JOURNAL
OF EUROPEAN ECONOMY
Vol. 25. № 2 (97). April–June 2026
Publication of West Ukrainian National University

Economic Theory

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ECONOMETRIC MODELLING IN THE PERSONNEL EVALUATION SYSTEM OF INDUSTRIAL ENTERPRISES

Abstract

This article examines the problem of assessing individual profiles of company employees across the EU, as well as candidate requirements for positions,based on the application of utility theory and the competence-based approach. Particular attention is paid to the justification of differences in the criteria and requirements for candidates on the part of managers representing different generations, who have distinct preferences and values when selecting candidates. The study focused on the processes of candidate evaluation, selection for various positions and salary determination by using competence-based approach

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for industrial enterprises in EU countries. The aims of the study were to develop a competence-based approach to human resource management in European industrial enterprises; to create a set of mathematical models for individual profiles in human resource management, specifically for evaluating the preferences of HR recruiters and job candidates across different generations; and to analyse wage formation based on competence models. The authors have developed original models that consider various preferences and requirements for candidates for various positions, as well as an objective assessment of salary levels. These models can be used in various candidate assessment programs for various industrial companies in Central and Eastern Europe.

Key Words:

econometric analysis, European Union, human resources, mathematical models, recruitment, utility theory.

JEL: C50, D91, J31.

1 formula, 5 figures, 5 tables, 59 references.

Problem Statement

A new EU economic and social policy framework was presented and formulated in the Lisbon Agreement and other key EU documents, aimed at increasing the competitiveness of the economies of EU countries through innovation and a higher educational level of human resources (Burger, 2016; Herrera Sosa et al., 2018; World Bank, 2018). The policy documents of the EU and WB emphasised the role of higher education and focused on the importance of ensuring greater access for young people to receive adequate education, increasing the mobility of labour resources, and strengthening the connection between educational programs with trends in labour markets (Ballarino et al., 2013; Bal-Domańska & Sobczak, 2018).

Numerous documents and reports from the European Commission have noted that these issues have necessitated a review of employment policy and the need to ensure greater openness of labour markets to migrants, particularly those

from the EU's "new member states" or candidate countries (Beňová et al., 2013; Bal-Domańska & Sobczak, 2018). Therefore, key challenges of our time include expanding education (postgraduate and continuous) along with lifelong learning.

In today's ever-changing business environment, organisations must respond swiftly to changes in their workforce. It is therefore crucial to have a clear recruitment policy that includes job descriptions. Suboptimal hiring decisions lead to organizational failures and additional costs incurred by selecting unqualified applicants or rejecting optimal candidates (Ye, 2022). In view of the above, recruitment procedures must be successful and effective in order to attract the best candidates. Workforce planning, candidate recruitment and selection are all part of this process.

The hiring and selection process is becoming increasingly important as businesses grow and as employers place greater value on candidates' willingness to learn, their flexibility and teamwork (Nirala & Chaudhary, 2014; Graser et al., 2024b). The significance of effective recruitment and hiring processes for various organisations has been widely discussed in numerous articles and books (Armstrong & Taylor, 2017; Naqshbandi & Jasimuddin, 2018; Dessler, 2020; Cedefop, 2020; Chakrabarty & Kanaujiya, 2023). Gaikwad & Vaishnav (2022) analysed the main steps in the recruitment process, namely assessing the job requirements, attracting candidates, vetting and selecting candidates, hiring, and integrating the new hire into the team (Jerrim et al., 2019).

One of the key challenges when recruiting personnel, particularly young employees, for specific positions within a company is assessing the competences of potential candidates (Boyatzis, 1982; Baker et al., 1993; Eraut, 1994; Wolf, 1995; European Commission, 2001, 2025; Rodolfa et al., 2005; Kaslow et al., 2007; OECD, 2001, 2025).

There are various approaches and models for competence assessment, based on both formal and informal methods. Formal methods are based on a rapid analysis of the candidate's profile's suitability for the position and include reviewing the assessment results presented in diplomas, verifying received certificates, examining internship recommendations, reviewing motivation letters, and verifying completed courses or additional training documents. Formal methods are used when there are only a few vacancies and a small number of applications received, when the primary requirement is to ensure the candidate's formal suitability for the position (Wolf, 1995; Eraut, 2001; Kaslow et al., 2007; OECD, 2025). Recently, many formal methods were also used in cases where there is a very large flow of received applications, and it is necessary to use artificial intelligence methods to select the most suitable applications. Informal methods, which are also used quite often, especially in dynamic companies, assume that the candidate for the position will directly participate in testing developed by the company based on its own or standard tests, will complete a mini-project that will include not only a test of professional competences, but also such qualities as creativity,

responsibility and punctuality, communication skills, self-presentation skills, demonstrated leadership qualities, and the level of proficiency in modern information technology (Björnavòld, 2000; Eraut, 2000; Pintsuk-Christof & Moritsch, 2021). The level of foreign language proficiency is also checked if the interview is conducted at an international company or with the participation of foreign specialists (European Commission, 2001; Pintsuk-Christof & Moritsch, 2021; OECD, 2025).

The last approach is also implemented within the framework of dual education and internships for young people and students. For example, large industrial companies such as Bosch and Siemens, as well as well-known automobile manufacturers such as Mercedes, BMW, and Volkswagen, offer students and young people various internship programs, career-focused excursions, part-time employment, and dual education opportunities (Euler, 2013). Of course, this second approach allows the company to evaluate a candidate for the position more objectively, but it also requires more time to assess the candidate's competences, the possibility of providing a manager (supervisor) or mentor for a mini-project, and the possibility of organizing a free or paid short internship for a potential candidate or candidates (Pintsuk-Christof & Moritsch, 2021).

