



**Global Scientific and Academic Research Journal of Economics, Business and Management**

ISSN: 2583-5645 (Online)

Frequency: Monthly

Published By GSAR Publishers

Journal Homepage Link- <https://gsarpublishers.com/journals-gsarjebm-home/>



**Dilemma of the selection of candidate on job position in the company as problem of utility and game theory**

**BY**

**Stefan Graser<sup>1\*</sup>, Nadiya Dubrovina<sup>2</sup>, Monika Hudakova<sup>3</sup>**

<sup>1</sup>PhD student, Bratislava University of Economics and Management, Slovakia

<sup>2</sup>Associate professor, Csc., PhD, Bratislava University of Economics and Management, Slovakia,

<sup>3</sup>Professor, PhD, Bratislava University of Economics and Management, Slovakia



**Article History**

Received: 25/02/2024

Accepted: 04/03/2024

Published: 06/03/2024

**Vol – 3 Issue – 3**

PP: -11-19

**Abstract**

*In this research, the model of candidate' selection was developed. This model is based on the application of matrix games. The two possible candidates were considered as players, which can take the different strategies. The professional and soft skills of the candidates are evaluated by different criteria and scale from 1 till 10 is used for each criterion. The decision maker is HR manager, who is responsible for hiring personal or who carry out functional duties for creation and development of internal personal potential and provide the program of career development in the company. This HR manager compares two candidates and chooses the best one according her/his utility function and suggestions about importance of the skills on the ideal candidate for certain position in the company. The problem is what is the best strategy for candidate, if she/he would like to get this position and obtain highest possible benefit. The developed model can be used for the improvement of recruitment process and the preparation of the candidate for the competition in the training. The elements of this model can be implemented in the software for the recruitment process in the company and allow to organize this procedure more effectively.*

**Keywords:** recruitment, model, game theory, strategy, optimal solution

**INTRODUCTION**

Organisations must react fast to people requirements in the ever-evolving business environment of today. Therefore, it's critical to have a clear recruitment policy in place, which may include job descriptions. The wrong decision results the possible fails in organisations and additional costs from choosing the incorrect applicant or turning down the best one (Genping, 2022). As a result, an organization's recruitment procedures need to be successful and efficient in luring the top candidates. Planning for HR, attracting candidates, and screening them are all part of this process. The hiring and selection process is becoming more crucial as the business develops and grows and as new hires demonstrate a willingness to learn, flexibility, and teamwork (Chaudhary, Nirala, 2014). The problems of effective recruitment and selection, their crucial role for different organisations are discussed in many articles and books (Armstrong, Taylor, 2017; Dessler, 2020, etc). S. Gaikwad and V. Vaishnav analysed the steps involved in the recruitment process are assessing the job requirements, luring candidates, vetting and selecting candidates, hiring, and integrating the new hire into the team (Gaikwad, Vaishnav, 2022).

The problem 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). 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 in the most qualified and motivated applicants with required professional skills (Schmidt et al, 1992; Kristof, 1996; Rafaeli, 1999; Chaudhary, Nirala, 2014; Genping, 2022). Nevertheless, many companies take into account the soft skills of the candidates, which are associated with an employee's work style and disposition (Chapman et al, 1999, 2003). In the same time, it is important to evaluate the candidate at whole according to the application of the set of criteria and their 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. The candidates estimate their chances to be selected, can take the different strategies to improve their skills, and consider their own rational behavior (Chapman et al, 1999, 2003). Since recruiting and selection are the main sources of talent, they

\*Corresponding Author: Stefan Graser



are more important in attaining a competitive edge. It is crucial to choose candidates who meet the qualifications requirements and who possess the right values and attitude to fit in with the workplace culture. 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 organizational growth objectives (Genping, 2022).

However, because the process of recruiting and selection is dynamic and so complicated, the recruiters overlook crucial aspects. Thus, various requirement and selection plans must be developed for various needs, jobs, and organisations. At the same time, a number of variables will impact it, including the candidate's qualifications, the organization's location, the industry, and the weather. Ignoring these factors could lead to certain negative issues (Genping, 2022).

