Comparative Study on Employability Skills of Engineering Graduates of Different Disciplines

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***Abstract*—**It is vital that fresh engineering graduates are aware of the requirements of a modern working environment and the employability skills that they should require to succeed in their professional career. The required skills may differ from one discipline to another. In this paper, the required employability skills for the electrical and electronic, and mechanical engineering disciplines are identified and compared with those of the civil engineering discipline. For this purpose, Descriptive Analysis, Principal Component Analysis together with Factor Analysis and Cronbach's Alpha Test were employed for analyzing the data collected through a questionnaire survey in which twenty eight attributes were extracted from the accreditation manual of the Institute of Engineers, Sri Lanka (IESL). These attributes were measured using five point Likert scale based on their importance levels. Through the analyses, six types of skills were found for the electrical and electronic engineering discipline namely *Personal and Working attitudes, Communication Skills, Intellectual Skills, Engineering Principles, Technical Knowledge and Skills, and Knowledge on Standards of Engineering Practice.* On the other hand, five types of skills were extracted for the mechanical engineering discipline namely *Personal and Working Attitudes, Skills on Communication and Engineering Knowledge, Knowledge on Technical Standards and Specifications, Technical Skills, and Knowledge on Basic Principles and Intellectual Skills.* Further, the one-way analysis of variance test revealed that there were no significant differences within the levels of importance of employability skills of four major sectors of each discipline except for the employability skill named *Knowledge on Standards of Engineering Practice* of the electrical and electronic engineering discipline.

***Keywords*—** Employability Skills, Engineering Graduates, Factor Analysis, Principal Component Analysis.

I. Introduction

ENGINEERS contribute a vital service to the economical, technological and infrastructural development in a country which sustains the satisfaction of the needs of lifestyles of the people. With the present development of Sri Lanka, engineers have to work in an environment with new demands and challenges which in turn create profound and constant changes to the environment. Employers expect to recruit engineers who are capable of working in such scenarios. In order to ensure that the fresh engineering graduates are capable of facing these issues successfully, Sri Lankan universities should examine whether they are well equipped with providing the necessary employability skills. The required employability skills may differ from one engineering discipline to another and are decided by the nature of the work involved in each discipline. Being aware of the required employability skills and the performance scores expected by employers will immensely help fresh engineering graduates to start their professional career with a smooth transition from academic environment to a professional life.

Various definitions are given for the term "employability skills". Employability skills can be viewed as a small set of skills that are reduced from a large set of specific attributes. Therefore, employability skills of engineering graduates can be explained with the aid of several specific attributes. From the Rasuls' view, an employability skill can be defined as a foundation for graduates to successfully get a job and to develop their career [1]. Hillage defined employability as being capable of getting a job and fulfilling all the work in the job. Employability depends on the knowledge, skills, and attitudes of individuals and the way they use and present these assets [2]. Yorke presented employability as "a set of achievements, understandings, and personal attributes that make individuals more likely to gain employment and be successful in their chosen careers" [3].

The employability skills considered by employers in recruiting fresh engineering graduates in Malaysia have been examined in [4]. It showed that engineering graduates should have not only excellent academic records but also the ability to perform and demonstrate specific soft skills. The required employability skills of graduates from seven countries (i.e., United Kingdom, Australia, United States, Canada, Japan, Europe, and Malaysia) have been investigated and the priorities of employability skills of each country were compared to understand the similarities and differences [5]. There were five employability skills, namely communication skills, teamwork, lifelong learning, problem solving skills, and professionalism, which graduates should acquire and demonstrate to enter into their professional career in all seven countries. A discussion on the expectations of employers with respect to the engineering based attributes of Malaysian engineering graduates from six sectors of the industry was presented in [6]. The results showed that the Healthcare,

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Social, Entertainment and Leisure sectors have minimal application of engineering-based attributes while the Education and Consulting sectors are considered as highly involved in engineering applications. Based on an investigation of the expectation levels of employers on the respective technical and non-technical attributes of Malaysian engineering graduates, it was found that the technical attributes are highly important for their engineering workforce whereas the non-technical attributes are less important to the employers [7]. From a study conducted on the required engineering employability skills of fresh engineers sought by countries in Asia such as Malaysia, Japan, Singapore, and Hong Kong, it has been revealed that the engineering graduates of above four countries should acquire a set of generic skills such as communication skills, problem solving and interpersonal skills from enlisted skills [8]. A formulation to evaluate the employability skills of new engineers using normalized skill weight has been proposed in [9]. These weights were used to explain the expected performance score by employers and the score obtained by new engineers during their job interviews.