Not all companies are prepared for such an approach, as it requires additional investment in both time and human resources. However, this approach is effective and important from the perspective of employment policy, corporate responsibility, and 360-degree candidate assessment. Many leading companies are adopting this approach, offering internship opportunities to young candidates or those with limited work experience. After completing the internship, candidates for the desired position have the opportunity to interview and be assessed for employment with the company (Korenková & Urbaniková, 2014; Liszka & Walawender, 2021). As noted above, this approach is also important from a social perspective, since in any case, a candidate who has completed a professional internship develops new competences and skills that will be useful in subsequent interviews and competitions for the position. Thus, this approach also helps address employment issues, which is particularly important when developing strategies to reduce long-term unemployment and integrate human resources with specific, previously developed knowledge and competences into a new production environment (Liszka & Walawender, 2021).

A review of selected articles, reports, and books showed that qualitative studies predominate, and most sources of the information and data are gathered by means of different questionnaires, surveys and experts' opinions. Then, for the elaboration of the data, descriptive statistics or other statistical methods are used (Schmidt & Hunter, 1992, 1998; Nikolaou & Oostrom, 2015; Welasari et al., 2019).

It is also worth noting that the candidate selection process can take place in several stages, when at the beginning a pairwise comparison of possible candidates is carried out, then the strongest candidates compete, and ultimately, the two strongest candidates remain for the position. This process can be represented by a game model with a choice of different strategies and a given payoff

matrix. The model can also incorporate initial assessments of candidate competence and their changes as a result of the chosen strategies, i.e., dynamic candidate assessments. This game model was developed by Graser et al. (2024b). The model presents a formalization of candidate evaluation based on utility functions and finds an optimal solution for selecting the best strategies by candidates.

These approaches are associated with the widespread use of psychological and sociological methods for the evaluation of human resources and employee motivation.

The purpose of this article is to develop a competence-based approach to human resource management in European industrial enterprises; to create a set of mathematical models for individual profiles in human resource management, specifically for evaluating the preferences of HR recruiters and job candidates across different generations; and to analyse wage formation based on competence models.

Literature Review

Changes in labour markets related to structural economic, demographic, or political shifts, external and internal shocks, or technological advances that impact industry conditions, employment, and labour and other migration patterns lead to necessary changes within enterprises, companies, and organisations (Burger, 2016; Urbancová et al., 2021). On the one hand, structural imbalances are observed in certain sectors of the economy, with some industries experiencing labour surpluses and others experiencing labour shortages. Furthermore, due to demographic changes, a younger generation, Generation Z, is entering the labour market. They were raised in a digital environment and have used gadgets and the internet for education and entertainment since childhood. Alongside this, leading positions among managers, professionals, and specialists are held by members of the X and Y generations, and sometimes even by “boomers”, due to their experience. Each generation grew up and was raised in its own era, which differed significantly in both the socioeconomic and political characteristics of the period. Furthermore, education and training systems, career advancement, opportunities to utilize new technologies, and so on, varied significantly (Dubrovina et al., 2022). Therefore, each generation brought its own values and contributions to the shaping of the work and organizational environments of enterprises, organizations, and companies. This led to both changes within companies and changes in human resource management policies.

The main objective of an effective recruitment process is to identify the best candidate for a job at the right time through an organization-specific sourcing mechanism (Carless, 2002; Nikolaou & Oostrom, 2015; Armstrong & Taylor, 2017; Dessler, 2020; Dubrovina et al., 2022). It is a methodical process for hiring bright

individuals who can contribute to the expansion of the business. The hiring procedure usually aims to identify the most qualified and motivated applicants with required professional skills (Schmidt et al., 1992; Kristof, 1996; Rafaeli, 1999; Nirala & Chaudhary, 2014; Ye, 2022; Bown, 2023). Nevertheless, many companies consider the soft skills of the candidates, which are associated with an employee's work style and disposition (Chapman et al., 1999, 2003; Houdin, 2017). In parallel, it is important to evaluate the candidate as a whole using a set of criteria and their corresponding weights. In addition, the problem of the choice of the successful candidate exists because several possible candidates can submit their application and participate in the selection process. Candidates assess their chances of being selected, can take the different strategies to improve their skills and consider their own rational behaviour (Chapman et al., 1999, 2003). Since recruiting and selection are the main sources of talent, they are more important in attaining a competitive edge. It is crucial to choose candidates who meet the qualifications requirements and who possess the values and attitudes required to fit within the workplace culture (Burger, 2016). A larger pool of candidates with the right abilities will be created by effective recruiting and selection, which will also increase the potential talent pool to satisfy organisational growth objectives (Ye, 2022).

However, because the process of recruiting and selection is dynamic and so complicated, the recruiters overlook crucial aspects. Thus, various recruitment requirements and selection plans must be developed for various needs, jobs, and organisations. Furthermore, several variables will impact it, including the candidate's qualifications (Mouzakitis, 2010; Petrovski, 2011; Urbancová et al., 2021), the organization's location, the industry, and external conditions. Ignoring these factors could lead to certain negative issues (Ye, 2022).

For example, in their article Schmidt & Hunter (1998) evaluate and summarise the findings of 85 years of personnel psychology research about the validity of measurements of 19 various selection procedures that can be used for hiring, training, and developmental assignments. The findings are based on meta-analysis and the Determinants of Practical Value (Utility) of Selection Methods are considered.

The study of Goldberg (2003) investigates the idea that candidates who share recruiters' demographics would have more positive opinions of the recruiters, positions, and organisations than those who do not. The theory of this study is based on social identification theory (SIT). SIT also proposed that candidates who belonged to a demographic minority in comparison to the majority of applications would separate themselves from the group by expressing a preference for employers, positions, and associations. While age or sex similarity did not show any significant effects, racial similarity did, indicating that race is a more prominent category than age or sex.

In the study presented by Tamayo et al. (2010), the authors gathered information about 235 employees of Davao City-based businesses. The employees were asked to respond to a hypothetical scenario in which they were asked what

their likely course of action would be to advance over a rival employee. Then four matrices were created, one for each of the competitors' actions, emphasising the attitude of being “mean” or “nice” in order to get the promotion: promoted – promoted; not promoted – promoted two steps; promoted two steps – not promoted; promoted one step – promoted one step. To analyse the influence of respondents' socioeconomic and demographic characteristics on the results of the promotion, the multinomial logistic regression was built and the correlation between the attributes of the respondents and the chance of selecting was examined.

