
**ANALYSIS OF THE FACTORS INFLUENCING THE CAREER
CHOICE OF UNDERGRADUATE IIT STUDENTS USING AHP**

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ABSTRACT

Choosing the right career is one of the most critical decisions in a student's life. Various aspects condition the decision of a student. This paper attempts to analyse the factors that affect the career choices of undergraduate engineering students. The possible factors shaping the choice of students are listed based on previous studies and judgements made by experts. The final- and pre-final-year students from Indian Institute of Technology, Roorkee, India, are surveyed. The survey finds the most dominating career preference among the students to be in the Information Technology and Management sector. Using analytical hierarchy process, the relative weights of the various factors affecting this trend are found. It is observed that for a majority of students, personal aptitude, growth prospects, and future income are the most dominating factors in the decision-making process. The job-training process is considered least important; long gestation periods or the need to pursue further specialisation are acceptable as long as more important factors like personal aptitude, growth prospects, and future income are favourable in that career option.

Key-words: *Analytical Hierarchy Process, Career Choice, Engineering Students, Undergraduate Students*

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INTRODUCTION

With advancements in technology and shrinking of the world into a global village, career opportunities have expanded manifold. Students have a vast choice of career fields, and new fields are securing their place in the list. Different opportunities have paved their way for students at the graduation level. In such a scenario, students need to make a well-rounded and informed choice.

The availability of myriad options has resulted in a slow but promising shift of trend. Students have begun to pick unconventional careers. Engineering students are increasingly exposing themselves to non-technical and creative fields.

However, the factors on which final career choices are made can be multifaceted and complex. Through research, it has been found that the major criteria that dominate the final decision patterns of the careers of engineering students are personal aptitude, societal expectations, growth prospects, specialisation requirements, future income, prestige of work etc. The degree of importance of each criterion is a subject matter of every individual's choice, environment, and conditions.

This paper aims to conduct a survey of engineering graduates and understand factors affecting their career selection after their technical degree, considering the various aspects that condition their final choice. Ultimately through Analytical Hierarchy Process (AHP), this paper aims to determine the weighted order of the different career alternatives in order to judge the recent trend of fields chosen by engineering students and their inclinations towards various deciding factors.

LITERATURE REVIEW

Extensive studies have been conducted in the field of career-selection criteria and their relative importance, as regarded by undergraduate students while deciding their careers after completing graduation (Lim and Soon, 2006). Previous research papers have reached varying results, as far as the degree of importance of the career-selection criteria are concerned.

The research by Ginsberg et al.(1951) and Super(1957) suggests that the choice of occupation is affected by personal choices, such as value system, aim, and personal ability as well as societal strata and structure, thereby constricting the gamut of careers which an individual can pursue. High income is observed as the most important criterion in the research of Bai (1998). However, Lau and Pang (1995) suggest that a person's ability can be validated by the amount of salary he or she receives. The opportunity for advancement is found to be of the primary importance in career selection by many research studies and literature (Moy and Lee,

2002; Boswell et al., 2003; Wilkinson, 1996). On the other hand, training and examination assistance are the important factors according to Chan and Simon (2000). Stephen A. Butler et al. (2000) have found that growth prospects and work stability are given the highest weightage by students. A study by Kyriacou et al. (2002) reveals that the choices made are moulded by the available career paths and the opportunities for growth in them. Özkale et al. (2004) surveyed around 400 undergraduate students to find that the most highly weighted factors affecting their choices are their interest in their career fields, their desire to be leaders, and their performance in the university's entrance exams. Zedeck (1977) analysed that the opportunities for growth, salary, flexible nature of work, and the duration of the project, respectively are the important criteria in descending order. Heneman, Rynes, and Schwab (1983) project the importance of pay scale and its variability in the market for job-related choices. In the study, it is found that salary is the chief determinant of the job appeal. It is also revealed that the higher the variability of salary, the more is the weightage of salary in the process of choosing the career. Feldman and Arnold (1978) demonstrate that compared to work characteristics such as flexible work hours, the opportunity to practice and demonstrate one's skill sets, non-pecuniary benefits, and independence, the pay holds much higher influence on one's decision-making process.