The review of some articles, reports, and books devoted to the different problems of hiring and selection of the personnel in the companies showed that the qualitative studies are dominated and most sources of the information and data are gathered by means different questionnaires, surveys, experts' opinions. Then for the elaboration of the data the descriptive statistics or other statistical methods are used (Schmidt, Hunter, 1992, 1998; Nikolaou, Oostrom, 2015; Welasari et al, 2023). The reasons of such approaches are connected with wide application of the psychological and sociological methods for the evaluation of human resources and their motivation.

For example, in their article F. L. Schmidt and J.E. Hunter 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-analytic analysis and the Determinants of Practical Value (Utility) of Selection Methods are considered (Schmidt, Hunter, 1998).

In study of C. Goldberg (2003) it is investigated 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 (Goldberg, 2003).

In the study presented by A.M. Tamayo et al (2010), the authors gathered information about 235 employees of Davao City-based businesses. The employees were asked to answer 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 were examined (Tamayo et al, 2010).

In other article, the authors (Welasari et al, 2019) examine the literature on the hiring and choosing of department heads on the example of in the Indonesian government of West Java Province. As they conclude, the State Civil Service (ASN) policies and management are based on qualifications, competencies, 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, competencies, and credentials in order to fill specific roles (Welasari et al, 2019).

Nevertheless, last years the methods of application of Artificial Intelligence (AI) for the organisation of recruitment processes are coming more and more (Jatoba et al, 2023). Many modern scientists focused on the opportunities of application of artificial intelligence (AI) for hiring personnel, due to the advanced procedures and e-recruitment for initial decision the technical efficiency in the selection of the need candidate(s) among big number of applicants is increasing and 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. In one of the hand, the benefits of big data and machine learning for selection procedure of the need 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 viewpoint monitors the moment when technology takes the role of arbitrary human judgments, however, it is not appropriate in situations when standardised evaluations are already in place (Kassir et al, 2023).

For example, in order to investigate the impact of artificial intelligence (AI) on recruitment effectiveness N. Nawaz 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 organization choose the best candidate from its talent pool (Nawaz, 2019).

In study presented by Jasim and Jawid (2023), the application of AI is shown for the human resources recruitment. The purpose of mentioned study is to illustrate staff members' viewpoints from different organisations. 22 people, ranging from senior executives to operational staff in charge of hiring workers for private companies in India, are interested in artificial intelligence innovation in HR recruitment, which depends on gathering data from the sample and theoretical research studies to examine the possibility. 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 (Jasim, Jawid, 2023).

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

That is why, one of the interesting approach for the analysis of the competition between two or more possible candidates is game theory (Samuelson, 2016). Game theory helps actors or decision-makers to choose one path of action against another in reaction to a competitor's predicted course of action (Chakrabarty, Kanaujiya, 2023). It's a field of mathematics that illustrates how players behave in a game and what the best moves are. It demonstrates how player one would reason in a scenario where his (her) actions have an impact on player two, whose actions have an impact on player one as well (Tamayo et al, 2010). The number of players in the economy has increased, which has raised the degree of competition. In the current competitive landscape, it has become increasingly difficult for any business to implement strategies that would make them stand out from the competition (Chaudhary, Nirala, 2014).

The application of the game theory and own development of the mathematical model of candidate' selection are presented in this article. The purposes of this research are: 1) to evaluate the candidate at whole identity according to the application of the set of criteria and their weights for the estimation of the professional and personal skills of the candidates and needs of the company; 2) to consider the rational behavior of the candidates on open positions, their possible strategies for the improvement of their characteristics and the results of the competition between them; 3) to develop the appropriate mathematical model based on the game theory and consider the algorithm for seeking the optimal solution; 4) to make some recommendations for the companies focused on the possible improvement of the hiring process and selection of the successful candidates.

