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METHODS OF ELICITING COMPANIES' DEMAND FOR INTELLECTUAL PRODUCTS

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Abstract: To influence the level of preparation of both IT specialties and economic fields closely related to IT technologies in higher or secondary educational institutions in order to meet the needs or requirements of various companies. Collaborative efforts between businesses and education can address the issue of quality potential personnel and enhance students' preparedness through the establishment of a standardized set of business demands. When identifying the requirements for IT specialties, the key vectors include not only work experience and skills but also business qualities and the ability to work in a labor collective, aligning with company values. To better define the competencies of future employees, one of the best methods we believe is the Delphi method, which involves expert judgment. This method is a form of collective expert assessment that includes several rounds of anonymous surveys of the expert group to achieve consensus. By involving interactions between companies and educational institutions in the study, surveys can be conducted to gather statistics and utilize educational plans that interest organizations. The competencies proposed by experts may carry similar semantic meanings but be described with different words. Additionally, the merging of similar competencies into more comprehensive ones is possible. In the era of rapid IT development, this issue can be addressed through existing text analysis and comparison techniques in databases. Thus, unification of competencies can be established during the learning process.

Keywords: IT, expert, higher education institution (HEI), competencies, Delphi method

JEL Classification: C13, C60, J24, J44, L15 O15, R15

Introduction

To influence the level of preparation of both IT specialties and economic fields closely related to IT technologies in higher or secondary educational institutions in order to meet the needs or requirements of various companies. Collaborative efforts between businesses and education can address the issue of quality potential personnel and enhance students' preparedness through the establishment of a standardized set of business demands. The indicators to consider include professional knowledge, practical skills, teamwork, business qualities, and alignment with corporate values.

The works of both domestic and foreign scholars are devoted to the issues of personnel management, including: Bertchel O. (Bertchel, 2003), Pryimak V.I. (Pryimak, 2003) and others. In contemporary scientific literature, the question of effective personnel selection is insufficiently explored.

Today, companies are willing to take on interns, provide training, and prepare the specialists they need for their operations. However, if employers start collaborating with educational institutions at the learning stage, it may be possible to address the significant challenge of ensuring that potential professionals have both the necessary theoretical knowledge and practical skills required by the company.

The main research findings.

Modern employers' criteria and requirements should receive special attention when shaping the structure of higher education institutions' academic programs. To create a comprehensive model of this academic field, all its components must be considered. Emphasizing employers' demands is crucial, but equal importance must be placed on online education.

Enhancing the quality of intellectual output is a fundamental factor influencing the competitiveness of future professionals and the institutions that educate them. To improve the quality of intellectual output, it is imperative to support decision-making in educational management.

In other words, graduates of higher education institutions should possess criteria and skills that can meet the requirements of employers as depicted in Figure 1 (Filatova, 2019).

Therefore, it is essential to identify key issues and challenges associated with preparing professionals for the job market and enhancing intellectual output Previous research (Filatova, 2021a) explored this issue and identified primary elements related to management challenges and achieving high-quality intellectual output. These elements encompass the criteria and skills that graduates of higher education institutions must possess, particularly those highly valued by employers.

This is especially relevant for professionals who need expertise not only in mathematics, economics, or other fields but, most critically, in information systems and technologies – essential components of modern professional roles.

These skills include both universal competencies and those tailored to meet the demands of contemporary employers. Moreover, it is crucial to recognize that the quality of IT education must remain high and keep pace with the rapid emergence of new technologies and systems (Figure 1).

Subject and Methods.

In delineating the prerequisites for IT roles, essential dimensions encompass not just professional experience and technical proficiencies but also essential interpersonal attributes and a knack for harmonizing with organizational values within a team dynamic. In our view, one of the most

effective approaches for refining the skill set of prospective employees is the utilization of the Delphi method, which relies on expert evaluation.

This technique constitutes a collaborative form of expert appraisal, incorporating multiple rounds of anonymous surveys among the expert panel to establish a consensus. The foundation of this expert evaluation methodology is detailed in the materials outlined in (Filatova, 2019; Zhuran, 2019).