A study by Aycan and Pasa (2003) examines the variation in the students' career choices as a consequence of their cultures and backgrounds. Though the room for growth and pay scale are commonly the pressing criteria, every study has generated unique results. For example, Phillips et al. (1994) and Karl and Sutton (1998) rank "job security" as the highest-but-one weighted criteria, while Moy and Lee (2002), rank it highest-but-two. Work location and conditions are identified as important criteria in the research of both Wilkinson (1996) and Boswell et al. (2003). Another research conducted by Hüseyin Selçuk Kılıç and Emre Çevikcan (2011) concludes that "loving the job" is the highest weighted criterion by faculty and male and female students. Ming Lu (2012) concludes that for college students choosing their future careers, the most important factor is the development prospects followed by the working conditions. Ethington Feldman, and Smart (2000) use the "theory of careers" (Holland, 1966; 1985), to find that a milieu resonating with the students' personal is an appealing factor in their choice making.

Chan and Simon (2000) suggest that demographic factors like gender are also key factors in the criteria selection process. Aytaç and Bayram (2001) reveal that even though the ordering of the factors is alike for both genders, the corresponding weights of the factors, which are

indicative of the degree of their importance, are different for males and females. However, Özkale et al. (2004) indicate reasonable variation in the choices of males and females. Females are influenced by inspiring figures of any gender while males are primarily inspired only by idolised, dynamic, and influential males. Brainard and Carlin (1998) discuss the impact of society, family, and family relatives on the engineering choices of students of either gender. They note that females are affected more by their peers and relatives as compared to their male counterparts. Similar results have been obtained in context of a few other nations (Brainard and Carlin, 1998).

AHP Process

The complexity of choosing a career may not be detangled by perspicacity, exposure, or intuition. The variety of criteria shaping the final decision can be overwhelming and, often, self-contradicting. What worsens the situation further is that not only is the interdependence of the criteria confusing but the proposed solutions can also be contradicting.

The AHP, proposed by Saaty (1977; 1980; 1982; 2008), is a tool for analysing complex, multi-criteria problems and reaching a strategic decision. In this method, the analyst forms a tree-like hierarchy to analyse the complex issue and then rates each branch and leaf node at every strata of the tree. To illustrate using an example, a typical hierarchy will have at least three levels: (a) the goal to be achieved, (b) the criteria involved, and (c) the alternative choices.

AHP technique does a pair wise analysis of the relative importance of all criteria to form a pair wise comparison matrix and find a scale to compare the relative dependence and importance of the criteria. These pairwise comparisons also establish the impact measure of the sub-criteria in the upper strata of the tree upon the next lower strata, thereby establishing a relationship among the various levels of the hierarchy. After this, eigen vectors are calculated for every criteria. Dr. Saaty (1990) has demonstrated through mathematical results that finding eigen vectors is the best way to solve the problem.

Multiplication of the individual weights of all the nodes of a branch from the root to the leaf, will give the final priority of the leaf, that is, the criteria. This is iteratively done till the final priorities of all the alternatives have been calculated. The consistency ratios are calculated for the questionnaire results to confirm the validity of the results of the pair wise analysis of the alternatives.

METHOD

Subjects

In 2013, this study surveyed pre-final and final-year students of Indian Institute of Technology, Roorkee, India, regarding the dominant trend in choosing their careers and the factors affecting the choices made. The questionnaire was distributed among two hundred students undertaking their third and fourth year of study.

