Career Path Choice in the Industry 4.0 using Grey Decision Making

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Abstract. Career path choice was an important decision in each individual life. Industry 4.0 has brought new challenges to a career path with much emphasis on smart instead of hard work. Globalization has also challenged Confucian culture in Vietnam and led to the change in the criteria of career path choice. The objective of this research was to explore and rank the criteria for career path choice in the context of Ho Chi Minh City, Viet Nam. The innovative grey decision-making method, namely Grey Analytical Hierarchy Process, was employed to reach the research objectives. The data of 30 experts who were researchers and practitioners in human resources were purposively selected to be used for the analysis. Research results showed that the hierarchical model of career path choice in the Vietnamese context had 3 levels. Level 2 included three main criteria with the priority orders as follows: (1) work diversity, (2) job prospects, and (3) family preference. Further, the ranking was made with 13 sub-indicators in level 3. The findings reflected the great changes in career path choice criteria, switching to work diversity from traditionally Confucian values with much reliance on family preference and job prospects in the public sector. This implied a proper performance of competency-based education for employees to meet the labor market demand of the private sector.

Keywords: career path, decision making, grey system theory, grey analytical hierarchy process, industry 4.0, Vietnam.

1. Introduction

Industry 4.0 affects all aspects of socio-economic life, which sets new requirements for future careers with an emphasis on smart work instead of hard work (Eberhard et al., 2017). A recent report by McKinsey Global Institute conducted by Manyika & Sneader (2018) shows that about 15% of the world's workforce, or about 400 million workers, will be replaced by robots between 2016 and 2030. At the same time, the demand for new jobs also increases with a forecast of about 21-33% by 2030. In particular, this demand is higher in emerging economies and Vietnam is not an exceptional case. Everyone from workers to managers must be prepared to work with artificial intelligence and machines. In the context of the explosion of online information, each individual needs to equip himself with the ability to filter, analyze and discover the critical information for career path choice. In addition, understanding technology will help individuals to be proactive in the digital world. Knowledge is no longer a top priority for recruitment strategy in the labor market. Instead, empirical evidence shows that thinking ability, social skills, and a persistent attitude are highly valued criteria by employers (Lippman, Ryberg, Carney & Moore, 2015). At the same time, as the industry changes, many new jobs will be created. Employees need to keep learning new skills (Nguyen, Luan, & Khoa, 2021). Therefore, the attitude and spirit of lifelong learning are important to be prepared for the challenge in the career path (Freddi, et al., 2018).

It can be said that the fourth industrial revolution is significantly different from previous industrial revolutions. To analyze deeper into these changes, PWC (2014) surveyed 10,000 people in China, India, Germany, the United Kingdom, and the United States. The respondents were asked how they think jobs will be changed over the next five to ten years, as well as how these changes will affect their careers. Research results show that both those who do not have a plan and those who have a plan are incapable of responding to changes. To cope with these changes, employees need to have a career path. This is gradually becoming a mandatory requirement rather than a negotiable issue in the labor market. Diversified career paths have been found in the literature. However, it's difficult to specify the career path choice (Kim & Choi, 2021). Criteria priority ranking is found as the solution to bridge this gap. However, the criteria importance analysis much relies on the context.

Ho Chi Minh City, with the advantage of trained human resources, has contributed to creating the leading position in the economic development of the country. In particular, the Resolution of the 10th City Party Congress on the Program to improve the quality of human resources for 2016-2020 has shown that the city's human resource development has been significantly improved. The percentage of trained workers is 84.8% and is estimated to reach 85% by the end of 2020 with the training quality meeting the standards of the ASEAN economic community (Canh, 2020). However, the impact of the 4.0 revolution on the labor market is inevitable. Therefore, the study on a career path is expected to bridge the current theoretical gap

in the career path choice ranking criteria and serve well for the process of developing high-quality human resources for Ho Chi Minh City, Vietnam. In this paper, we ranked the criteria for career path choice of employees in Ho Chi Minh City, Vietnam. We contributed to the literature in three ways. Firstly, the Vietnamese contextual criteria for career path choice were developed. Secondly, the exact share of each criterium in the career path choice was quantified for the proper intervention of the Vietnamese policymakers. Finally, we added to the debate on the priority of criteria and sub-criteria in the career path choice.

The paper started with an introduction, followed by literature in section 2. Section 3 described the research method. Our findings and discussions were reported in section 4. The last section concluded the study.