In Sri Lanka, there has been a great concern among authorities and professionals in government and private industries about the necessary practical skills of fresh graduates. Recently, several steps have been taken by the government to improve some skills that are alleged to be lacking in the fresh graduates at present. For example, improving communication skills and competencies in Information Technology are being currently addressed through several programs such as Higher Education for Twenty-first Century (HETC), a World Bank assisted project. However, the pertaining issues associated with engineering graduates might differ from those of the other graduates. Therefore, it is important to look into the employer expectations on the employability skills of engineering graduates since they contribute greatly to the present development of Sri Lanka. Further, having awareness on the employability skills of fresh engineering graduates in their specialized disciplines will help them to succeed in their career. Employability skills required for fresh civil engineering graduates in Sri Lanka were analyzed based on the employer expectation in previous research works [10]. As an extension, this study investigates the important employability skills expected by the industry from the fresh electrical and electronic engineering and mechanical engineering graduates and the results are compared with those of civil engineering graduates.

II. Methodology

A. Questionnaire Survey

The accreditation manual of the Institute of Engineers, Sri Lanka (IESL) is a source which provides a description of the generic attributes that should be acquired during the engineering degree programme by an engineering graduate [11]. This study makes use of those attributes together with some other attributes found from past studies. A questionnaire was designed including a total of twenty eight attributes that were considered to be important at present. Each attribute was measured using a five–point Likert scale ranging from 1 to 5 where 1 is indicated for “Not Important”; 2 for “Fairly Important”, 3 for “Important”, 4 for “Very Important”; and 5 for “Highly Important”.

A questionnaire survey was conducted among employers from electrical and electronic engineering, and mechanical engineering organizations from both government and non-government sectors. Data collection was carried out through postal and electronic mail facilities.

B. Data Analysis

A descriptive analysis was conducted separately for each engineering discipline to estimate the sample mean and the standard deviation of each and every attribute measured from which the most important attributes are to be identified for each discipline. In addition, descriptive analyses are used to create the covariance and correlation matrices of attributes which are to be used in factor analysis.

Factor analysis was conducted for each discipline to reduce the large number of observed inter-related attributes of engineering graduates to a few underlying factors that describes their latent employability skills. As preliminary tests, the suitability of the use of factor analysis is determined through the Bartlett’s test of Sphericity, the Kaiser-Mayer-Olkin indicator and the computed communalities.

The correlation matrix, which is an identity matrix, is rejected in the factor analysis because its presence implies that there is no correlation among attributes (null hypothesis). The Bartlett’s test of Sphericity, which involves a chi-square (χ^2) test, is employed to determine whether the correlation matrix is not an identity matrix and whether the null hypothesis can be rejected. The chi-square test statistic (χ^2) can be computed in terms of sample size (N), number of attributes (k) and the determinant of the correlation matrix $|R|$ as given in (1)[12].

$$\chi^2 = -\left[(N-1)-\left(\frac{2k+5}{6}\right)\right]\log_e|R| \tag{1}$$

A higher value of χ^2 than the critical value obtained based on the degree of freedom (df) and the 0.05 significant level, concludes that the correlation matrix is not an identity matrix. The degree of freedom represents the number of correlations based on the level of significance ($p<0.01$ or 0.05) above or below the principal diagonal of the correlation matrix. The degree of freedom is computed using (2) [12].

$$df = \frac{k(k-1)}{2} \tag{2}$$

The Kaiser-Mayer-Olkin test (KMO) is a measure of sampling adequacy that compares the magnitude of the calculated correlation coefficients to the magnitude of the same coefficients with the partial correlation coefficients, as given in (3).

$$KMO = \frac{\sum\sum_{i\neq j} r_{ij}^2}{\sum\sum_{i\neq j} r_{ij}^2 + \sum\sum_{i\neq j} a_{ij}^2} \tag{3}$$