In another article,Welasari et al. (2019) examine the literature on the recruitment and selection of department heads using the example of the Indonesian government of West Java Province. As they conclude, the State Civil Service (ASN) policies and management are based on qualifications, competences, and performance; they are fair and reasonable regardless of political background, race, colour, origin, gender, marital status, age, or disability condition, according to the Indonesian Government Management of State Civil Service. But the practice of using open selection to fill the High Leadership Position (JPT) has been widely used in order to pick state civil apparatus members with high performance standards, competences, and credentials in order to fill specific roles.

Nevertheless, in recent years, the application of artificial intelligence (AI) methods for the organisation of recruitment processes has increased (Jatobá et al., 2023). Many modern scientists focused on the opportunities of the application of artificial intelligence (AI) for hiring personnel. Due to the advanced procedures and e-recruitment for initial decision-making, technical efficiency in the selection of the needed candidate(s) among a large number of applicants increases and the cost of recruitment is declining (Gupta et al., 2018). Artificial intelligence is being used in the recruiting process to speed up and improve the accuracy of applicant data (Upadhyay & Khandelwal, 2018). In the recruitment process, AI searches for the best candidates for open positions in the company (Nawaz, 2019). Nevertheless, some important aspects should be taken into account. On the one hand, the benefits of big data and machine learning for the selection procedure of the needed candidates can be summed up as follows: consistency, objectivity, and efficiency. On the other hand, there is a risk of oversimplifying complex circumstances and reproducing historical discrimination. This perspective addresses instances where technology takes over the role of arbitrary human judgements; however, it is not appropriate in situations when standardised evaluations are already in place (Kassir et al., 2023).

For example, to investigate the impact of artificial intelligence (AI) on recruitment effectiveness, Nawaz (2019) used a structured questionnaire and gathered data from 100 human resource professionals at Bangalore-based CMMI (capability maturity model integration) software businesses. Then descriptive statistics and structural equation modelling were employed to test the hypothesis in and around Bangalore. This study discovered that the application of artificial intelligence in the hiring process helps the organisation choose the best candidate from its talent pool.

In the study presented by Jasim et al. (2023), the application of AI is shown for human resources recruitment. The study involved 22 participants, ranging from senior executives to operational staff responsible for recruitment in private companies in India. It examined their views on the use of artificial intelligence in HR recruitment. The benefits and impacts of applying artificial intelligence innovation to human resource recruiting are discussed, along with suggestions for organisations looking to implement this strategy.

Despite the application of different approaches and methods for the analysis of the recruitment processes in the companies, it is possible to identify the problem of conflict or competition, on the one hand, and the problem of the evaluation of human resources utility, on the other hand.

Methodology

This study uses elements of a systems approach, some sections of mathematical modelling related to the study of utility functions, methods of hierarchy analysis, game theory, econometric methods and models, some problems of utility theory, and the application of expert methods.

In this study, the competences required for managerial, specialist, or executive positions are considered as a set of necessary knowledge, skills, abilities, qualities, and characteristics.

These knowledge, skills, abilities, qualities, and characteristics are mutually complementary and interchangeable, but at the same time, the absence of one of the qualities, skills, knowledge or competences leads to the elimination of the candidate, since the usefulness of the candidate is considered as the product of the estimated values of these factors, raised to the appropriate powers.

Thus, the utility function is nonlinear, according to a power-law, and if one of the factors is zero, the value of the utility function will also be zero.

That is, it is assumed that the utility function will be a power-law function, and the analytic hierarchy process developed by Saaty (1977) will be used to find its parameters.

The Analytic Hierarchy Process (AHP) constructs a multi-level hierarchical model, with the lower levels containing factors or resources (alternatives), followed by criteria, and the top level corresponding to the goal. Experts compare the influence of elements of the previous level on each element of the next level using a specific scale. Thus, Saaty's AHP algorithm is a structured decision-making process that breaks a complex problem down into a hierarchy (goal, criteria, alternatives). It works through pairwise comparison of elements on a scale of 1 to 9, calculation of priority vectors, consistency checks, and synthesis of priorities to select the best alternative.

Next, various experts, for example, representatives of different generations or specific professional groups, evaluate the factors and, using the analytic hierarchy process, generate different utility functions for different positions within the company.

Moreover, utility functions may differ in the values of the parameters characterizing the degree of influence of the required qualities and characteristics of a job applicant on the company's utility indicator.

Experts also evaluate the minimum acceptable values of the required qualities and characteristics of a job applicant on a 10-point scale, from 1 to 10. Experts indicated that their companies use various tests and methods, both formal and informal, to assess a candidate's competences and qualities on a 10-point scale.

Based on these minimum acceptable values, the minimum acceptable values of the utility function required for consideration of the candidate's application for the specified position are calculated.

Experts also assess salary levels based on the impact of specific skills, characteristics, or competences on the compensation of an employee occupying a given position and performing the corresponding functions. Experts were selected from several countries of EU (Germany, Austria and Slovakia) and represented three generations of the managers: X, Y, and Z. The respondents indicated the salary level in euro, per month, taking into account that the industrial companies were located in Central and Eastern European countries.

Then, based on the data obtained from the experts, multivariate regression models are constructed using dummy variables reflecting whether the salary data relates to a managerial (specialist) or executive position.

Finally, based on these models, salary forecasts are determined for selected employee categories, and confidence intervals are estimated for the minimum and maximum forecast values. The point and interval estimate of the forecasts are then used to consider three scenarios: pessimistic (likely minimum salary values), neutral (average possible salary values), and optimistic (likely maximum salary values).