## Methodology, Materials, and Methods:

In this research the model of candidate selection was developed. This model is based on the application of matrix games. In addition, some elements of the utility theory and hierarchy method were used too. In this reason, for the evaluation of the set of qualitative characteristics of the candidates and comparative analysis of their importance, the

experts from human resources recruitment were asked. The developed mathematical model of candidate' selection is more theoretical, nevertheless it can be adapted for the certain companies.

The suggestions for our model are presented below.

The two possible candidates were considered as players, which can take the different strategies. The professional and soft skills of the candidates are evaluated by different criteria and scale from 1 till 10 is used for each criterion. The decision maker is HR manager, who is responsible for hiring personal or who carry out functional duties for creation and development of internal personal potential and provide the program of career development in the company. This HR manager compares two candidates and chooses the best one according her/his utility function and suggestions about importance of the skills on the ideal candidate for certain position in the company. The problem is what is the best strategy for candidate, if she/he would like to get this position and obtain highest possible benefit.

Such approach allows to formalize the procedure of hiring candidates in the different job positions in the company, nevertheless, the role of psychological issues and individual attitudes of HR manager to possible candidates is important. So if the utility function and scheme of benefits for payoff matrix will be different, the optimal solutions for mixed strategies also will be varied.

The developed model can be used for the improvement of recruitment process and the preparation of the candidate for the competition in the training. The elements of this model can be implemented in the software for the recruitment process in the company and allow to organize this procedure more effectively.

The company also analyses the potential of each candidate for open job position and the perspectives of her/his employment, the possible advantages for the company. But in other side the company has the interest to minimize the potential risks and extra costs associated with new candidates. All of the mentioned factors prove that it is necessary to develop some detailed mechanism of the candidates' selection based on the appropriate mathematical model and algorithm for seeking the optimal solution.

## Results and discussion:

In this research the model of candidate job position choice is based on the application of matrix games. The matrix games are often used for some kind of economic problems and due to the idea and tools of game theory are possible to find the best (optimal) solution (Samuelson, 2006; Chakrabarty, Kanaujiya, 2023).

Let consider the problem of candidate job position choice by means tools of game theory. We formulate the problem as matrix game with 2 players. Thus, two possible candidates act as players, who can take the different strategies. The skills of the candidates are evaluated by different criteria and scale from 1 till 10 is used for each criterion. The decision maker is

HR manager, who is responsible for hiring personal or who carry out functional duties for creation and development of internal personal potential and provide the program of career development in the company.

This HR manager compares two candidates and chooses the best one according her/his utility function (Chakrabarty, Kanaujiya, 2023) and suggestions about importance of the skills on the ideal candidate for certain position in the company.

The problem is what is the best strategy for candidate, if she/he would like to get this position and obtain highest possible benefit.

Let formulate this problem as mathematical model.

- At first let introduce 9 important skills and characteristics, which are important for assessment of candidate for certain job position in the company. The set of need skills was developed on the recommendation of the experts.

We used such skills and characteristics:

- $x_1$  – professional skills and experience (PSE);
- $x_2$  – cognitive and analytical skills (CAS);
- $x_3$ - personal characteristics and skills (PERS);
- $x_4$  – responsibility, time management skills;
- $x_5$  - leadership (LDP);
- $x_6$  – skills in IT using (ITS);
- $x_7$  – health condition and ability to keep health lifestyle (HC);
- $x_8$  – communication skills (CS);
- $x_9$  – language skills (LGS).

The skills are evaluated by means scale from 1 to 10 and for the assessment the different tests may be applied.

- Then the utility function of HR manager is introduced. There are two approaches: to consider theoretical utility function with certain values of parameters or to use empirical utility function with estimated parameters.