Analytic Hierarchy Process (AHP)

In 1970, Saaty, expounded the AHP technique as a measure for making cogent judgements and reaching an informed solution from varied judgements. In this study, students assigned their own values (judgements) after comparing among a set of criteria. The mean of all the values assigned by students depicts their preferences and notions on the given criteria. The course followed for establishing an AHP model was as follows:

Step 1: The problem was decomposed into a hierarchy of complementary factors in order to setup a hierarchy system. In this study, based on a literature review, the hierarchy system was established and later modified according to the opinions of experienced professors and three preliminary surveys.

Step 2: A pair wise comparison matrix was generated in order to calculate the relative weight age among the given criteria involved.

Step 3: The opinions of each student were synthesized and comparative weights were estimated.

Step 4: Average relative weights of the criteria were determined in order to generate a preference order for the various alternatives. Principal eigen vector of the pair wise comparison matrix was used by Saaty to calculate the relative weight age among the attributes of the tree structure. To compare 'n' attributes pair wise as per their relative weight age, represent the attributes by a_1, a_2, \dots, a_n and their corresponding weights by W_1, W_2, \dots, W_n .

Let, $W = (W_1, W_2, \dots, W_n)^T$, the pair wise analysis may be shown by matrix Masfollows

$$(M - \lambda_{\max} I)W = 0 \quad \text{--- (a)}$$

In Equation (a) M = positive reciprocal matrix of comparison. Eigenvector W with respective λ_{\max} must be calculated to find out the priority eigen vector. λ_{\max} must satisfy $MW = \lambda_{\max} W$. Consistency Index was suggested by Saaty to test the consistency of innate judgement. Generally, the Consistency Index with the value less than or equal to 0.1 is tolerable.

$$\text{Consistency Index} = (\lambda_{\max} - n)/(n - 1)$$

Designing the AHP questionnaire

In order to establish the important factors affecting students' choice of a career, the study first reviewed the aforementioned literature dealing with a similar research goal. The tiers of the

AHP questionnaire were then constructed using these factors. This was followed by the use of Delphi Technique by consulting a group of ten final-year students from assorted departments to review and modify the questionnaire.

The first tier gauged the three aspects of *Personal Priority*, *Job Training Process*, and *Work Characteristics*. The second tier gauged leading eleven criteria: personal intelligence/aptitude, influence of role model, opportunity to establish an independent setup, future income, growth prospects, prestige of job, contacts in the field, related internship and projects, gestation period, societal and family expectations, and speciality requirements. The glossary consists of the description of these criteria. Students were first made to choose their career choice out of the nine fields given in the third tier.

The AHP Consistency Test proposed by Saaty was applied to analyse data integrity, and the questionnaires succeeding in the consistency test were considered valid. The questionnaire's efficacy was also validated by a number of senior professors.

RESULTS

A total of 188 questionnaires were returned out of which 180 were conclusive. Incomplete questionnaires or those that failed the consistency test were rejected. The accepted questionnaires were then divided according to gender and career preference. There were 147 valid entries from male students and 37 from their female counterparts. The trend in career selection was seemingly similar in both male and female students.

Analysing all the accepted samples (n=180), among the three criteria in the first tier, *Personal Priority* had the highest weight of 0.51, followed by *Work Characteristics* having weight of 0.34 and *Job Training Process* having a weight of 0.14. From the 11 attributes in the second tier, *Personal Aptitude* achieved the largest weight of 0.15, followed by *Growth Prospects* with 0.14, which was, in turn, followed by *Future Income* with the corresponding weight of 0.13. Other than the overall weight analysis, supplementary analysis was done based on