2. Literature Review

Research on career and related issues has been focused on in many studies. Differences in the research context led to different definitions. Greenhaus et al. (2009) stated that a career is a series of all positions held by an individual during a working period. Super (1980) extended the concept to the inclusion of positions holding spans to the whole lifetime. This was supported by Hutchison & Niles (2016), and Otluoğlu (2014) when considering career development as the course of events constituting a life. This viewpoint has recently been applied by Uysal & Ak (2021), given its comprehensiveness. The career path was further clarified by Sharafizadeh et al. (2021) as a series of consecutive positions in a job. In other words, a career path implied a set of jobs taken by an individual over either his/her career or a career lifetime (Hamidian et al., 2022; Pontinela & Berg, 2022). Most studies on career choice in general in particular examine the overall influence of factors on choice behavior (Papathanassis, 2021). In contrast, career path choice is not especially focused (Kim & Choi, 2021). Previous studies also rarely considered the classification of factor groups (Suhi et al., 2021). Therefore, this study makes a comparison of career path criteria to better understand career factors.

The social exchange theory (SET) of Homans (1974) has been widely applied in the studies of career behaviors. SET argued that individuals always tended to engage in behaviors that maximize their own benefits, whether tangible or intangible (Homans, 1974). Details, when individuals perform personal relationships-related behaviors, they will tend to consider and analyze what they have to spend and what they can receive (Wikhamn et al., 2021). Moreover, Sousa & Vala (2002) suggested that the relationships between individuals and organizations have also been examined by SET. Not only taking place between people, the interaction of individuals for interests was also reflected in this theory. Specifically, in the context of career research, when an individual felt or evaluated the achieved results as positive, he/she intended to perform the behavior (Gergen, 2021).

Besides Social exchange theory, Social capital theory (Coleman, 1998) is also a popular basis for exculpating the way that social relationships are associated with career behaviors. Pham et al. (2019) suggested that Social capital can be considered as conglomerating of resources from individuals' social relationships. These relationships help them to appreciate mental health or other related aspects like job satisfaction (Aloisio et al., 2019), reliance, or adaptability (Wang et al., 2021). As stated by Coleman (1998), Social capital is the foundation for combining social resources that helps individuals achieve better at work. SCT explained the relationship between human capital and social capital and specified the role of social relationships as a kind of resource in career development (Nawaz and Pangil, 2016). In addition, the study of Ehlen et al. (2016) reveals that SCT helps to elucidate important elements of the process and outcome of career-related prospects.

Hamidian et al. (2022) revealed many subjective and objective factors affecting the success of career path choice. Based on the two presented theories, many studies have demonstrated and supported the heterogeneous role of factors affecting behavior career choice in general or related areas in particular. Owusu et al. (2018) found that advancement opportunities, the chance to contribute, the element of variety and adventure, and flexibility in career options could influence career choice. Agarwala (2008) grouped these factors into three groups (1) intrinsic (interest in the job, personally satisfying work); (2) extrinsic (availability of jobs, well-paying occupations); and (3) interpersonal (influence of parents and significant others). Suhi et al. (2021) based on SET and SCT have classified the factors in a more detailed and comprehensive way. Specifically, the subjective and objective factors were presented in three groups including job prospects; family preference, and workplace diversity.

The first criterium, job prospects refers to the expectancy of the career/job that an individual is going to choose (Le Vigouroux et al., 2021). This is an important factor in building the basis for career choice. Besides, it ensures a more suitable and sustainable career development path (Aidukaite & Blaziene, 2021). In some situations, job prospects help to improve individuals' imagination, ideas, benefits, or risks that relate to career choices. According to Suhi et al. (2021), job prospects included job security, salary, future safety & security, and incentive. These are factors that ensure employee living. Besides, satisfaction (Suhi et al., 2021), and interest (Agarwala, 2008) are the two items of intrinsic motivation. Work diversity was considered to include travel opportunities, and high social demand (Suhi et al., 2021). Moreover, Chesters (2021) considers lots of conditions in which a career can be selected. In particular, individuals have to make sure that the position is still available, or "availability of jobs" (Chesters, 2021). Besides, well-paying occupations are also an important factor that ensures employees' income (Ngussa & Rehema 2019). In this article, we linked among internal and external factors that affected career path choice, which can warrant basic and higher needs of personnel.

For this research context, based on SET and SCT, we focus on the relationship between individuals and families, as this is where people spent most of their early stages of career development (Whiston & Keller, 2004). According to SCT, Wu et al. (2020) proved family's roles in affecting individuals' career choices. This standpoint was also agreed upon by Duarte Alonso & Kok (2021). Otherwise, individuals with different contexts of family or family backgrounds experienced different career path choices (Vautero et al., 2021; Yuan & Li, 2020; Nguti et al., 2021). Family preference consisted of time for family, family responsibility, and working hours (Suhi et al., 2021). On the other hand, parental influence promoted the relationship with interaction (Yuan & Li, 2020). In short, three major criteria including (1) job prospects, (2) work diversity, and (3) family references were explored in this study.