In our approach we suggested that utility function will be presented as function of several variables or

$$U = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9).$$

We used typical utility function with certain important mathematical features, thus our function is given below:

$$U = x_1^{\alpha_1} \cdot x_2^{\alpha_2} \cdot x_3^{\alpha_3} \cdot x_4^{\alpha_4} \cdot x_5^{\alpha_5} \cdot x_6^{\alpha_6} \cdot x_7^{\alpha_7} \cdot x_8^{\alpha_8} \cdot x_9^{\alpha_9}.$$

In this function  $\alpha_i$  are parameters, which are evaluated by using of method of hierarchy developed by T. Saati (Matrosova et al, 2021).

For the evaluation of unknown parameters  $\alpha_i$  we used M\_Priority, which allows the expert to provide comparative pair analysis for two elements and evaluate their level of importance by special scale.

In our research, we used several experts who were responsible for hiring personal in the companies and also some other specialists took part in the experiments with creation of such utility function for evaluation of the importance of the skills on the ideal candidate for certain position in the company.

One of the utility function which was constructed by mentioned approach is given below:

$$U = x_1^{\alpha_1} \cdot x_2^{\alpha_2} \cdot x_3^{\alpha_3} \cdot x_4^{\alpha_4} \cdot x_5^{\alpha_5} \cdot x_6^{\alpha_6} \cdot x_7^{\alpha_7} \cdot x_8^{\alpha_8} \cdot x_9^{\alpha_9},$$

where  $\alpha_1 = 0,2925$ ;  $\alpha_2 = 0,1952$ ;  $\alpha_3 = 0,1664$ ;  $\alpha_4 = 0,1601$ ;  $\alpha_5 = 0,0713$ ;  $\alpha_6 = 0,0406$ ;  $\alpha_7 = 0,0303$ ;  $\alpha_8 = 0,0222$ ;  $\alpha_9 = 0,0209$ .

Thus, it is clear to seen that 1<sup>st</sup> place of importance is belonged to professional skills and experience ( $\alpha_1 = 0,2925$ ); next 2<sup>nd</sup> place is for cognitive and analytical skills ( $\alpha_2 = 0,1952$ ), then the 3<sup>rd</sup> and 4<sup>th</sup> places are closed each other and belonged to personal skills and responsibility management skills, where  $\alpha_3 = 0,1664$  and  $\alpha_4 = 0,1601$  respectively. The leadership has fifth position and  $\alpha_5 = 0,0713$ . Other three last positions are belonged to skills in IT, health condition, and languages skills, where  $\alpha_7 = 0,0303$ ;  $\alpha_8 = 0,0222$ ;  $\alpha_9 = 0,0209$ .

- Then the possible strategies for 2 players were created. There description is given in the table 1. We suggested that the possible costs for actions are related with prices in Eastern Europe. The figures in table 1 may be different in the cases of other countries.

**Table 1. Description of the strategies for 2 players – candidates for job position**

Strategy	Actions	Costs, euro and ours	Effect on the skills
$S_1$	Do nothing	No costs and no spending additional time	0
$S$	Take additional professional courses or trainings with certificate	300 euro and 30 hours of leisure time	Improve the professional skills on 3 or less points
$S_3$	To use ability for self-teaching, read additional books, watching videos with professional recommendations, etc.	100 euro and 50 hours of leisure time	Improve communication skills on 5 or less points
$S_4$	To take language courses with certificate	200 euro and 100 hours of leisure time	Improve language skills on 4 or less points
$S_5$	Self-improvement, reading books focused on psychological issues	50 euro and 100 hours of leisure time	Improve personal skills on 3 points
$S_6$	Take courses on management and leadership	150 euro and 100 hours of	Improve responsibility, time

		leisure time	management skills on 2 or less points and improve leadership on 1 point
S <sub>7</sub>	Take courses or advices how to improve self-presentation	70 euro and 35 hours of leisure time	Improve personal skills on 1 point, heal condition on 1 point, and communication skills on 1 point

Source: elaborated by authors

In the table 2 the matrix for changes in the skills and personal characteristics is given for each strategy.