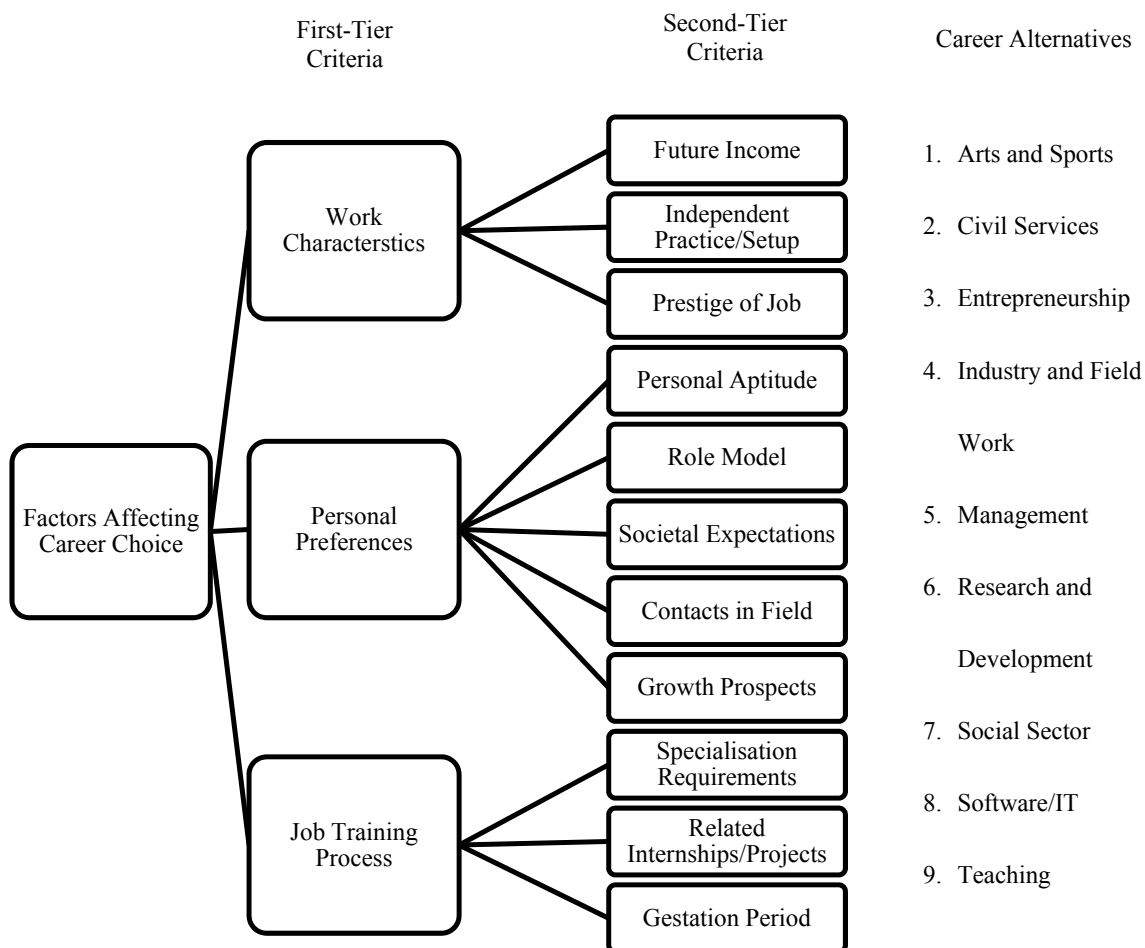


Fig. 1: The AHP framework modelling the factors for career selection. Gender and career choices.

Respondents were classified by their first choice of career. The most popularly observed trend of preference of criteria in the first tier is *Personal Preferences* with the [redacted] followed by *Work Characteristics* and then *Job Training Process*. Students [redacted] Information Technology, Management, Research and Development, and Entrepreneurship have specified their preferences in the aforementioned order. Students opting for Civil Services have ranked their preferences in the following order (descending by weight): *Work Characteristics*, *Personal Preferences*, and *Job Training Process*. On the contrary, students who want to make Industry and Field Work their career have given *Work Characteristics* primary importance, followed by *Job Training Process*, giving least weightage to *Personal Preferences*.

