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Wroclaw University of Technology Graduates' Career Paths

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Malara Z., Miśko R., Sulich A. **Wroclaw University of Technology Graduates' Career Paths**[1]

Abstract

Graduates' careers are the most spectacular and visible proof of excellent university education. It is also significant for the university performance assessment when its graduates can easily find a job in the labour market. Information about graduates matching their qualifications and fields of study versus undertaking employment is important for future students. The choice of a future career path is based on specific criteria, which were backed by surveys performed among graduates by the career office at the Wroclaw University of Technology. The aim of this article is to address questions about the most significant criteria for career paths among graduates of the Wroclaw University of Technology. In this article, the Bellinger's multi-criteria method was explained and presented, then used to analyse chosen factors in graduates' career paths; these were then compared with the Gale-Shapley algorithm results. The graduates' career paths are not really connected with chosen jobs that matched their graduated fields of study; therefore, young graduates' careers are not always the best benchmark for assessing university performance. Results obtained in this paper proved that a majority of students possess great awareness of the significance of self-development because they selected an education path that ensures future employment. Young graduates of WUT become well-versed in the requirements of the labour market very quickly and capable of formulating their own opinions.

Keywords*: Gale-Shapley algorithm, the Bellinger Method, career paths*

Introduction

On the labour market, we can observe at least two main actors . One of them is companies, which are looking for the best candidates, and the other one is the candidates' group, who have to decide which job and employer to pick. Both groups make their decision based on group intertwined criteria; therefore, they are looking for the best way to become the "perfect candidate" or the "ideal employer".

The specific group of candidates that is particularly targeted by companies is that of young educated people, who have recently graduated from university and are one of the most preferred groups on the segmented labour market. Recruitment teams are interested in this group of candidates because they possess often-demanded qualifications, and their salary expectations are not so high, unlike among more experienced employees [9, p. 606]. In this article, the choice made by graduates is the most important and, to better understand their decision process, it is necessary to recall a few game theories.

The text is organised as follows: The first part describes a few game theories that are important in career-related decision-making and their potential scope in career path choice . The following section distinguishes the role of choice factors. The next part presents Bellinger's method and analyses data obtained from research conducted in 2015. Interested readers may find a broader survey of the subject in other works [1, p. 605–613], [2, p. 13–23]. The final section contains brief conclusions and questions which should be addressed in further studies.

The goal of this article is to address the question about which criteria of career path choice are most important for the graduates of Wroclaw University of Technology (WUT). The second goal is to present and use the modified multi-criteria Bellinger's method to analyse the chosen factors of career path choice among the graduates of WUT [3]. The results obtained from calculations in the presented Bellinger's method were compared to results obtained from the Gale-Shapley algorithm to check if there is any difference in matches between proposed job positions (p) and criteria of choice (c) and correctness of the chosen method.

Theoretical background

The decision about the choice of career path is one of the elements of the game theory explored mostly by John Nash, Thomas Ferguson, David Gale and Lloyd Shapley. In 1951 J. Nash explained that specific processes, such as choice of company or choice of employer, can be described by equilibrium, which is not Pareto optimal [4, p. 48–49]. Nash's equilibrium states that preferences are the most important factors of these decisions (i.e., in zero-sum game, which means that someone has to stay unemployed when others get their jobs).

Gale and Shapley described their stable matching theory; they developed an algorithm leading to an equilibrium state (in nonzero-sum game) [5, p. 9]. This theory assumes that each decision leads to a stable relationship between candidate

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and employer (employment). The algorithm to reach matching is finite, which is essential because both numbers, the number of candidates and companies (open positions), are irrelevant. Therefore, according to these two theories, candidates are always in a better position because they always have the right to choose the best employer for them (or even establish their own business).
On the other hand, companies cannot make their choice of all possible candidates from the job market but only from among those who applied for a specified position. Recruitment nowadays is more a marketing part of employment because recruiters want to attract as many candidates to enable rational selection, which is computed and managed by computers [1, p. 608]. Companies' choices are then limited by the number of candidates who apply for open positions.
Research conducted among students and graduates in 2015 (N=1242) showed that there is no one main factor of choice, and they are all related to each other [3, p. 15]. However, every year, young people expect a high salary towards employers, not only in financial matters. Young graduates of WUT have high requirements towards their jobs, but do not revere employment and are not prone to make it to the top of the career ladder irrespective of the price.
Still, the amount of time and energy consumed to cater for professional development might lead to different conclusions. The list of factors for future career path was ranked by students who chose eleven most important criteria from more than twenty listed in poll form. This result allowed for analysis of them with two methods, Bellinger's method and Gale-Shapley algorithm, because they use selected previously criteria to analyse the best possible choice.
It is remarkable in further analysis of the same student group that graduates' career plans and criteria hierarchy are subject to change. Over time, graduates often change their criteria or add new criteria that were previously rejected or neglected (like work-life balance, job stability, lack of anxiety and stress, large degree of independence, long holiday leave, and prestigious position). Fresh WUT graduates usually do not start family life early, so some values (time for family, or benefits dedicated for home) become more important in time [6, p. 24–27].