Where, $\sum_{i \neq j}\sum$ = sum over all attributes when attribute $i \neq j$

r_{ij} = Pearson correlation between attributes i and j

a_{ij} = Partial correlation coefficient between attributes i and attribute j

The *KMO* measure can be laid between 0 and 1, with smaller values indicating that r_{ij}^2 is small, relative to a_{ij}^2 and therefore a factor analysis may not be appropriate at all. The ranges defined with indices for *KMO* values were identified as "Don't factor" (0.00-0.49), "Miserable" (0.50-0.59), "Mediocre" (0.60-0.69), "Middling" (0.70-0.79), "Meritorious" (0.80-0.89), and "Marvelous" (0.9-1.0) [13]. The KMO value should be larger than 0.6 for a factor analysis to be appropriate.

The examination of communalities also indicates how well a factor analysis is being performed. These indicate the variance of each attribute explained.

Among the several common forms of factor analysis, the principal component analysis was used appropriately to define factors when the minimum numbers of factors were needed and to use them in subsequent analysis. This method is sometimes called "the Principle Component Factor Method".

Among the different methods available, the Eigen values that represent the amount of variance associated with a factor were used to select important factors. The Eigen values λ_i are found by solving (4) where C is the covariance matrix of the attributes i to j and in which I is an identity matrix.

$$|C - \lambda I| = 0 \qquad (4)$$

Using this approach, factors with Eigen values less than one were excluded and the factors retained were considered as the important factors for the analysis. Ideally, these factors should explain at least 60% of the cumulative variance.

The output from the factor analysis is the factor matrix that contains coefficients that show the relationship between a factor and the attributes. Sometimes, it is difficult to interpret factors when factors are correlated with many attributes. Therefore, one of the factor rotation methods called the "Varimax Rotation" procedure was used to transform the factor matrix into a simplified matrix for easy interpretation. With this method, the factors were interpreted using the attributes that have a high load on the particular factor. The factors were named based on the attributes correlated on each factor and were identified as the employability skills (unobserved skills) for the particular engineering discipline.

A reliability coefficient (Cronbach's Alpha) that represents the association of the attributes on each factor can be explained as the ratio of true variance to the total observed variance. As Nunnally presents a reliability coefficient (α) above 0.5 was considered to be acceptable [14]. The reliability coefficient for each factor was computed by using (5).

$$\alpha = \frac{k}{k-1}\left(1 - \frac{1}{s_T^2}\sum_{i=1}^{k} s_i^2\right) \qquad (5)$$

where,

s_i = Variance associated with attribute i

s_T = Variance associated with the total of all k attributes

The employability skills extracted from above analyses were further analyzed by using one-way analysis of variance (ANOVA) to check whether there is a significant difference in the level of skills among the major sectors of each discipline. Here, the alternative hypothesis (H_a) expresses that the importance level of employability skills found are not significant for the sectors selected. This test compares the mean scores obtained from each sector for the particular employability skill by analyzing the *F* value that represents the ratio of variation of the mean scores between sectors to the variation within the sectors. The *P* value that represents the probability of getting particular *F* value is compared with the significant level of 0.05. When this *P* value is greater than 0.05, the alternative hypothesis is rejected.

III. Results and Discussion

A. Characteristics of the Samples

The characteristics of the samples are described in terms of the profile of employers who responded to the questionnaires from each engineering discipline and the categories of the organizations, as shown in Table 1.

Table 1: Profile of the sample

Sample Characteristics	Percent (%)	
	EE (N=48)	ME (N=49)
Profile of employers		
Chairman/General Manager	8	14
Director/Chief Executive Officer	19	22
Project Manager	35	43
Senior Engineer	38	20
Others	0	0
Organization Category		
Government	31	22
Non-Government	69	78

EE - Electrical & Electronic Engineering

ME - Mechanical Engineering

N - Total number of organization

The nature of the work conducted by the responded organizations in two disciplines is shown in Table 2.

Clearly, the majority of the employers in each discipline were high ranking officers in their organizations. Further, the majority of organizations that participated in the questionnaire survey were non-government organizations.