In the second tier, *Personal Aptitude* had the highest weight age in 5 among the 9 fields: Research and Development, Civil Services, Teaching, Arts and Sports, and Social Sector. Students opting for Information Technology and Entrepreneurship rated *Growth Prospects* the highest, while *Future Income* was the primary criterion for students aspiring to work in Management Sector. *Related Internships and Projects Requirement* was given the highest

Table 1: Descriptions of the criteria of judgement used in the study

<u>Criteria</u>	<u>Description</u>
<i>Personal Priority</i>	Composed of five criteria: personal aptitude, role model, societal and family expectations, growth prospects, contacts in the field
Personal Aptitude	A judgement made by self-assessment of factors like personal interest, intelligence, and intellectual capabilities
Role Model	Referring to the behaviour of supervisors and significant personalities that impressed the student
Societal and Family Expectations	Societal expectations, peer encouragement, and family expectations
Growth Prospects	Opportunities for promotions, hikes in financial benefits, etc.
Contacts in the Field	Any prior influential connections in the field
<i>Job Training Process</i>	Composed of three criteria: length and difficulty of training period, time required to establish oneself in the industry after starting work, and the need for specialisation
Related Internships/ Projects	The mandatory need to complete certain projects and internships
Gestation Period	The time needed to establish oneself in industry and gain a reputation after beginning work
Specialisation Requirements	Need for higher degrees like Doctorate for pursuing the chosen career
<i>Job Characteristics</i>	Composed of three criteria: future income, prestige of job, and the prospect of establishing an independent practice or setup
Future Income	Financial rewards relative to other careers
Prestige of Job	Prestige and power connected to the field
Independent practice/setup	The possibility of having a setup or practice of self-ownership

weight in case of Industry and Field Work. Though *Future Income* was observed to have high ranking for students opting for Information Technology, Management, and Industry and Field Work, it had relatively low weight age for students pursuing Research and Development, Entrepreneurship, Social Sector, Civil Services, Teaching, and Arts and Sports. *Gestation Period* received the one of the least weight ages throughout by all the students irrespective of the career choice. *Prestige of Job* was given high weight age by students who had filled Civil Services and Research and Development as their career choice.

The analysis of the responses was also done on the basis on gender. Although there was no stark variation in the top weights for male and female respondents, male respondents gave slightly higher weight age to *Personal Intelligence/Aptitude* compared to their female counterparts. A noteworthy contrast was that female students were found to give a

Table 2: Career preferences of engineering students in descending order

Career Choice	Males	Females	Total
Software/IT	34	7	41
Management	25	8	33
Research and Development	24	6	30
Entrepreneurship	18	4	22
Industry and Field Work	16	3	19
Civil Services	10	2	12
Teaching	6	4	10
Arts and Sports	5	2	7
Social Sector	5	1	6
Total	143	37	180

significantly higher weight age to *Societal and Family Expectations* as compared to male students.

IMPLICATIONS AND DISCUSSION

The outcomes of the study suggest that most students are making career choices based on their personal preferences and aptitude assessment. These results support the findings of

Ginsberg et al.(1951), Super(1957), and Lau and Pang (1995). Contrary to some studies in past that indicate that students' preferences lean towards pay scale (Bai, 1998) and job security (Phillips et al., 1994; Karl and Sutton, 1998) over personal aptitude, these results indicate a trend of independent thinking and decision making among the students. The need for fulfilment in the work has gained importance over security and stability. Interviews with a few students, professors, and human resource (HR) representatives of certain industries revealed a common observation that employees working in their areas of interest are more productive and self-motivated, thus creating a win-win relationship for both the enterprise and the individual.

Though the general trend has been towards personal aptitude, a considerable number of students have given high priority to other criteria as well.

The booming Information Technology sector in India and the plethora of job availability in this field have succeeded in pulling a respectable number of students towards jobs in the Software and IT industry. A study by Kyriacou et al. (2002) suggests that the availability of various options of growth in a career field moulds the decision pattern of students. In accordance to Kyriacou et al. and this study, the students from various branches and departments of engineering were found to be inclined towards Software and IT. From an employer's point of view, the ability of the field to accommodate masses would influence the candidate employees' willingness to opt or to not opt for the field.