Research Results

Utility function is one of the fundamental concepts in modern microeconomic theory. Applying a utility theory approach allows for a better understanding of choice theory, the role of various factors (resources) and constraints, their substitutability, and so on. Utility theory can also be applied to studying the labour market from a microeconomic perspective.

For example, it is imperative to study the requirements of various employers for applicants for specific positions, what competences are important to them, and how they assess the value of each candidate to the company. As a rule, the process of assessing a candidate's qualities and competences cannot be based solely on a formal analysis of their biography and work experience; an interview is necessary to better understand the candidate's strengths and weaknesses, their motivation, skill level, foreign language proficiency, communication style, etc.

Nevertheless, the process of assessing a candidate's profile and their results after the interview is quite subjective, since each expert (recruiter) and each manager may have their own preferences for selecting a candidate, certain preferences related to age, gender, level of qualification, analytical or social skills, requirements for proficiency in foreign languages or the use of information technolgy.

In this study, we formalize the approach using utility theory and the construction of utility functions.

We use a simple hierarchy consisting of two levels. The first level represents the skills and knowledge required for a managerial, specialist, or executive position within the company, and the second level represents the goal – selecting the best candidate.

The following characteristics are used as necessary skills and knowledge: professional skills and experience; cognitive and analytical skills; personal characteristics and skills; responsibility and time management skills; leadership; information technology skills; health status and the ability to lead a healthy lifestyle; communication skills; foreign language skills.

Thus, we identify nine key skills and characteristics relevant to the assessment of a candidate for a given position within the company. As was mentioned earlier, the set of necessary skills was developed on the recommendation of the experts. The skills are evaluated by means of a scale from 1 to 10; for the assessment, different tests may be applied.

The required skills and characteristics are represented as variables whose values range from 1 to 10.

Thus, the variables include professional skills and experience (PSE); cognitive and analytical skills (CAS); personal characteristics and skills (PERS); responsibility, time management skills (RTM); leadership (LDP); IT skills (ITS); health condition and ability to maintain a healthy lifestyle (HC); communication skills (CS); language skills (LGS).

We use a typical non-linear utility function:

$$U=\prod x_i^{\alpha i} \quad (1)$$

where α_i are parameters, which are evaluated by using the method of hierarchy developed by Saaty (1977).

In the research we drew on the assessments of several experts who were responsible for hiring personnel in the companies; in addition, some other specialists took part in the experiments with the creation of such a utility function or evaluating the importance of skills for the ideal candidate for a given position.

We present the results of the evaluation of the parameters by AHP from two experts: one expert represented Generation X (Expert X) and the other expert was a representative of Generation Y (Expert Y).

Expert X conducted an assessment of the parameters only for the position of manager of the production department.

Thus, based on this expert's assessment and the AHP results, professional skills and experience are prioritized highest; next, second place is for cognitive and analytical skills, then the third and fourth places are close to each other and belong to personal skills such as responsibility and time management skills. Leadership occupies the fifth position. The three lowest-ranked factors are IT skills, health status, and language skills (Graser et al., 2024a).

Next, we present the results of parameter assessments for the impact of required knowledge, skills, and qualities for various positions within the company, obtained using the Analytic Hierarchy Process and taking into account the opinion of the second expert.The parameter values are presented in Table 1.

Table 1

Parameters of the utility function obtained for various positions for recruitment in the company (assessments of Expert Y)

Name	PM	HPD	SM	HSD	FM	HFD	ITS	HITD	MM	HMD
Parameters	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
α_1	0.3221	0.3149	0.2747	0.2903	0.2011	0.3508	0.2644	0.3149	0.3157	0.3489
α_2	0.1218	0.1678	0.1428	0.1437	0.1767	0.1857	0.1272	0.1659	0.1860	0.1926
α_3	0.0744	0.1659	0.0776	0.0807	0.1175	0.0732	0.0706	0.0744	0.0856	0.0779
α_4	0.2263	0.1087	0.2180	0.2265	0.2669	0.1504	0.224	0.1678	0.1700	0.1594
α_5	0.0936	0.0744	0.1141	0.1016	0.0922	0.0958	0.1402	0.1087	0.0991	0.0970
α_6	0.0538	0.0533	0.0575	0.0489	0.0591	0.0478	0.0525	0.0553	0.0454	0.0433
α_7	0.0536	0.0523	0.0545	0.0524	0.0153	0.0446	0.0574	0.0523	0.0431	0.0354
α_8	0.0330	0.0371	0.0369	0.0343	0.0455	0.0316	0.0371	0.0371	0.0245	0.0216
α_9	0.0208	0.0230	0.0230	0.0212	0.0251	0.0196	0.0261	0.0230	0.0302	0.0235

Note: PM = Manager in Production Department; HPD = Head of Production Department; SM = Manager in Sales Department; HSD = Head of Sales Department; FM = Manager (Specialist) in Finance Department; HFD = Head of Finance Department; ITS = Specialist in IT Department; HITD = Head of IT Department; MM = Manager in Marketing Department; HMD = Head of Marketing Department.

Source: authors' calculations.

As can be seen from the data presented in Table 1, the parameters of the utility functions differ significantly for the various possible positions within the company.

For example, the maximum impact of professional skills and experience is observed for the head of the finance department (0.3508); the minimum impact of professional skills and experience is observed for the finance manager (specialist) (0.2011). This result can be interpreted as indicating that the specifics of a finance manager's work within the finance department may differ, so previous experience and knowledge are useful but not decisive, as is the case for a candidate for the position of head of finance.

A comparative analysis of the parameter α_1, which indicates the degree to which professional skills and experience influence the selection of a candidate for a particular position in the company, allows us to identify those positions where these results are most important. As can be seen from the data in Table 1, for all management positions (except for the production department), the parameter values α_1 were higher for department heads than for regular managers or specialists.

Relatively high values of α_1 were observed for the following positions: head of the marketing department (0.3489); marketing department manager (0.3157); head of the production department; and head of the IT department (0.3149).