**Table 2. The changes in the skills and personal characteristics for each strategy**

	PSE	CAS	PERS	RTS	LDP	ITS	HC	CS	LGS
A1	0	0	0	0	0	0	0	0	0
A2	3	0	0	0	0	0	0	0	0
A3	0	0	0	0	0	0	0	5	0
A4	0	0	0	0	0	0	0	0	4
A5	0	0	3	0	0	0	0	0	0
A6	0	0	0	2	1	0	0	0	0
A7	0	0	1	0	0	0	1	1	0

Source: elaborated by authors

- Let take two possible candidates with characteristics, some of them are not differed significantly. The characteristics of two candidates, candidate A, and candidate B, are presented in the table 3.

**Table 3. The characteristics of Candidate A and Candidate B and calculation of utility for HR manager**

Parameters $\alpha_i$	0,2925	0,1952	0,1664	0,1601	0,0713	0,0406	0,0303	0,0222	0,0209	$\sum_{i=1}^9 \alpha_i = 1$
Skills and characteristics	PSE	CAS	PERS	RTS	LDP	ITS	HC	CS	LGS	Utility
Candidate A	1	1	9	4	1	8	10	5	7	2,2666
Candidate B	1	1	7	4	7	2	4	9	8	2,3326

Source: elaborated by authors

- Then it is necessary to calculate the elements in the matrices of personal characteristics and utility function for candidate A and candidate B, if they will use strategies S<sub>1</sub>, S<sub>2</sub>, ..., S<sub>7</sub> from tab. 1.

The characteristics of the candidate A and candidate B are presented in the tables 4 and 5 respectively.

**Table 4. The characteristics and values of utility function calculated for candidate A**

Candidate A	PSE	CAS	PERS	RTS	LDP	ITS	HC	CS	LGS	Utility
A1	1	1	9	4	1	8	10	5	7	2,2666
A2	4	1	9	4	1	8	10	5	7	3,2645
A3	1	1	9	4	1	8	10	10	7	2,21
A4	1	1	9	4	1	8	10	5	10	2,1762
A5	1	1	10	4	1	8	10	5	7	2,2147
A6	1	1	9	6	2	8	10	5	7	2,4399
A7	1	1	10	4	1	8	10	6	7	2,2237

Source: elaborated by authors

**Table 5. The characteristics and values of utility function calculated for candidate B**

Candidate B	PSE	CAS	PERS	RTS	LDP	ITS	HC	CS	LGS	Utility
B1	1	1	7	4	7	2	4	9	8	2,3326
B2	4	1	7	4	7	2	4	9	8	2,8231
B3	1	1	7	4	7	2	4	10	8	1,8864
B4	1	1	7	4	7	2	4	9	10	1,882
B5	1	1	10	4	7	2	4	9	8	2,6885
B6	1	1	7	6	8	2	4	9	8	2,0274
B7	1	1	8	4	7	2	5	10	8	2,1705

Source: elaborated by authors

- The decision of HR manager depends on the results of comparative analysis for values of utility function in the case of candidate A and candidate B. The choice Q is defined as function:

$$Q = f(U_1, U_2) = \begin{cases} 1, & \text{if } U_1 \geq U_2 \\ 0, & \text{if } U_1 < U_2 \end{cases}$$

If Q is equal to 1, it means that candidate A was selected for job position, otherwise the candidate B is winner.

The results of the decisions of HR manager is presented in the table 6.

**Table 6. The results of the selection by HR manager between candidate A and candidate B**

	B1	B2	B3	B4	B5	B6	B7
A1	0	0	1	1	0	1	1
A2	1	1	1	1	1	1	1
A3	0	0	1	1	0	1	1
A4	0	0	1	1	0	1	1
A5	0	0	1	1	0	1	1
A6	1	0	1	1	0	1	1
A7	1	0	1	1	0	1	1

Source: elaborated by authors

- Then the elements in payoff matrix for 2 players were calculated. We used the suggestions that the results of benefits will be dependent on the individual salary with addition premiums for some higher skills. Also the results of benefit were depended on the comparative analysis of the salaries for possible candidate A and candidate B. The HR manager choose the minimum of the cost for payment for the winner or candidate which was selected. Also, we took in the account the results of the costs which were taken by candidates. Thus, the final benefits are equal to the benefits, defined by employer and HR manager minus costs for improvement skills which were taken by candidates.