The respondents from the electrical and electronic engineering division were mainly from Power, Telecommunication, Automation, and Electronics sectors. On the other hand, the majority of respondents in the mechanical engineering discipline were from the sectors involved in Service, Factory/Workshop/Plant works, Mechanical Equipment, and Buildings.

Table 2: Nature of the samples

Engineering Discipline	Nature of works carried out in the organizations	Percent (%)
Electrical & Electronic	Power	43
	Telecommunication	25
	Automation	19
	Electronics	13
Mechanical	Services	19
	Factory/Workshop/Plant	37
	Equipment	33
	Buildings	11

B. *The Important attributes perceived by employers*

The importance level of attributes perceived by the employers of each discipline is presented using the values of mean and standard deviation in Table 3.

Table 3: Mean Ratings given by respondents

No.	Attribute Measured	EE		ME	
		Mean[a]	Std. Dev.[b]	Mean[a]	Std. Dev.[b]
1	Punctuality	4.42 (5)	0.58	4.33 (1)	0.77
2	Commitment	4.54 (2)	0.62	4.24 (4)	0.95
3	Integrity	4.54 (1)	0.71	4.18 (6)	0.97
4	Engineering Fundamentals and Application	4.31 (6)	0.88	4.29 (2)	0.82
5	Written Communication Skills	4.15 (13)	0.71	4.08 (9)	0.79
6	Verbal Communication Skills	4.27 (9)	0.74	4.10 (8)	0.87
7	Problem-solving Skills	4.46 (3)	0.74	4.18 (5)	0.88
8	Approachability	4.15 (14)	0.62	3.92	0.81
9	Reliability	4.27 (10)	0.64	4.04 (11)	0.89
10	Conscientiousness	4.46 (4)	0.68	4.18 (7)	0.83
11	Flexibility	4.13 (15)	0.73	4.00 (13)	0.88
12	Tolerance	4.17 (12)	0.78	4.02 (12)	0.88
13	Competence	4.31 (7)	0.66	4.06 (10)	0.88
14	Computer Science and Technology	4.10 (16)	0.81	3.92	1.02
15	Logical Thinking	4.29 (8)	0.74	3.92	0.95
16	Engineering Practice	4.25 (11)	0.81	4.24 (3)	0.82
17	Testing Practices	3.77	0.66	3.78	0.74
18	Presentation Skills	4.00 (18)	0.77	3.94	0.8
19	Proficiency Standards	3.81	0.7	3.71	0.82
20	Specifications and Inspection Standards	3.81	0.67	3.82	0.73
21	Code of Ethics	3.9	0.9	3.73	1.00
22	Technical Standards	3.81	0.7	3.78	0.69
23	Measurement Systems	3.9	0.75	3.88	0.88
24	Design Skills	3.81	0.79	3.73	0.78
25	Science Fundamentals	4.04 (17)	1.01	3.73	1.02
26	Team Work	3.79	0.94	3.69	1.08
27	Environmental Constraints	3.69	0.83	3.73	0.88
28	Probability and Statistics	3.56	0.85	3.27	0.84

[a]Mean Scale: 5- Highly Important to 1- Not Important

[b]Standard Deviation

From the results, employers perceive that the most important attribute among all was “Punctuality” which scored 4.33 (mean) in the mechanical engineering discipline while “Integrity” from the electrical and electronic engineering discipline with a score of 4.54. This indicates that the employers in mechanical engineering highly expect engineers to be punctual in all the activities that they perform and the employers in electrical and electronic engineering expects employees to have full faith and loyalty to their organization. Meanwhile in both disciplines all the attributes were found to be important. Further, among the whole attributes, eighteen were found to be very important for electrical and electronic engineering graduates while thirteen for mechanical engineering graduates.

C. *Extraction of employability skills*

The results obtained from the Bartlett’s test of Sphericity and the Kaiser-Mayer-Olkin indicator are shown in Table 4.