Furthermore, another important characteristic should be considered: cognitive and analytical skills. The degree of influence of this characteristic is reflected by the parameter α_2. The highest value of the parameter α_2 was obtained for the head of the marketing department (0.1926). Relatively high values of the parameter α_2 were obtained for positions such as marketing department manager (0.186) and head of the finance department (0.1857).

Thus, for applicants for these positions in the company, cognitive and analytical skills are of great importance. These include the ability to analyse and structure new information, work with sufficiently large amounts of information, make rational decisions based on the use of both qualitative and quantitative methods, develop and apply structural and logical schemes, and possess a high ability to learn and acquire new skills and knowledge.

The influence of another important characteristic, namely personal characteristics and skills (honesty, integrity, teamwork, etc.) on certain positions in the company is reflected by the parameter α_3. The highest values of this parameter are observed for applicants for the following positions in the company: head of the production department (0.1659) and financial manager (0.1175).

Parameter α_4 is associated with the influence of such qualities as responsibility and time management skills. The highest value of this parameter was observed for the position of financial manager (0.2669), and fairly high values were noted for positions such as: sales manager (0.2665); production department manager (0.2665); and IT department specialist (0.224).

As can be seen from the results presented in Table 1, the remaining candidate qualities and characteristics, while significant, have a much lower degree of

influence, as evidenced by the values of parameters α_5, α_6, α_7, α_8 and α_9 for the specified positions within the company.

A further consideration is that the results of assessing the influence of the required qualities and characteristics of candidates for the specified positions within the company significantly depend on the experts' preferences, their previous experience, education, cultural background, generation, country, etc.

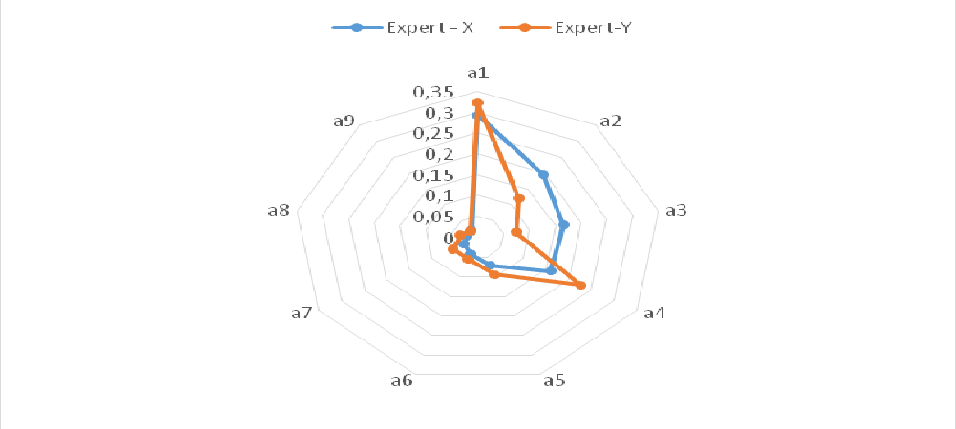
To demonstrate the differences in the opinions of experts representing Generations X and Y, a radar chart was used (Figure 1). This chart shows that, when considering the position of a production department manager, Expert X places a significantly greater emphasis on the role of characteristics x_2 (cognitive and analytical skills) and x_3 (personal characteristics and skills) than Expert Y.

This is evidenced by the values of parameters α_2, α_3. Beyond this, expert Y places much greater emphasis on the role of characteristic x_4 (responsibility, time management skills), which is evident both in the diagram and in the value of parameter α_4.

It should also be noted that the parameters α_i not only indicate the degree of influence of the corresponding characteristics but also coincide with the elasticities of the utility functions. The properties of the constructed utility functions and the elasticity of substitution of one characteristic for another can also be traced using indifference curves.

Figure 1

Values of the estimated parameters of the utility function for the position of production department manager



Source: authors' calculations.

When evaluating candidates for a particular position within a company, it is necessary to establish minimum candidate requirements, which will allow for the initial rejection of applications that do not meet these requirements.

Table 2 presents the recommended minimum requirements for applicants for these positions within the company, considering the opinion of expert Y. We should note that the minimum threshold for applicants for different positions may vary significantly depending on the company's requirements, its HR policies, the preferences of HR managers, etc.

For example, in the article by Graser et al. (2024b), we examined examples of selecting young candidates (representatives of Generation Z) for the position of production department manager, and the required minimum requirements for candidates were lower than those in Table 2.

Table 2

Recommended minimum requirements forapplicants for these positions at the company (opinion of Expert Y)

Position		Manager/Specialist (Baseline Scenario)					Head of Department (Baseline Scenario)				
Code	Variable	Production	Sales	Finance	IT	Marketing	Production	Sales	Finance	IT	Marketing
PSE	x1	3	4	4	4	3	4	5	5	5	4
CAS	x2	3	3	5	5	3	4	4	5	5	4
PERS	x3	3	3	4	4	3	4	4	5	5	4
RTM	x4	3	4	4	4	4	4	5	5	5	5
LDP	x5	3	4	3	3	3	4	5	5	4	4
ITS	x6	3	3	5	5	4	4	5	5	6	5
HC	x7	3	3	3	3	3	4	4	4	4	4
CS	x8	3	4	3	3	4	4	5	4	4	5
LGS	x9	3	3	3	3	4	4	4	4	4	5

Note: PSE = professional skills and experience; CAS = cognitive and analytical skills; PERS = personal characteristics and skills; RTM = responsibility, time management skills; LDP = leadership; ITS = IT skills; HC = health condition and ability to maintain a healthy lifestyle; CS = communication skills; LGS = language skills.

Source: authors' calculations.

Table 3 presents the self-assessment characteristics of a fairly experienced manager (30 years old, Generation Y), who was asked to rate his or her qualities on a 10-point scale (1 to 10) considering three scenarios: neutral (Scenario 1), pessimistic (Scenario 2), and optimistic (Scenario 3).