The elements of the payoff matrix are given in the table 7.

**Table 7. The payoff matrix for the game**

	B1	B2	B3	B4	B5	B6	B7
A1	0	0	1305	1305	0	1305	1305
A2	1035	1080	1037,5	1055	1042,5	1070	1042,5
A3	-100	-100	1235	1235	-100	1235	1235
A4	-200	-200	1135	1135	-200	1135	1135
A5	-50	-50	1257,5	1257,5	-50	1257,5	1257,5
A6	1185	-150	1187,5	1190	-150	1190	1190

A7	1240	-70	1240	1240	-70	1240	1240
----	------	-----	------	------	-----	------	------

Source: elaborated by authors

The positive elements mean the benefit or gain, which was obtained by the candidate, the negative elements mean losses, which the candidate had if he/she spent some money for improvement of skills, but they were not selected on job position.

- Thus we have the typical matrix game with 2 players and payoff matrix  $P = (p_{i,j})$  and the problem is to define the optimum strategy for player 1 (candidate B), if other player, player 2 or candidate B, can take each strategy from set  $S_1, S_2, \dots, S_7$ <sup>1</sup>.

The elements of the payoff matrix should be positive, thus after adding 201 to each element in the initial matrix, we get new payoff matrix (see Table 8)

**Table 8. The modified payoff matrix for the game**

	B1	B2	B3	B4	B5	B6	B7
A1	201	201	1506	1506	201	1506	1506
A2	1236	1281	1238,5	1256	1243,5	1271	1243,5
A3	101	101	1436	1436	101	1436	1436
A4	1	1	1336	1336	1	1336	1336
A5	151	151	1458,5	1458,5	151	1458,5	1458,5
A6	1386	51	1388,5	1391	51	1391	1391
A7	1441	131	1441	1441	131	1441	1441

Source: elaborated by authors

- Now we can define values for  $\max_i \min_j p_{i,j}=1236$  and  $\min_j \max_i p_{i,j}=1243,5$ . Let  $V_* = 1236$  and  $V^* = 1243,5$ . So, the saddle point in pure strategies does not defined.

But, we can see that  $V_* < V^*$ , but these values are relatively close each other. It means that if solution exist the probability for some strategies will be very closed to 1.

In general case we have deal with game in mixed strategies and it is necessary to define the probabilities for optimal set of selected strategies for player 1 and player 2.

The approach how we can define the optimal mixed strategies by means linear programming and seeking solutions for primal and dual problems are described in the many books on operation research or game theory (Samuelson, 2016).

The results of the solution of matrix game with two players in mixed strategies are given in table 9.

**Table 9. The results of the solution of matrix game with two players in mixed strategies**

Candidate	Candidate A						
	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5	Strategy 6	Strategy 7
Probability $p_i$	0	0,9938	0	0	0	0	0,0062
Candidate	Candidate B						
	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5	Strategy 6	Strategy 7
Probability $q_i$	0	0	1	0	0	0	0

<sup>1</sup> <https://kanchiuniv.ac.in/coursematerials/Game%20theory.pdf>

Source: elaborated by authors

For solution of primal and dual problems in linear programming, we used Solver in Excel.

Thus, we can see that in this case the recommendation for players 1 is to take Strategy 2 (the probability is approximately equal to 1) or improve professional skills and experience. The recommendation for player 2, if player 1 will take Strategy 2, is to take Strategy 3, where his losses as non-obtained benefits will be minimal.

This approach with application of game theory may be developed for the cases of different companies and features of the companies and various job positions should be taken into account. Such approach allows to formalize the procedure of hiring candidates in the different job positions in the company, nevertheless, the role of psychological issues and individual attitudes of HR manager to possible candidates is important. So if the utility function and scheme of benefits for payoff matrix will be different, the optimal solutions for mixed strategies also will be varied.