Table 4: Results from KMO and Bartlett’s Test

Test Parameters		EE	ME
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.65	0.8
Bartlett's Test of Sphericity	Approx. Chi-Square (χ^2)	909	1006
	df	378	378
	Sig.	0.000	0.000

The overall significance of the correlation matrices was found to be 0.00 (below 0.05 significance level) with the Bartlett’s test of Sphericity value of 909 for electrical and electronic engineering and 1006 for mechanical engineering. This indicates that the data matrices have a sufficient correlation to the factor analysis. The values of KMO for the electrical and electronic engineering and mechanical engineering disciplines were 0.65 (Mediocre level) and 0.8 (Meritorious level), respectively, which were within the acceptable level.

The results obtained for the electrical and electronic engineering discipline from the principal component factor analysis with a VARIMAX rotation technique are shown in Table 5. There are six factors with Eigen values greater than one suggesting there is a six-factor solution explaining 68.45% of the cumulative variance for electrical and electronic engineering discipline. Factor 1 was identified as the most effective factor that explained 29.62% of the variance whereas the remaining five factors explained 11.95%, 8.95%, 8.13%, 5.28% and 4.55% of the variance, giving a cumulative variance of 68.45%. It was observed that the most of the attributes have loaded heavily only on one factor. The higher loading indicated the correlation of the attributes with the factors on which they were loaded. All communalities were above the acceptable level 0.4. The value of Cronbach’s Alpha was calculated to test the reliability of each factor. The results showed that the values of Cronbach’s Alpha of all six factors ranged from 0.55 to 0.90 which are above the minimum value of 0.50. However, it was found that the attributes named “Design Skills” and “Proficiency Standard” that loaded on the Factor 4 (reliability coefficient = 0.77) and Factor 5 (reliability coefficient = 0.73), respectively, have caused some reduction in reliability coefficients (i.e., when these attributes are excluded from factors, the reliability coefficients increase to 0.80 and 0.87 respectively for Factor 4 and Factor 5). This indicates the adverse association of those attributes to Factor 4 and Factor 5. As a result, these attributes were considered separately and excluded from the factors without consideration for the subsequent calculations because they were identified as important attributes from the results shown in Table 3. The six factors were named as "Personal and Working attitudes", "Knowledge on Standards of Engineering Practice",

Table 5: Attributes correlated with extracted employability skills for the Electrical and Electronic Engineering Discipline

Factor groupings	Factor Loadings	Communality	Eigen Value	Percentage of Variance	Reliability Coefficient	Mean
Factor 1: Personal and Working Attitude			8.29	29.62	0.9	**4.33**
Reliability	0.819	0.702				4.27
Conscientiousness	0.800	0.708				4.46
Approachability	0.796	0.751				4.15
Integrity	0.752	0.698				4.54
Tolerance	0.722	0.654				4.17
Flexibility	0.713	0.738				4.13
Punctuality	0.678	0.723				4.42
Commitment	0.632	0.574				4.54
Competence	0.477	0.567				4.31
Factor 2 : Knowledge on Standards of Engineering Practice			3.35	11.95	0.74	**3.81**
Technical Standards	0.847	0.771				3.81
Environmental Constraints	0.802	0.689				3.69
Specifications and inspection standards	0.797	0.723				3.81
Measurements Systems	0.715	0.677				3.90
Testing Practice	0.584	0.697				3.77
Code of Ethics	0.500	0.571				3.90
Factor 3 : Communication Skills			2.51	8.95	0.85	**4.14**
Verbal Communication Skills	0.900	0.831				4.27
Presentation Skills	0.774	0.713				4.00
Written Communication Skills	0.719	0.693				4.15
Factor 4 : Intellectual Skills			2.28	8.13	0.80(*0.77*)	**4.09**
Problem-solving Skills	0.753	0.817				4.46
Team Work	0.717	0.654				3.79
Logical Thinking	0.501	0.794				4.29
Design Skills	0.351	0.494				3.81
Factor 5 : Engineering Principles			1.48	5.28	0.87 (*0.73*)	**4.05**
Science Fundamentals	0.863	0.845				4.04
Engineering Fundamentals and Applications	0.837	0.750				4.31
Proficiency Standards	0.525	0.627				3.81
Factor 6 : Technical knowledge and Skills			1.27	4.55	0.55	**3.97**
Probability and Statistics	0.759	0.593				3.56
Engineering Practice	0.588	0.563				4.25
Computer Science and Technology	0.438	0.558				4.10
Total variance explained				**68.48**		
Total scale reliability					**0.9**	

"Communication Skills", "Intellectual Skills", "Engineering Principles", and "Technical knowledge and Skills".