3. Research Methodology

Both qualitative and quantitative research methods have been employed in this study. Firstly, the qualitative Delphi method has been applied to explore the criteria in career path choice (see Table 1). Delphi technique has relied on the assumption of superior reliability of consultation made by experts panel to the individual (Joia & Sily de Assis, 2019). Its progress allowed for the unavailability of experts' direct confrontation (Milkovich, Annoni & Mahoney, 1972).

Table 1: Criteria for career path choice.

Criteria	Description
Job prospects	Job security
	Salary
	Future safety & security
	Incentive
	Satisfaction
	Interest
Work diversity	Travel opportunities
	High social demand
	Availability of jobs
Family preference	Parental influence
	Time for family
	Family responsibility
	Working hour

Next, the surveyed data of 30 experts have been used for the Grey Analytic Hierarchy Process (Grey-AHP) method which was applied in this study. This approach combined the grey system theory with the analytical hierarchy process (AHP) decision-making approach to minimize subjective judgments in weighting the criteria in career path choice. Instead of using crisp sets and crisp numbers, the Grey-AHP technique uses grey numbers (Liu, Fang, Yang, & Forrest, 2012; Liu & Forrest, 2010). In the Grey-AHP approach, pairwise comparisons with linguistic and grey

scales are used. There are several phases in the Grey-AHP approach, all of which are described in this section (Duleba, Çelikbilek, Moslem, & Esztergár-Kiss, 2022; Pham, Nguyen, & Phan, 2022; Li & Zhu, 2019):

Step 1. Define the hierarchical structure, and construct the pairwise comparison matrix using construction experts' evaluations with linguistic scales containing grey numbers in Table 2.

Table 2: Grey-AHP scale.

Level of importance	Linguistics Scale	Grey Numbers
1	Equivalent Importance	[1, 2]
3	Medium Importance	[2, 4]
5	Strong Importance	[4, 6]
7	Very Strong Importance	[6, 8]
9	Extreme Importance	[8, 10]

The grey comparison matrix is constructed as follows:

$$D = \begin{bmatrix} \otimes x_{11} & \otimes x_{12} & \cdots & \otimes x_{1n} \\ \otimes x_{21} & \otimes x_{22} & \cdots & \otimes x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \otimes x_{m1} & \otimes x_{m2} & \cdots & \otimes x_{mn} \end{bmatrix} \quad (1)$$

where $\otimes x_{ij}$ is the pairwise comparison concerning the ith criterion over the jth criterion?

Step 2. The normalization for the grey numbers is given in equations (2) through (4).

$$D^* = \begin{bmatrix} \left[\underline{x}_{11}^*, \overline{x}_{11}^* \right] & \left[\underline{x}_{12}^*, \overline{x}_{12}^* \right] & \cdots & \left[\underline{x}_{1n}^*, \overline{x}_{1n}^* \right] \\ \left[\underline{x}_{21}^*, \overline{x}_{21}^* \right] & \left[\underline{x}_{22}^*, \overline{x}_{22}^* \right] & \cdots & \left[\underline{x}_{2n}^*, \overline{x}_{2n}^* \right] \\ \vdots & \vdots & \vdots & \vdots \\ \left[\underline{x}_{m1}^*, \overline{x}_{m1}^* \right] & \left[\underline{x}_{m2}^*, \overline{x}_{m2}^* \right] & \cdots & \left[\underline{x}_{mn}^*, \overline{x}_{mn}^* \right] \end{bmatrix} \quad (2)$$

$$\underline{x}_{ij}^* = \frac{\underline{x}_{ij}}{\dfrac{1}{2}\left(\displaystyle\sum_{i=1}^{m} \underline{x}_{ij} + \sum_{i=1}^{m} \overline{x}_{ij} \right)} = \frac{2\underline{x}_{ij}}{\displaystyle\sum_{i=1}^{m} \underline{x}_{ij} + \sum_{i=1}^{m} \overline{x}_{ij}} \quad (3)$$

$$\overline{x}_{ij}^* = \frac{\overline{x}_{ij}}{\frac{1}{2}\left(\sum_{i=1}^{m}\underline{x}_{ij} + \sum_{i=1}^{m}\overline{x}_{ij}\right)} = \frac{2\overline{x}_{ij}}{\sum_{i=1}^{m}\underline{x}_{ij} + \sum_{i=1}^{m}\overline{x}_{ij}} \tag{4}$$

Step 3. Calculate the grey weight of each criterion by using equation (5) as follows:

$$\otimes w_i = \frac{\sum_{j=1}^{n}\otimes x_{ij}^*}{n} = \frac{\sum_{j=1}^{n}\left[\underline{x}_{ij}^*, \overline{x}_{ij}^*\right]}{n} \tag{5}$$