Multi-criteria method

In this article, the decision process is a non-zero sum game, which leads to graduates choosing an ideal job position. The choice is based on many criteria, and each candidate ranks his own by creating a list. Therefore, the multi-criteria method here can be used to check which of these criteria are most important to the whole group.
The multi-criteria method was founded by Bernhard Bellinger [7, p. 57–84], but was developed and propagated in Poland in the 1990s by professor Zbigniew Malara [8, p. 67–76], [9 p. 20–23], [2, p. 13–23]. B. Bellinger was using this tool in West Germany banks in the 1970s. He ranked a list of customers (applying for a loan) in order from the most reliable to the least reliable. Bellinger's method allows for comparing evaluation results when different criteria are used (mainly, it is useful because of their different labels). It consists of several steps, shown below [9, p. 20–23].

1st Step: Choose which criteria will be used for decision-making.
2nd Step: Identify the measuring units and the desired changes (in the given criteria).
3rd Step: Determine the lower and the upper limit change of each criterion.
4th Step: In association with the subjective choice of the decision-maker, give meaning to criteria by specifying weights so that the sum of all weights is equal to one.
5th Step: Create a table containing the actual values of the criteria for all variants.
6th Step: Present any number from the table formed in step 5 as a percentage of the "way" from the least desirable to the most desirable state. It should be started by determining the size of the entire "path" from the least desirable to the most desirable state for given criteria. Thus, differences between the states are calculated. Then, from the actual value of the criteria, we subtract the value of the least desirable state (calculating the actually covered "way"). Finally, we divide the actually covered "way" by the entire "path".
7th Step: Multiply the number obtained in step 6 by the weight in step 4.
8th Step: Finally, determine the best variant by summing the ratings from the previous step for each variant.

It is assumed that students who are looking for a job are also following some criteria. Because of the limits of this paper, it is decided that there are only 5 job positions, hereafter referred to as p1, p2, p3, p4 and p5. It is not necessary to show details of those positions to use the method. All possible combinations between the number of job position (p=5) and criteria which can be chosen (c=11) can be calculated as follows:

$$\binom{c}{p} = \frac{c!}{p!\,(c-p)!} = \frac{11!}{5!\,(11-5)!} = 462$$

The Bellinger method allows to choose only most significant examples, what makes method much simple to analyse and friendly.
In the first step it is necessary to set criteria which will be used to make decision. According to research of Wroclaw

University of Technology [3, p. 15] there are following criteria:

1. possibility of career development
2. earnings (appropriate pay as net salary)
3. job position related with finished studies,
4. skills and interests (job matching skills),
5. reputation of the company,
6. transparent career paths (possibility of fast promotion)
7. market success of the company,
8. experience
9. social benefits
10. localisation of the company
11. size of the company

It was decided that criteria mentioned above, will be labelled sequentially from c1 to c11. Second step requires measuring units and direction of change:

- c1 numbers, growth desired
- c2 thousands of Polish złoty, growth expected
- c3 numbers, growth desired
- c4 numbers, growth desired
- c5 numbers, growth desired
- c6 numbers, growth desired
- c7 numbers, growth desired
- c8 numbers, growth desired
- c9 thousands of Polish złoty, growth expected
- c10 kilometres from home to location of the company, decrease desired
- c11 numbers, growth desired

In the next step, the lower and upper limits for each change criteria are adopted as follows (conventionally and arbitrarily for this study [6, s. 25–26]):

- c1 numbers 1-5
- c2 thousands of Polish złoty 2502,87-3238,53
- c3 numbers 1-2
- c4 numbers 1-5
- c5 numbers 1-5
- c6 numbers 1-2
- c7 number 1-5
- c8 number 1-5
- c9 thousands of Polish złoty 200-800
- c10 km form home to the company 0-762,4
- c11 numbers 1-4

The fourth stage is to determine weights for all the criteria. This is an important analysis stage because it significantly affects the final results. It was decided to rely on the results of the WUT research [3, p. 15]. It means that the highest weight is assigned to the positions of the criteria.