The weight age to future income was mostly much lower as compared to personal aptitude and growth prospects for a majority of the students. This observation is backed by the research of Kuei-Ing Wang et al. (2007) according to which, students who were yet to

Table 3: AHP criteria and their weight analysis based on gender

Aspect/ Criteria	All		Males		Females	
		CR		CR		CR
Personal Preferences	0.51		0.55		0.58	
Personal Aptitude	0.15	0.0127	0.15	0.0014	0.14	0.0087
Role Model	0.07		0.07		0.08	
Society/Family Expectations	0.09		0.07		0.1	
Growth Prospects	0.14		0.12		0.17	

Contacts in the field	0.07		0.08		0.08	
Job Training Process	0.14				0.11	
Related Internship/Projects	0.05	0.0083	0.06	0.0321	0.05	0.0087
Gestation Period	0.03		0.02		0.02	
Specialisation Requirements	0.05		0.05		0.04	
Job Characteristics	0.34				0.31	
Future Income	0.13	0.0011	0.14	0.0001	0.1	0.0575
Prestige of Job	0.12		0.12		0.11	
Independent Practice/Setup	0.08		0.09		0.09	

enter the professional world give less priority to monetary incentives. A stark contrast was observed in the case of students willing to pursue management who had largely given future income the highest priority. When this perspective of the students was discussed with the HR representatives of certain companies, it was found that though the high pay scales in management jobs is a popular notion, not all management positions are so glamorous and high-paying. According to a survey by the U.S. Bureau of Labor Statistics(2010) titled "Occupational Employment and Wage Estimates," some managers earn less than \$15,000 a year.

Previous studies indicate that negative and traumatic influences in the past direct students towards the Social Sector. Royse and Rompf(1994) cross-examined family issues and indicated that similar factors might have led a student to pick social work as a profession. Studies by Russel, Gill, Coyne, and Woody (1993) as well as Marsh(1988) conclude that students having an abusive family atmosphere or alcoholic parents have higher inclination towards social work as compared to any other field. Effects of atrocious family histories (Black,Jeffries, and Hartley,1993)and an atmosphere of tension (Lackie,1983) were analysed by similar studies. This study has analysed the role of positive influences on the decision-making process of students willing to opt for Social Sector as a career. It was found that students choosing Social Sector gave high weight age to *Role Model* showing that a positive figure in their lives working in similar area had encouraged them to choose this career.

The existence of contacts in the field was given high priority by students willing to pursue entrepreneurship. Though the most important factors assessed by students aspiring to be entrepreneurs were the personal aptitude, growth prospects, and the opportunity to have an independent practice or setup; having contacts in the field was evaluated as an important criteria. Interviews with these students revealed that they hold a perception that the contact might help them get a head-start in establishing their startup.

Students pursuing industry and field work find internships and project work very important. The exposure to actual groundwork is crucial in shaping the understanding of the job. Therefore, if industrial training is provided by academic institutions, students' inclination towards this area might increase. Moreover, traditionally, industry and field work has been perceived as men's domain. Fieldwork has been regarded as a tough and grandiose activity, characteristic of masculinity (Sparke, 1996; Rose, 1993). Moreover, Stoddart(1986) has described fieldwork as being "much about the physical challenge." Despite such results in the past, this study revealed a growing trend of females opting for field work. About 15% of students choosing this area were women, showing that even though the numbers are still low, women have started considering industry and field work as a career option.