## Conclusions

The process of the selection of the candidates on open position are complicated and needs the implementation of qualitative and quantitative approaches. The candidates estimate their chances to be selected, can take the different strategies to improve their skills, and consider their own rational behavior. The company also analyses the potential of each candidate for open job position and the perspectives of her/his employment, the possible advantages for the company. But in other side, the company has the interest to minimize the potential risks and extra costs associated with new candidates. All of the mentioned factors prove that it is necessary to develop some detailed mechanism of the candidates' selection based on the appropriate mathematical model and algorithm for seeking the optimal solution. The developed model can be used for the improvement of recruitment process and the preparation of the candidate for the competition in the training. The elements of this model can be implemented in the software for the recruitment process in the company and allow to organize this procedure more effectively.

## 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.

## References

1. Armstrong, M., Taylor, S. (2017). *Armstrong's Handbook of Human Resource Management Practice*,
2. Carless, S. A. (2002). Recruitment and job choice: How important are fit perceptions? Paper presented at the 17th Annual Meeting of the Society for

- Industrial and Organizational Psychology, Toronto, Ontario, Canada
3. Chakrabarty, P.S., Kanaujiya A. (2023). *Mathematical Portfolio Theory and Analysis*. Springer Nature Singapore. 2023. <https://doi.org/10.1007/978-981-19-8544-7>
4. Chapman, D. S., Rowe, P. M., Webster, J. (1999). Modeling applicant reactions to selection interview structure and communication medium: Signal detection, justice or meta-perception? In R. L. Dipboye: From both sides of the desk: Applicant and interviewer perspectives. Symposium conducted at the 14th Annual Meeting of the Society for Industrial and Organizational Psychology, Atlanta, GA.
5. Chapman, D. S., Uggerslev, K. L., Webster, J. (2003). Applicant reactions to face-to-face and technology-mediated interviews: A field investigation. *Journal of Applied Psychology*, 88, 944–953.
6. Chaudhary, N., Nirala, A. (2014). Recruitment and Selection and Its Current Challenges. *International Research Journal of Management Sociology & Humanity (IRJMSH)*. Vol 5 Issue 5. 2014. 233-242.
7. Dessler, G. (2020). *Human resource management (16th ed.)*. Pearson. Fourteenth edition. New York: Kogan Page Limited. <https://www.pearson.com/us/higher-education/program/Dessler-My-Lab-Management>
8. Gaikwad, S., Vaishnav, V. (2022). Stages in Recruitment and its Importance: A Study. *International Journal of Engineering Research & Technology (IJERT)*. Vol. 11 Issue 03, March-2022. 128-131.
9. Genping, Y. (2022). Critically Discuss Challenges and Recommendations in Recruitment and Selection. *Proceedings of the 2022 7th International Conference on Financial Innovation and Economic Development (ICFIED 2022)*. *Advances in Economics, Business and Management Research*, Vol. 648. Atlantic Press. 274-279.
10. Goldberg, C. (2003). Applicant reactions to the employment interview. A look at demographic similarity and social identity theory. *Journal of Business Research* 56 (2003) 561 – 571
11. Gupta, P., Fernandes, S.F., Jain, M. (2018). Automation in recruitment: a new frontier. *J. Inf. Technol. Teach. Cases*, vol. 8, no. 2, pp. 118–125, Nov. 2018. <https://doi.org/10.1057/s41266-018-0042-x>
12. Jasim, F.T., Jawid, M.H. (2023). Artificial intelligence innovation and human resource management. *Tamjeed Journal of Healthcare Engineering and Science Technology*. Volume 1 (2): 2023. 20-29, <https://doi.org/10.59785/tjhest.v1i2.22>