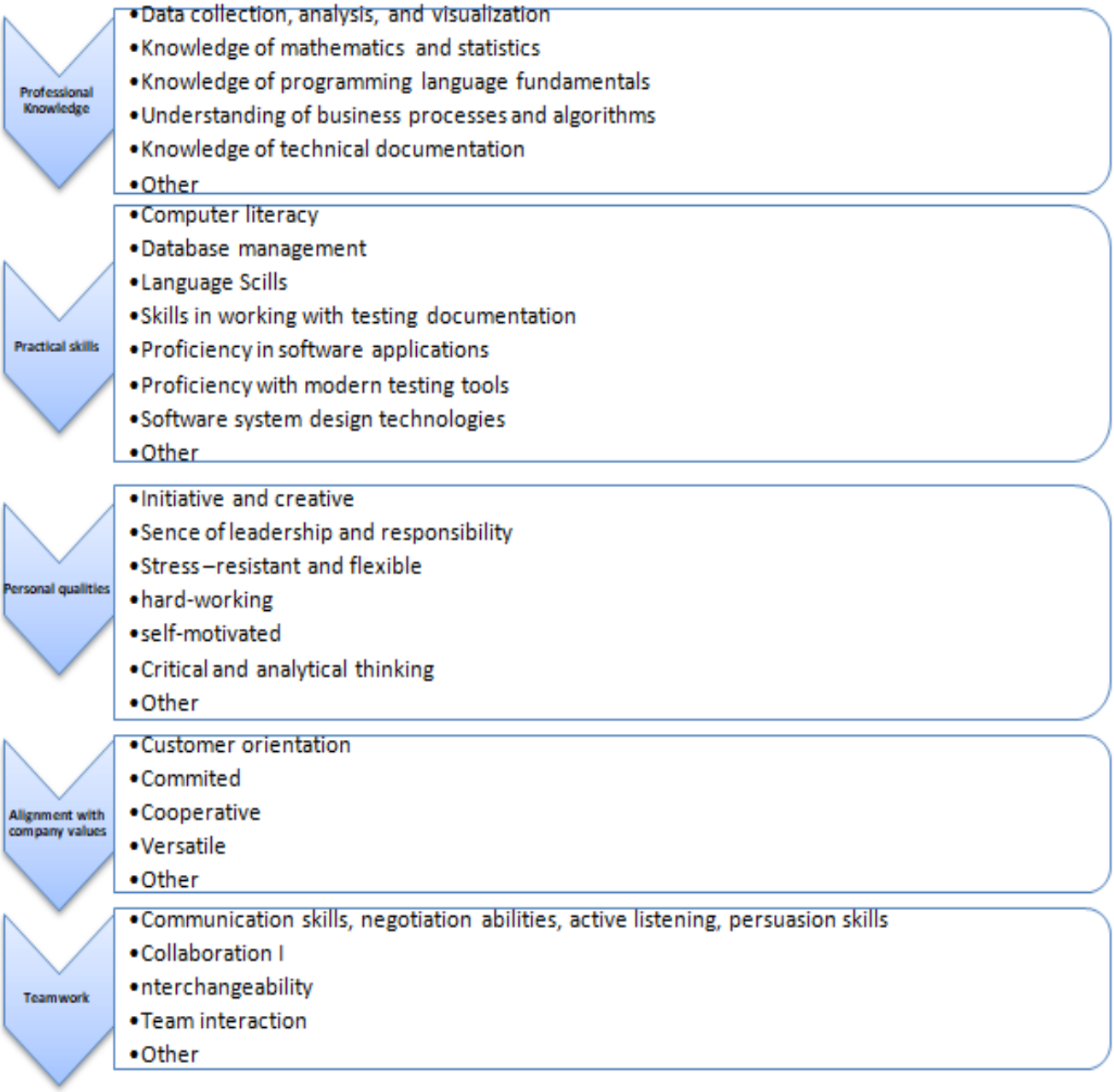

Figure 1. Requirements for graduates of IT specialties

Features of the expert assessment method as a scientific tool for solving complex non-formalized problems include, firstly, a scientifically substantiated organization of all stages of expertise, ensuring the highest efficiency of work at each of the stages, and secondly, the use of quantitative methods both in the selection of experts and in the evaluation of their judgments and the processing of obtained results.

