{sq}\}$

Competencies of an IT specialist

c_1	c_2	...	c_m	
c_{11}	c_{12}	...	c_{1m}	$=\{c_{s1}\}$
c_{21}	c_{22}	...	c_{2m}	$=\{c_{s2}\}$
...
c_{k1}	c_{k2}	...	c_{km}	$=\{c_{sq}\}$

Formally, the task of the correspondence of supply and demand in the market of IT specialist can be reduced to solving a linear programming problem by choosing an optimal combination of S and V. The target system of functions is presented in the following way:

$$\begin{cases} \{l_{sq}\} \cap \{l_{vk}\} \rightarrow \max \\ \{c_{vk}\} - \{c_{sq}\} \rightarrow \min \end{cases}$$

Solution of the problem will determine such correspondence as V_k and S_q , where one of the candidates will meet the requirements of a vacancy (employer) most.

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