Step 4. Calculate the winterization of the grey weight by using equation (6) as follows:

$$M_i = (1-\lambda)\underline{w}_i + \lambda\overline{w}_i \tag{6}$$

where λ is the whitening coefficient

Step 5. The calculation of the consistency ratio from experts is as follows (Sárdi & Bóna, 2021):

$$CR = \frac{CI}{RI} \tag{7}$$

where

CI is the consistency index, and

RI is the random index

4. Research Results

By applying Equations (1) to (7) of the Grey-AHP methodology, we obtained the grey weights as shown in Table 3. The research results in Table 3 showed the hierarchical model and sub-criteria rank of career path choice in the Vietnamese context. Theoretically, the model has three levels to explain for human economic choice, which is supported by Suhi et al. (2021). Three main criteria at level 2 with the priority orders are empirically calculated as follows: (1) work diversity (0.3002); (2) job prospects (0.4718); and (3) family preference (0.2280).

Table 3: Ranking criteria and sub-criteria of career path choice.

Criteria & Weight	Sub-Criteria	Weight	Rank
Job prospects (0.3002)	Job security	0.3200	1
	Salary	0.2460	2
	Future safety & security	0.0720	6
	Incentive	0.1597	3
	Satisfaction	0.1130	4
	Interest	0.0893	5
Work diversity (0.4718)	Travel opportunities	0.1552	3
	High social demand	0.5535	1
	Availability of jobs	0.2913	2
Family preference (0.2280)	Parental influence	0.4202	1
	Time for family	0.2712	2
	Family responsibility	0.1118	4
	Working hour	0.1967	3

Work diversity was an important criterion that shared the highest weight in the career path choice. Job prospects were ranked second, followed by family preference. The findings reflected the "cost" and "benefit" analysis prior to deciding human beings (Homans, 1974). People tend to select the alternative with rewards. In Vietnam, the private sector has recently taken the role of driving employment opportunities (Jaax,2020). This is considered as a "nudge" in Vietnamese career path choices. In fact, work diversity was found to be associated with the private sector while job prospects and family preference were preferable in the public sector (Suhi et al., 2021). The recent emergence of FDI enterprises in Vietnam has benefited the private domestic sector, which is explained by this choice (Thao, Trung & Huong, 2022). The findings further shaped the trend of career path choice toward private employers, given its advantages in economic opportunities (Jaax, 2020).

As for the sub-criterial at level 3 of the career path choice model, our result confirmed social demand as the key driver of career path choice (Babin, Grant, & Sawal, 2010; Greculescu, Todorescu, & Popescu-Mitroi, 2014). The empirical results also recorded job availability and travel opportunities as the next important criteria. This implied the need of balancing social demand and job availability in career path choice to move towards the optimal equilibrium in the labor market (Zagonari, 2009).

Regarding job prospects, we found that current job security, salary, and incentive are the top three sub-criteria. In practice, the pursuit of both job security and high pay was mutually exclusive (Chen & Hsieh, 2015). Job security was long considered important criterion for attracting employees to the public sector (Frank & Lewis,

2004). In the context of Vietnam, it is not practical to desire high pay in the public sector (Demombynes & Testaverde, 2018). Therefore, our findings revealed the bias toward the public sector in career path choice with the 1st priority of job security. Vietnam is a country of Confucian values (Truong, Hallinger & Sanga, 2017). Family, especially parental influence has therefore driven the career path choice (Tran, Tran, Pham & Van Vu, 2018; Dang & Tran, 2020). However, global integration has dramatically challenged the family role. This study provided empirical evidence about the divergence from family preference toward job diversity, which empirically supported the cost-benefit analysis in making decisions introduced by Homans (1974).

5. Conclusion

Career path choice marks a milestone in each professional decision. Our study has provided a hierarchical model of three-level criteria of career path choice in the context of Vietnam. Job diversity has become superior to family preference and job prospects. This reflects the great change in Vietnamese perceptions under the impact of Industry 4.0. Despite some exciting findings on the priority of criteria as well as sub-criteria, readers' discretion to interpret the research implication should be made. The generalization of the results is limited to the expert's views in the Vietnamese context, especially in Ho Chi Minh City. The socioeconomic background of city dwellers was also much different from rural areas. Future research should pay attention to this cultural gap which may impact the findings. Regardless of the limitation, reliable and valid techniques of analysis in career path choice, including Delphi and Grey -AHP were applied for a decent ranking of criteria in the career choices model which provided a profound knowledge about the career dynamics of Ho Chi Minh City dwellers.

Acknowledgements

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