From the similar analysis conducted for the mechanical engineering discipline, it was found that a five-factor solution explained 68.48% of the cumulative variance as shown in Table 6. The most effective factor, Factor 1, explained 40.22% of the variance and the other remaining four factors shared the variance 11.16%, 6.49%, 5.81%, and 5.06%. The Cronbach's Alpha values were also in the acceptable range.

Table 6: Attributes correlated with extracted employability skills for the Mechanical Engineering Discipline

Factor groupings	Factor Loadings	Communality	Eigen Value	Percentage of Variance	Reliability coefficient	Mean
Factor 1: Personal and working Attitude			11.26	40.22	0.92	**4.11**
Reliability	0.722	0.684				4.04
Conscientiousness	0.797	0.748				4.18
Approachability	0.624	0.661				3.92
Integrity	0.786	0.717				4.18
Tolerance	0.773	0.721				4.02
Flexibility	0.743	0.819				4.00
Punctuality	0.627	0.667				4.33
Commitment	0.764	0.721				4.24
Competence	0.554	0.646				4.06
Factor 2 : Technical Skills			3.13	11.16	0.85	**3.82**
Design Skills	0.764	0.611				3.73
Engineering Practice	0.718	0.767				4.24
Code of Ethics	0.704	0.657				3.73
Proficiency Standards	0.663	0.551				3.71
Testing Practices	0.613	0.556				3.78
Environmental Constraints	0.598	0.638				3.73
Factor 3 : Skills on effective communication and Engineering knowledge			1.82	6.49	0.86	**4.07**
Presentation Skills	0.713	0.670				3.94
Written Communication Skills	0.696	0.750				4.08
Verbal Communication Skills	0.685	0.692				4.10
Engineering Fundamentals and Applications	0.605	0.696				4.29
Computer Science and Technology	0.571	0.508				3.92
Factor 4 : Knowledge on Basic Principles and Intellectual Skills			1.63	5.81	0.83 (*0.82*)	**3.02**
Probability and Statistics	0.717	0.654				3.27
Science fundamentals	0.638	0.645				3.73
Logical Thinking	0.701	0.778				3.92
Problem-solving Skills	0.639	0.719				4.18
Team work	0.402	0.520				3.69
Factor 5 : Knowledge on Technical Standards and Specifications			1.42	5.06	0.87 (*0.88*)	**3.83**
Measurement Systems	0.823	0.873				3.88
Technical Standards	0.642	0.815				3.78
Specification and Inspection Standards	0.588	0.764				3.82
Total variance explained				**68.48**		
Total scale reliability					**0.94**	

Table 7: Summary of the extracted employability skills in each discipline

Employability Skills Extracted for		
Civil Engineering	**Electrical and Electronic Engineering**	**Mechanical Engineering**
Personal Attitudes (4.12)	Personal and Working Attitudes (4.33)	Personal and Working Attitudes (4.11)
Working Attitudes (3.90)	Communication Skills (4.14)	Skills on Communication and Engineering Knowledge (4.07)
Engineering Knowledge (3.82)	Intellectual Skills (4.09)	Knowledge on Technical Standards and Specifications (3.83)
Technical and Administrative Skills (3.81)	Engineering Principles (4.05)	Technical Skills (3.82)
Management Skills (3.74)	Technical Knowledge and Skills (3.97)	Knowledge on Basic Principles and Intellectual Skills (3.02)
Knowledge on Engineering Design and Construction Standards (3.57)	Knowledge on Standards of Engineering Practice (3.81)	

Reliability coefficients found for Factor 4 and Factor 5 were reduced from 0.83 to 0.82 and 0.88 to 0.87 respectively due to the adverse association of the attributes "Probability and Statistics" and "Measurement Systems". They were excluded from Factor 4 and Factor 5 keeping them as important additional skills. The five factors extracted were named as "Personal and Working attitudes", "Skills on Communication and Engineering knowledge", "Knowledge on Technical Standards and Specifications", "Technical Skills", and "Knowledge on Basic Principles and Intellectual Skills".