The organization of interaction with experts depends on the chosen method of collecting expert information. Today, various types of expert assessment methods are used. They can be divided into two groups: individual and group (collective) expert surveys. Expert methods belonging to the first group involve individual work of researchers with each of the involved experts. In contrast, group methods involve collective work of experts (in-person or remotely), requiring the consensus of opinions of all experts and the development of a common expert conclusion based on consensus.

The comprehensive use of intuition, logical reasoning, and quantitative assessments with formal processing allows for an effective problem-solving approach.

The method entails remote and anonymous surveys of an expert group over multiple rounds to reach a consensus among experts. Experts are provided with survey sheets (questionnaires) related to the research problem. The questionnaire questions can take various forms, including closed-ended and open-ended questions, considering both quantitative and qualitative responses. Variations in argumentation and justification of expert assessments may also be allowed or optional.

The methodology for conducting expert assessments is based on the materials presented in (Filatova, 2019).

The Delphi Method involves conducting several rounds of surveys. In each round, experts express their opinions and provide assessments of studied phenomena. Additionally, quantitative ratings of the main advantages of each set type are determined through "weighting," assigning a specific numerical value to each of them in a scoring system in the following sequence:

The initial step in conducting the expertise involves forming an expert group. Common practice recommends forming a group of 10-15 experts in the respective field (not exceeding 20 individuals). The list of experts is compiled based on their professional status, years of experience in managerial positions, and education.

The first stage involves a quantitative assessment of the qualitative significance of each advantage. This assessment is conducted using a scoring system. After completing the first round of surveys, for each advantage, experts calculate the overall significance coefficient using the provided formula:

$$Q_j = \frac{\sum_{i=1}^{N} Q'_{ij}}{n}, \quad (1)$$

where Q'_{ij} - is the quantitative rating of the importance of the j-th indicator given by the *i*-th expert after the first round of surveys,

n - is the number of experts.

b) When processing information obtained from experts, all ratings are arranged in descending order, and then the median (*M*), quartiles (*Q1, Q2*) are determined, dividing the scale into 4 parts.

c) Each expert is informed about the values of Q'_{ij} and Q_j based on the results of the first round of surveys, providing necessary motivation. If the ratings of some experts fall into extreme intervals, they are anonymously asked to justify their opinion on providing such ratings. The justifications from these experts are considered by other participants. Experts can refine their ratings, and in the second round, they fill out a questionnaire with new assessments.

In the second round, experts determine the final coefficients of "weight" for any *j*-th indicator Q'_{ij} with corresponding justifications and clarifications. The final coefficients of "weight" for any *j*-th indicator Q''_j are established using a formula similar to the one used in the first round:

$$Q''_j = \frac{\sum_{i=1}^{N} Q''_{ij}}{n} \quad (2)$$

The possibility of conducting a third round of expert survey is enabled. Typically, with each new round, the convergence of expert opinions in rating assessments strengthens, leading to more consistent scores for each indicator. Thus, the "weights" of product advantages become more accurately defined.

After several rounds, the discrepancy in assessments becomes insignificant. Then, divergent viewpoints are documented, and a decision is made. This method is quite relevant for determining the probability of occurrence of risky events, assessing losses, and the probability of losses falling within a certain interval.

The iterative nature of multiple rounds allows for a refinement of opinions and a convergence toward a consensus, making the Delphi Method a valuable tool in situations where experts' judgments play a crucial role in decision-making.

By incorporating the interaction between IT companies and educational institutions into the research, it is possible to conduct surveys, gather statistics, and utilize educational plans that have been approved by organizations interested in this collaboration.

Experts are provided with a questionnaire containing a basic list of characteristics that influence a professional's competitiveness.

Based on the above, it can be concluded that to address issues in educational process management and enhance the quality of intellectual output of professionals, it is necessary not only to utilize existing methods, technologies, and opportunities but also to embrace new approaches, including various forms of online learning, such as distance learning platforms.