Table 3

Self-assessment results of a Generation Y manager

Set of necessary skills and knowledge	Variable	Estimate Value (Scenario 1)	Min Value (Scenario 2)	Max Value (Scenario 3)
Professional skills and experience (PSE)	x1	8	7.5	8.5
Cognitive and analytical skills (CAS)	x2	7.5	7	8
Personal characteristics and skills (PERS)	x3	7	6	8
Responsibility, time management skills (RTM)	x4	8.5	8	8
Leadership (LDP)	x5	8	7	9
IT skills (ITS)	x6	7	6.5	8
Health condition and ability to maintain a healthy lifestyle (HC)	x7	8	7	8.5
Communication skills (CS)	x8	8.5	8	9
Language skills (LGS)	x9	7.5	7	8

Source: authors' calculations.

Different values of candidate characteristics for different positions allow us to determine the candidate's utility function values for a given position (see Table 4). Preference is given to candidates with a higher utility function value than other potential candidates. In addition to this, a company's HR policy may be quite open and aimed at creating additional opportunities for younger candidates without the necessary experience (as is the case with representatives of Generation Z and the values for Baseline Scenario).

Table 4

Values of the utility function for various applicants for the specified positions

Department	Production		Sales		Finance		IT		Marketing	
Manager/Specialist or Head of Department	M	H	M	H	M	H	S	H	M	H
Utility Function	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
Value of Utility for Estimate (Scenario 1)	7.906	7.701	7.88	7.897	7.85	7.846	7.908	7.855	7.838	7.842
Value of Utility for Min Scores (Scenario 1)	7.287	7.046	7.249	7.271	7.227	7.233	7.266	7.23	7.216	7.229
Value of Utility Max Scores (Scenario 1)	8.297	8.244	8.292	8.293	8.228	8.309	8.321	8.311	8.289	8.297
Value of Utility Baseline Scenario	2.998	3.986	3.607	4.675	4.002	4.89	3.86	4.803	3.241	4.225

Note: M = Manager; S = Specialist; H = Head of the department.

Source: authors' calculations.

A further important step in selecting candidates for a given position is determining salary requirements, bonuses, and material and non-material rewards. Young or less experienced candidates for a given position within a company typically do not have strict salary requirements. By contrast, more experienced candidates or those from countries with higher incomes and quality of life will only consider a position within the company if they meet certain requirements.

Based on these criteria, we surveyed representatives of various generations from several countries asking them to complete questionnaires indicating salary levels they would be willing to pay employees in a country with an average income and standard of living. Respondents were also asked to indicate the salary level (in euro, per month) they would accept if the candidate met the necessary requirements but had one characteristic that was particularly prominent.

Thus, using regression analysis, it was possible to determine the estimated salary of an employee based on their position in a given department. Also, using regression analysis and a dummy variable (d2) for managers, it was possible to determine differences in the salaries of managers and executives across various departments.The results of the constructed models are presented in Table 5.

Table 5

Regression models for predicting wages for selected manager/specialist and head-of-department positions

Code	Variables	PM	SM	FM	IT	MM
PSE	x1	97.468*** (27.927)	70.056** (30.539)	82.595** (33.896)	71.801** (33.716)	52.665* (28.668)
CAS	x2	59.480* (31.009)	44.038 (29.426)	75.737** (34.520)	62.572* (34.287)	34.379 (31.906)
PERS	x3	49.084 (32.293)	20.381 (32.682)	64.666* (37.740)	58.253 (37.530)	11.015 (35.947)
RTM	x4	78.711*** (25.390)	63.175** (27.773)	79.612** (32.098)	68.769** (31.931)	83.536*** (31.015)
LDP	x5	102.731 (27.392)	118.038*** (30.714)	94.139*** (33.689)	87.627** (33.954)	106.324*** (28.668)
ITS	x6	34.912 (31.865)	32.988 (34.906)	75.439** (36.089)	85.554** (34.751)	160.699*** (45.569)
HC	x7	18.206 (26.749)	1.837 (26.817)	33.457 (34.114)	40.201 (33.954)	11.202 (28.668)
CS	x8	52.910* (26.351)	81.330*** (27.914)	69.888** (31.985)	58.058 (31.837)	83.536*** (31.015)
LGS	x9	74.020** (31.852)	54.200* (29.787)	56.491 (36.463)	49.438 (36.288)	27.803 (39.500)
Head of Department	d2	482.616*** (99.314)	474.059*** (104.649)	138.693 (148.811)	432.874*** (142.179)	473.517*** (99.363)
Number of observations	N observ.	54	54	54	54	54
Fisher criterion	F (10,44)	340.58	335.29	185.56	178.82	422.03
p-value	p	<0.0000	<0.0000	<0.0000	<0.0000	<0.0000
Standard error of estimate for model	Std.Error of estimate	321.28	323.26	522.88	520.5	324.72
Durbin-Watson criterion	DW	0.559	0.407	0.493	0.774	0.504
Coefficient of determination	R-sq.	0.987	0.987	0.977	0.976	0.990
Used regression	Type of Regression:	Normal	Ridge	Ridge	Ridge	Normal

Notes: PSE = professional skills and experience; CAS = cognitive and analytical skills; PERS = personal characteristics and skills; RTM = responsibility, time management skills; LDP = leadership; ITS = IT skills; HC = health condition and ability to maintain a healthy lifestyle; CS = communication skills; LGS = language skills. Standard errors in parentheses; * p<0.1; ** p<0.05; *** p<0.01.