The expected mean scores of the employability skills obtained for fresh electrical and electronic and mechanical engineering graduates together with those found in [10] for fresh civil engineering graduates are summarized in Table 7. It shows that "Personal Attitude" is the most important employability skill that a fresh civil engineering graduate should improve. "Personal and Working Attitude", "Communication Skills", "Intellectual Skills", and "Engineering Principles" are the most important employability skills for fresh electrical and electronic engineering graduates whereas "Personal and Working Attitudes", and "Skills on Communication and Engineering Knowledge" are the most important skills for fresh mechanical engineering graduates. Meanwhile the rest of the employability skills in each discipline are also found to be important as their mean scores were greater than the average score of 3.0.

The results presented in Table 8 and Table 9 explain the effect of the work sectors shown in Table 2 on the employability skills found for each engineering discipline.

As shown in the results given in Table 8, the *F* value for all employability skills except for the skill "Knowledge on Standards of Engineering Practice" (Factor 2) was significant since the *P* values were greater than 0.05. Hence, all the employability skills are applicable for each sector considered except for the skill "Knowledge on Standards of Engineering Practice". An additional analysis has to be conducted for the employability skill "Knowledge on Standards of Engineering Practice" to examine its variation among the work sectors.

Table 8: Results of the one-way ANOVA for comparison of employability skills for major sectors in the electrical and electronic engineering discipline

Factor Groupings	Mean Score						
	Power	Telecommunication	Automation	Electronics	*F* Ratio	F Prob (*P-value*)	Sig. diff. between groups
Factor 1: Personnal and Working Attitude	4.310	4.362	4.267	4.417	1.473	0.240	No
Factor 2 : Knowledge on Standards of Engineering Practice	3.803	4.065	3.847	3.867	10.635	0.000	Yes
Factor 3 : Communication Skills	4.167	4.101	3.960	4.000	1.616	0.201	No
Factor 4 : Intellectual Skills	4.149	4.304	4.093	4.183	0.171	0.913	No
Factor 5 : Engineering Principles	4.145	4.283	4.180	4.175	0.133	0.936	No
Factor 6 : Technical knowledge and Skills	3.877	4.101	3.947	3.850	0.345	0.794	No

Table 9: Results of the one-way ANOVA for comparison of employability skills for major sectors in the mechanical engineering discipline

Factor Groupings	Mean Score						
	Services	Factory	Equipment	Buildings	*F* Ratio	*F* Prob *(P-value)*	Sig. diff. between groups
Factor 1 : Personnal and working Attitude	4.059	4.182	4.183	4.162	1.348	0.276	No
Factor 2 : Technical Skills	3.822	3.864	3.904	3.917	0.243	0.865	No
Factor 3 : Skills on communication and Engineering knowledge	4.127	4.139	4.205	4.273	1.168	0.353	No
Factor 4 : Knowledge on Basic Principles and Intellectual Skills	3.817	3.902	4.050	4.034	1.349	0.305	No
Factor 5 : Knowledge on Technical Standards and Specifications	3.850	3.924	3.888	3.841	0.205	0.888	No

The *F* values presented for each employability skill of the mechanical engineering discipline in Table 9 were significant and there was no difference in the level of employability skills required by each sector in this discipline.

IV. Conclusion

This study revealed that employers from all the engineering disciplines highly expect fresh graduates to have excellent personal and working attitudes. The employers' expectations on Communication Skills are comparatively high in electrical and electronic engineering, and mechanical engineering disciplines. Meanwhile, expectations of employers from electrical and electronic engineering discipline on all the skills were higher than those of the other two disciplines. Expectations on Engineering Knowledge from civil and mechanical engineering graduates received high priority than that of electrical engineering, still the level of expectation is higher in latter. Even though the priority of the expected skills differs from discipline to discipline, everybody considered that all the skill categories extracted in this study are very important for their organizations. Therefore, it is recommended that higher education institutions in Sri Lanka should pay high attention to improve the skills of engineering undergraduates such as "Personal and Working Attitudes", "Communication Skills", and "Intellectual Skills" in addition to the basic engineering knowledge developed from regular knowledge-based engineering courses.

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