Currently, critical criteria and methodologies aimed at improving the skills of graduates and attracting employers' attention to students using modern approaches are essential. The global experience shows that a graduate's professionalism is paramount for employers. Therefore, we must make use of all the opportunities that already exist and those that are emerging to prepare professionals.

Even during their university education, students should acquire new knowledge and skills to become qualified professionals in high demand in the job market. All these efforts to enhance the level of students' education will help them become competitive in the future. However, this is only possible through continuous improvement of the educational process, the adoption of new technologies, and the professional development of instructors who implement these technologies.

When addressing complex non-formalized problems where statistical approaches are not applicable, experts play a significant role. Therefore, we believe that the Delphi method is relevant for solving these issues. The essence of the expert judgment method lies in experts conducting intuitive-logical analysis of the researched problem with a quantitative assessment of their judgments and formal processing of the results obtained. The synthesized opinion of experts resulting from this processing is accepted as the solution to the problem. The comprehensive use of intuition, logical thinking, and quantitative assessments with formal processing allows for an effective solution to the problem.

Building such a scheme is a highly responsible and complex task, so it should be carried out in collaboration with experts. The author should distribute the questionnaire they have developed to the experts. The questionnaire contains a basic list of characteristics that influence the competitiveness of IT professionals.

One of the shortcomings of expert methods often includes the labor-intensive processing of the obtained results, especially when it comes to textual information. The competencies proposed by experts may carry the same semantic load but be described using different words. Additionally, there is a possibility of consolidating similar competencies into a more complex one. In the era of rapid development of information technology, this problem can be addressed using existing developments in comparing and analyzing textual information in databases (Ivchenko, 2023).

Using a specific set of criteria (employer requirements and university competencies), it is possible to apply set intersection and union operations to the subject areas of Employers and Higher Education Institutions (HEIs) and construct a linear function. This can serve as an objective function for maximizing the attainment of performance quality and qualifications, encompassing factors influencing graduate performance and high qualifications. It also includes weight coefficients indicating the importance of each coefficient from an expert perspective. As a result, suitable parameters can be selected to enable the function to enhance knowledge attainment by adjusting model parameters. The factors within the objective function contribute to the acquisition of quality education, which subsequently shapes a competitive professional.

Solving a scientific problem

In other words, by initially employing analysis, modeling, manipulation of the subject area, utilizing expert assessment, and then employing mathematical tools to solve the problem, it is possible to streamline and enhance the process of preparing professionals with contemporary knowledge and skills, which are rapidly evolving in our time. This can be achieved through the creation and analysis of a subject area model, information management within this domain, and the application of specific methods described in the article, not only improving educational services but also meeting the needs of stakeholders. This is particularly achieved by aligning with the modern employer's requirements.

Before delving into the development of any model or system, it is essential to first design and select a data model that allows for the definition of data, their relationships, and constraints imposed on the data within the research context. For this purpose, the following categories of data models can be used: object-oriented, record-based, and physical. The first two are used to describe data at the conceptual (subject area) and external (logical data representation) levels, while the last one is employed at the internal level.

At the conceptual level, an "Entity-Relationship" (ER) model should be utilized. It will help define all objects belonging to the research subject area and the relationships established among them, forming the basis for the research. This model will serve as a graphical representation of the metamodel.

Logical data representation should be organized using a relational data model, which is currently one of the most widespread approaches. It provides a convenient data structure and allows the use of relational algebra for analysis. All these qualities are necessary both for conducting research and for implementing software in line with the research findings.

Since the methods for building a system that will facilitate research have already been defined, it is necessary to explain how this system will be utilized during the research process. Additionally, it is important to specify the scope of application of the research results within this system.

The entire path from searching for methods to implementing the stated problem, as described above, will allow for improving the interaction system between educational institutions and companies.

Results and Conclusions

The competencies proposed by experts may carry similar semantic meanings but be described with different words. Additionally, the merging of similar competencies into more comprehensive ones is possible. In the era of rapid IT development, this issue can be addressed through existing text analysis and comparison techniques in databases.

By applying expert assessment methods, it is also possible to determine the correspondence of educational qualification levels at different accreditation levels (Filatova, 2011). Thus, unification of competencies can be established during the learning process.

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