The choice patterns also varied according to cultural and gender differences. Results of this study, along with the results of the studies by William J. Bigoness(1986), Brenner and Tomkiewicz (1982), and Bartol and Manhardt(1979) convey that among women, a pronounced shift is taking place in the preference of job attributes. Over the years, instead of giving less weight age to job attributes (as suggested by the results of earlier research [Jurgensen, 1978; Schuler, 1975]), females are emphasising more on the opportunity for demanding and growth-oriented work. The study shows that women are now actively participating in the professional world and are contributing at par with men. Despite these findings, it was also observed that women still lay more emphasis on Societal and Family Expectations. This is suggestive of the fact that though women are prospering on the professional front, it is being appended to their traditional roles and not replaced by them.

To summarise, using the AHP model, it is possible to recognize factors that affect students when they choose a career. We can also identify the relative weights of each factor pondered upon in the decision-making process. Also, the study shows that despite the fact that all of these students are pursuing engineering, a fair share of them wish to pursue careers unrelated to their present area of study. Academic institutions should make their curriculum more interactive and industry-oriented to make more students interested in their fields. Also,

students should be encouraged to undertake more internships, as characteristics and potentials of their field can be thoroughly understood by students during the internship. The experienced professionals that students meet during internships can guide them to choose the most appropriate careers. Since this will help students in evolving the views of various fields, they might modify their choices later.

This study suggests that industries/companies should emphasize more on a wholesome and innovative incentive structure that will create an influential and inspiring milieu in which fresh talent can pursue their own interests and genius and have scope for further

Aspect/ Criteria	Software/IT		Management		R&D		Entrepreneurship		Industry and Field Work		Civil Services		Teaching		Arts and Sports		Social Sector	
	N=41	CR	N=33	CR	N=30	CR	N=22	CR	N=19	CR	N=12	CR	N=10	CR	N=7	CR	N=6	CR
<i>Personal Preferences</i>	0.53		0.46		0.52		0.6		0.23		0.57		0.77		0.77		0.56	
Personal Aptitude	0.08	0.0302	0.18	0.0175	0.18	0.0027	0.16	0.0433	0.05	0.0098	0.19	0.0205	0.41	0.0014	0.22	0.0691	0.25	0.063
Role Model	0.05		0.08		0.08		0.09		0.02		0.04		0.24		0.17		0.09	
Society/Family Expectations	0.16		0.07		0.07		0.07		0.05		0.12		0.03		0.22		0.04	
Growth Prospects	0.18		0.11		0.11		0.18		0.06		0.17		0.08		0.12		0.13	
Contacts in the Field	0.06		0.08		0.08		0.1		0.05		0.05		0.03		0.04		0.05	
<i>Job Training Process</i>	0.15		0.1		0.16		0.12		0.34		0.09		0.13		0.07		0.12	
Related Internship /Projects	0.07	0.0000	0.04	0.0037	0.04	0.0189	0.05	0.0005	0.22	0.0006	0.03	0.0021	0.04	0.0181	0.02	0.4442	0.05	0.008
Gestation Period	0.06		0.04		0.04		0.03		0.05		0.02		0.04		0.01		0.05	
Specialisation Requirements	0.06		0.08		0.08		0.04		0.07		0.04		0.05		0.05		0.02	
Job Characteristics	0.32		0.44		0.32		0.28		0.43		0.34		0.1		0.16		0.32	
Future Income	0.05	0.0167	0.07	0.0167	0.07	0.0167	0.07	0.0001	0.2	0.0126	0.12	0.1111	0.01	0.0257	0.12	0.1013	0.12	0.033
Prestige of Job	0.05		0.16		0.16		0.08		0.15		0.16		0.05		0.03		0.07	

Independent Practice/Setup	0.03		0.09		0.09		0.13		0.09		0.06		0.05		0.02		0.13	
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Table 4:AHP Assessment Aspects and Criteria Weight Analysis by Speciality (First Preference)

advancement. The ability of an industry to accommodate the freshly-out-of-college students instils a sense of security among the students. Such an industry is likely to become a magnet for the talent of the country. The needs of every new generation of students are different. This must be recognised by the policymakers in order to formulate the strategies to adorn the attractiveness of the fields which currently are devoid of sufficient talented people.

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