- c1, 0.107
- c2, 0.105
- c3, 0.101
- c4, 0.10
- c5, 0.095
- c6, 0.092
- c7, 0.088
- c8, 0.086
- c9, 0.085
- c10, 0.083
- c11, 0.059

The fifth step involves the formation of a table that contains the actual values of the criteria for each variant.

Table 1. Actual of values for criteria.

	p1	p2	p3	p4	p5
c1	5	4	3	4	1
c2	2502,87	3000	3238,53	2900	2700
c3	2	1	2	1	1
c4	1	3	4	4	3
c5	2	1	4	5	3
c6	2	1	1	2	1
c7	5	4	1	4	4
c8	5	4	3	4	1
c9	500	400	800	200	300
c10	0	50	125	762,4	200
c11	1	4	3	3	3

Source: authors' own work.

Table 2. Numbers form previous step as a percent of a distance.

	p1	p2	p3	p4	p5
c1	1	0,75	0,5	0,75	0
c2	0	0,67	1	0,53	0,26
c3	0,25	0	0,25	0	0
c4	0	0,5	0,75	0,75	0,5
c5	0,25	0	0,75	1	0,5
c6	1	0	0	1	0
c7	1	0,75	0	0,75	0,75
c8	1	0,75	0,5	0,75	0
c9	0,5	0,33	1	0	0,16
c10	1	0,93	0,83	0	0,73
c11	0	1	0,66	0,66	0,66

Source: authors' own work.

Table 3. Values after consideration of weights.

weights		p1	p2	p3	p4	p5
0.107	c1	0,107	0,080	0,053	0,080	0
0.105	c2	0	0,070	0,105	0,056	0,028
0.101	c3	0,025	0	0,025	0	0
0.1	c4	0	0,05	0,075	0,075	0,05
0.095	c5	0,023	0	0,071	0,095	0,047
0.092	c6	0,092	0	0	0,092	0
0.088	c7	0,088	0,066	0	0,066	0,066
0.086	c8	0,086	0,064	0,043	0,064	0
0.085	c9	0,042	0,028	0,085	0	0,014
0,083	c10	0,083	0,077	0,069	0	0,061
0,059	c11	0	0,059	0,039	0,039	0,039

Source: authors' own work.

In the last step it is necessary to sum up the individual values for each variant. Thanks that a final evaluation is obtained.

Table 4. Total ranking and the best variant.

Variant	Total rating
p1	54,75
p2	49,65
p3	56,67
p4	56,87
p5	30,63

Source: authors' own work.

The Bellinger method showed that the best choice (in a given criteria) is a p4 offer because it has the highest score from all the available job positions.
The highest-ranked match in Gale-Shapley's algorithm was the pair c1–p4. Both results suggest that the criterion of possible career development is the most important one, regardless of the salary criterion (matching c2–p3). Surprisingly education factor (matching c3–p1) is not the most important factor, which can be explained by seeking employment in various activities and professions.

Table 5. Matching results calculated by Gale-Shapley's algorithm with values form Bellinger's method ranked.

Weight of criterion	Criterion	Job position	Total rating
0.107	c1	p4	56,87
0.105	c2	p3	56,67
0.101	c3	p1	54,75
0.1	c4	p2	49,65
0.095	c5	p5	30,63

Source: authors' own work.

Conclusions

B. Bellinger's method was presented in a detailed manner in this article. It is a useful tool for facilitating multi-criteria decision. We can evaluate results using different criteria and compare them (even though they are measured on a different scale). The advantage of this method is its simplicity and ease of use. The procedure does not require complex and time-consuming calculations. It can be automated using a spreadsheet, so it seems to be a useful tool. It also has some disadvantages because it partly relies on a subjective assessment and the choice of random examples for analysis. Despite the limitations which Bellinger's multi-criteria method possesses, which are arbitrarily assigned criteria, and their significance, this method can be useful for analysing multi-criteria decisions like the choice of a career path. In the future, rules of respondents' choice of certain criteria should be more specified and maybe there should even be a more objective list of them created by some independent committee, to allow respondents to choose weights of ranked criteria. The graduates' career paths are not really connected with matching chosen jobs to the graduated field of studies. Therefore, young graduates' careers are not always the best benchmark for the assessment of university performance. Results obtained in this paper proved that the majority of students possess awareness of the significance of self-development, because they selected an education path to ensure future employment. Young graduates of WUT quickly become well-versed in the requirements of the labour market and formulate their own opinions.
The scientific contributions of this paper are as follows: 1. Analysing the factors of choice for future careers of Wroclaw University of Technology graduates. 2. Presenting Bellinger's method and its advantages and limitations. 3. Describing the most important factor of choice in a future career. 4. Mathematical verification of the decision-making process.

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