13. Jatoba, M., Ferreira, J., Fernandes, P., Teixeira, J. (2023). Intelligent human resources for the adoption of artificial intelligence: a systematic literature review. *Journal of Organizational Change Management*. 10.1108/JOCM-03-2022-0075.
14. Kassir, S., Baker, L., Dolphin, J., Polli, F. (2023). AI for hiring in context: a perspective on overcoming the unique challenges of employment research to mitigate disparate impact. *AI and Ethics* (2023) 3:845–868 <https://doi.org/10.1007/s43681-022-00208-x>
15. Kristof, A. L. (1996). Person - organization fit: An integrative review of its conceptualization, measurement, and implications. *Personnel Psychology*, 49, 1–50
16. Matrosova, E., Tikhomirova, A., Matrosov, N., Dmitriy, K. (2021). Visualization of T. Saati Hierarchy Analysis Method. In: Samsonovich, A.V., Gudwin, R.R., Simões, A.d.S. (eds) *Brain-Inspired Cognitive Architectures for Artificial Intelligence: BICA\*AI 2020*. BICA 2020. *Advances in Intelligent Systems and Computing*, vol. 1310. Springer, Cham. [https://doi.org/10.1007/978-3-030-65596-9\\_32](https://doi.org/10.1007/978-3-030-65596-9_32)
17. Nawaz, N. (2019). Artificial intelligence is transforming recruitment effectiveness in CMMI-level companies. *International Journal of Advanced Trends in Computer Science and Engineering*. Vol. 8, No. 6. 3017-3021. [http://www.warse.org/IJATCSE/static/pdf/file/ijatcs\\_e56862019.pdf](http://www.warse.org/IJATCSE/static/pdf/file/ijatcs_e56862019.pdf) <https://doi.org/10.30534/ijatcs/2019/56862019>
18. Nikolaou, I., Oostrom, J. K. (2015). *Employee recruitment, selection, and assessment: Contemporary issues for theory and practice*, Psychology Press.
19. Rafaeli, A. (1999). Pre-employment screening and applicants' attitudes toward an employment opportunity. *Journal of Social Psychology*, 139, 700–712
20. Samuelson, L. (2016). Game Theory in Economics and Beyond. *Journal of Economic Perspectives*, 30 (4): 107-30. DOI: 10.1257/jep.30.4.107
21. Schmidt, F. L., Hunter, J. E. (1992). Development of causal models of processes determining job performance. *Current Directions in Psychological Science*, 1, 89-92.
22. Schmidt, F. L., Hunter, J. E. (1998). The Validity and Utility of Selection Methods in Personnel Psychology: Practical and Theoretical Implications of 85 Years of Research Findings. *Psychological Bulletin*. September 1998, 262-274.
23. Schmidt, F. L., Ones, D. S., Hunter, J. E. (1992). Personnel selection. *Annual Review of Psychology*, 43, 627-670.
24. Tamayo, A. M., Senajo E., Japay, R., Layasan, S., Abellanosa, G. (2010). Workers' Nash Equilibrium: Application of Game Theory in Business. 11th National Convention on Statistics (NCS), Philippines, 2010. Retrieved from: [https://www.researchgate.net/publication/283663295\\_WORKERS%27\\_NASH\\_EQUILIBRIUM\\_APPLICATION\\_OF\\_GAME\\_THEORY\\_IN\\_BUSINESS](https://www.researchgate.net/publication/283663295_WORKERS%27_NASH_EQUILIBRIUM_APPLICATION_OF_GAME_THEORY_IN_BUSINESS)
25. Upadhyay, A.K., Khandelwal, K. (2018). Applying artificial intelligence: implications for recruitment. *Strateg. HR Rev.*, vol. 17, no. 5, pp. 255–258, Oct. 2018.
26. Welasari, U. S., Agustino, L., Sulaeman, A. (2019). Recruitment and Selection of Head Department (In West Java Province's Government of Indonesia). *Proceeding of the 6th International Conference on Social Sciences*, Vol. 6, 2019, pp. 11-20. DOI: <https://doi.org/10.17501/2357268X.2019.6102>