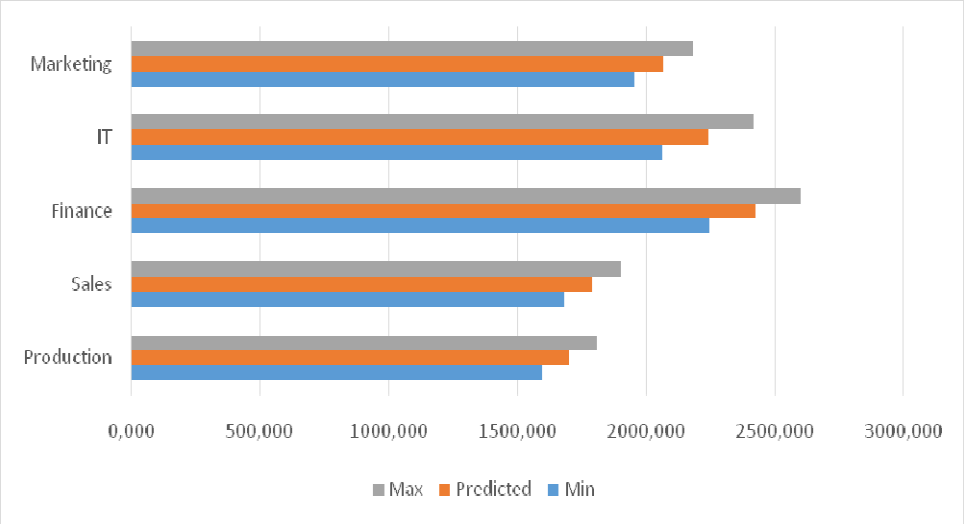
Source: authors' calculations.

As can be seen from the parameter estimation results presented in Table 5, most of the parameter estimates were statistically significant. Only for certain respondent trait characteristics, such as health status, foreign language proficiency, or modern information technology, were the parameter estimates not statistically significant. This is explained by the relatively high heteroscedasticity of the model's variances, the potential for variation in the requirements for these positions at specific companies, and the small number of observations. Ridge regression also had to be used for certain models, which leads to some bias in the model's parameter estimates.

Based on the constructed models, forecasted salary values were obtained for candidates for various positions for the Baseline Scenario and Scenario 1. Figure 2 and Figure 3 show examples of forecast values, taking into account confidence intervals, for applicants for various positions under the Baseline Scenario, i.e., for young candidates, representatives of Generation Z. Figure 4 and Figure 5 show examples of forecast values, taking into account confidence intervals, for more experienced applicants (representatives of Generation Y) for various positions under Scenario 1.

Figure 2

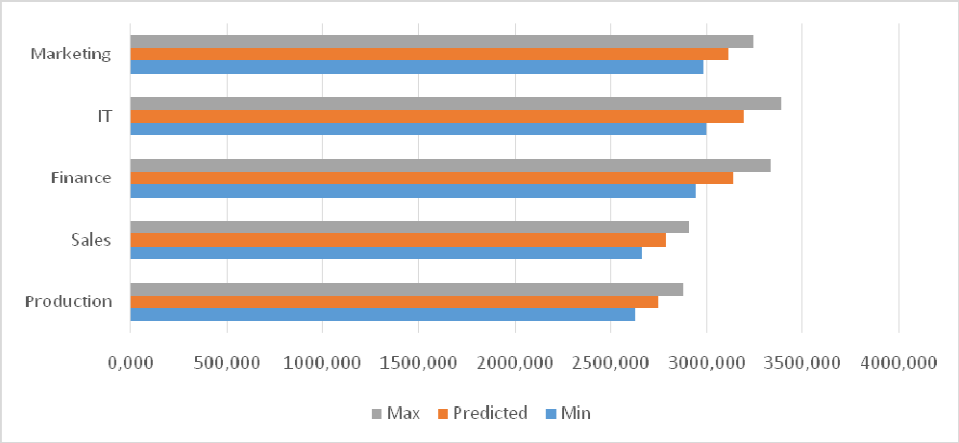
Forecast values of salary levels (in euro, per month) for various manager (specialist) positions in the department (Baseline Scenario, Generation Z)



Source: authors' calculations.

Figure 3

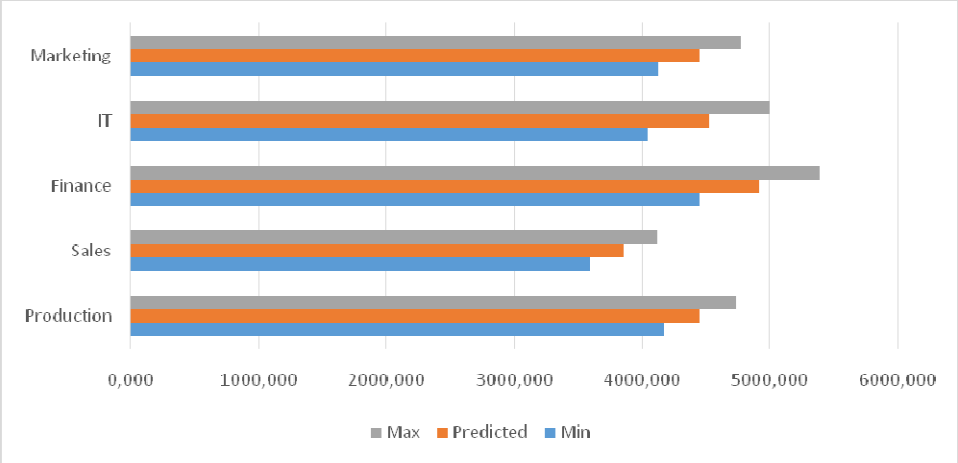
Forecast values of salary levels (in euro, per month) for various manager positions in the department (Baseline Scenario, Generation Z)



Source: authors' calculations.

Figure 4

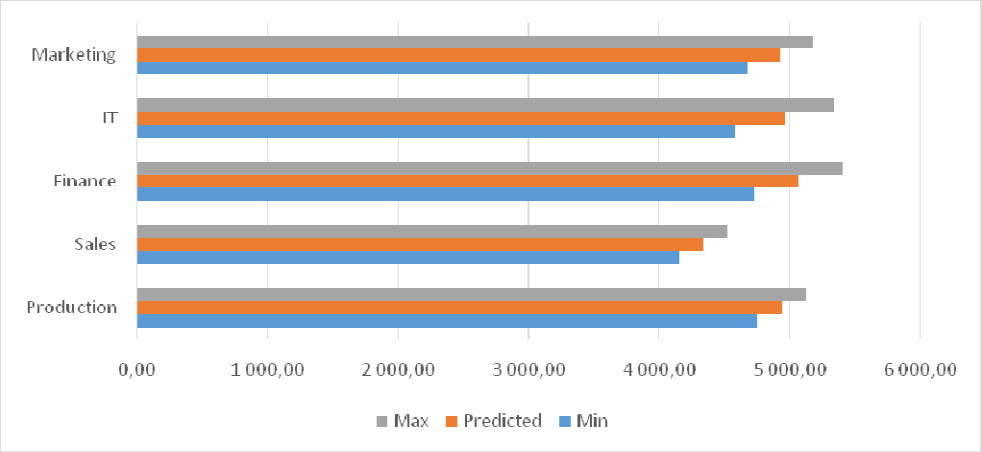
Forecast values of salary levels (in euro, per month) for various manager (specialist) positions in the department (Scenario 1, Generation Y)



Source: authors' calculations.

Figure 5

Forecast values of salary levels (in euro, per month) for the Head of Department position in the department (Scenario 1, Generation Y)



Source: authors' calculations.

The forecasting results based on the regression models presented in Table 5 indicate that there are significant differences in salary levels for different departments, representatives of generations X and Y, as well as differences between salary levels for the position of manager, specialist, or head of department.

The resulting models and forecasts allow for a more objective explanation of salary formation, taking into account both the varying levels of candidate utility to the company and the varying levels of bonuses for specific candidate qualities and skills. The developed regression models can also be used to generate payoff matrices when applying game theory to candidate selection.

Discussion

The application of utility theory to candidate evaluation and the formation of utility functions based on the competence-based approach are an important area of research not only in economic theory or human resource management theory, but also for a deeper understanding of candidate recruitment processes in practice.

When analysing utility functions reflecting the necessary requirements for candidates, one must take into account the various preferences and values that

may differ among representatives of different generations. Therefore, the hypotheses regarding differences in the preferences of managers from different generations are confirmed, which is consistent with the conclusions drawn from other studies conducted by various authors.

Simultaneously, for a more objective analysis of the degree of difference in preferences and requirements for candidates, it is necessary to survey a larger number of managers working in various industrial companies and representing different generations.

When developing models used to assess employee salaries using competence-based approach, it is also necessary to consider the differences in these values across EU countries. Furthermore, the model for analysing and assessing candidate competences can be refined and expanded by incorporating various cognitive, professional, and psychological tests and methodologies necessary to comprehensively capture the profile of a candidate or company employee.

It should also be noted that the problem of assessing the competences of candidates for specific positions within a company is quite important. Given the subjectivity of some assessments and the differences in company values and priorities, as well as the specifics of specific positions within the company, it makes sense to develop these competence assessment models using fuzzy sets and to develop decision-making models that take into account the rules of fuzzy logic. This will allow for the consideration of subjective probabilities and possible candidate selection decisions.

Taking into account these features, as well as the limitations of the research presented in this article, it would be advisable to supplement the results obtained in the future by studying the experience of various companies in different countries and the possibilities of implementing this approach to make more objective and rational decisions in the procedures of recruiting personnel and motivating employees based on a competence-based approach.

Implementation of Research Results

The developed model can be used to improve the recruitment process and candidate preparation for selection procedures and training. The elements of this model can be implemented in recruitment software and can help companies organize this process more effectively. This approach allows for the consideration of dynamic assessments of newly acquired and previously developed competences, more objective benchmarking for comparison with other candidates, the formation of a basis for a targeted and sustainable production policy, and the improvement of human resource development strategies (Baker et al., 1993; Eraut, 1994; Liszka & Walawender, 2021).

Conclusions

Despite the expansion of educational opportunities, the key problem that has become particularly apparent since the global economic crisis in contemporary labour markets within the EU is related to acute competition and demand for candidates with appropriate knowledge and skills for different positions and occupations.

Enterprises, companies, and organizations must adapt to changes in labour markets caused by structural economic, demographic, or political shifts, internal and external shocks, or technological advancements that affect industry conditions, employment, and labour and other migration patterns. On the one hand, several economic sectors exhibit structural imbalances, with labour surpluses in some industries and labour shortages in others. Additionally, opportunities to use new technologies, pursue career progression, and access education and training systems also differed greatly. As a result, the work and organizational environments of businesses, organizations, and firms were shaped by the ideals and contributions of each generation. This resulted in changes to human resource management policies as well as internal organizational adjustments.

The development of AI and the widespread use of human-machine procedures in assessing the individual profiles of candidates for various positions lead to very high requirements for applicants for certain positions, reflecting the specific preferences and values of companies where the organizational culture is shaped by leading managers representing different generations.

In this regard, the models we developed incorporate an approach based on utility theory and the construction of various utility functions reflecting various preferences and requirements for candidates. Based on an analysis of expert opinions from managers and department heads at industrial companies in Central and Eastern Europe, we constructed econometric models to determine salary ranges based on employee competences and the necessary requirements for applicants for various positions. This approach will contribute to the development of certain areas of human resource management theory, particularly in understanding the specifics of recruitment procedures and motivation based on competence assessment. The developed models can be used in various personnel assessment programs in industrial enterprises.

In the future, this approach can be expanded for use in various companies; a comparative analysis of the necessary requirements for candidates for certain positions will be conducted, taking into account the characteristics of the organizational and business culture, industry specialization, and the influence of representatives of different generations among top managers on the formation of requirements for competences and selection procedures for candidates for certain positions.

Acknowledgments

This article is an output of the scientific project: 4/2023-M "The meaning and application of social responsibility in selected companies" (2023-2025) funded by Bratislava University of Economics and Management (BUEM), Slovakia. We thank Prof. M. Hudáková, the project leader, for organizational support in conducting the research presented in this paper.

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Received: March 6, 2026.
Reviewed: May 15, 2026.
Accepted: June 12, 2026.