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In Search of Performance Gap of education service providers: An Empirical analysis based on engineering education sector of West Bengal

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Abstract: Today, engineering education is thriving through a crucial phase in which performance of this program is under scrutiny. The increasing competition in the field of higher education has compelled the engineering institutions to reevaluate the performance of the program, they offer, to match with the demand of the corporate sector. Performance of an academic program is correlated on the quality dimensions of the same. The present study attempts to enlist various dimensions of quality that affect the performance of an engineering program from stakeholders' point of view. Further, we have identified the perceptual gaps between these stakeholders' vis-à-vis quality dimensions of the academic program. Multivariate t test has been carried out to identify the said industry-academia gaps. The results help to focus on items, which need immediate attention to lower the gaps and successively enhance the performance of the engineering program. The study suggests that in reforming engineering education a well-balanced and interactive program should be developed, which in turn will benefit both academia and industry.

Keywords: Engineering education, performance of the program, industry-academia gap, stakeholders, multivariate analysis, engineering institutions.

1. Introduction

Business performance management is not a very new concept in the field of management. In present days, performance management is related more with effective as well as efficient attainment of stakeholders satisfaction. Stakeholders' satisfaction is achievable only by delivery of quality to them. In case of service, especially for education service, all these stated relationships are having high relevance. Placement of the students is dependent on the satisfaction of the industry towards the program. Therefore, fulfillment of industry expectation leads to the satisfaction of multiple stakeholders, related to education sector. Engineering education is purely a service and its dimensions of program quality primarily measure the performance of engineering education. The quality of conventional engineering program and traditional teaching pedagogy in engineering institutes is not satisfactory as it proved to be less effective in terms of effective design and delivery of the program. Therefore, outcome based education in engineering has emerged as the way forward for the academic community in addressing the challenges. India has now become a global leader in terms of producing engineering professionals and technocrats in the context of the global technological revolution. The Indian government is now emphasizing more on the development of a knowledge-based economy rather than commodity-based economy for better sustainability. At present India has 2,872 approved degree-level engineering institutes and an intake of 10,71,896 students, as well as 1,659 approved diploma-level engineering institutes with an intake of 4,71,006 students [1]. Although, the number of engineering institutions has been increased, yet, complain of the absence of adequate performance among the fresh engineering graduates are increasing day by day from the industry. Therefore, it is now inevitable to assess the quality of an engineering program to match with the current global industrial requirements.

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In this study, we have constricted our focus on the engineering sector of West Bengal, because of the phenomenal development of technical education in this state during the last few years. In West Bengal the entry of the private institutions has vividly changed the facade of engineering education.

West Bengal University of Technology (WBUT), which has been established in the year 2001 to broaden the scope of engineering education in the state, has played the role of catalyst in this growth program. WBUT alone has more than 86 engineering institutes, out of which 79 institutes are private and 7 are Government with an intake capacity of 28,100 approximately [2]. Despite the phenomenal growth of engineering education in West Bengal during last 10 years after the introduction of WBUT, the quality of the growth is still under suspicion [3]. This University is the only technical university of the state that affiliates the private engineering institutes. However, the tremendous growth of engineering education in West Bengal during last 10 years has witnessed mushrooming of private engineering institutions in the state. This growing number of private engineering institutions has increased the intake capacity of the students but performance in terms of quality of engineering education provided by these private institutes is yet to be measured.

Therefore, it is imperative to evaluate the performance of engineering program of these institutes to ascertain the quality wise performance of engineering education in the state. In the next section, we have discussed the existing literatures on this issue to pinpoint our research objectives.

2. Literature Review

Several researches have been carried out in the field higher education with a variety of outcomes. These researches have identified various dimensions of service quality in the field of higher education. Globalization of higher education has brought competition and which prompted the researchers to focus on quality initiatives [4], [5]. At the education institution perspective, the concept of perceived service quality means students perceived quality because the primary stakeholder of the educational institution is students [6]. Therefore, we could define students' perceived quality is the difference between student evaluation for the services performance level of the educational services provides and service expectation level [7]. Ford et al., [8], have viewed the program in an alternative way and identified reputation, career opportunities, program, physical aspects, and location are the important attributes to form expectation about the service of education service providers. However, the perceived quality is not limited only to the student's perspective, because education service is characterized as a multi-stakeholders segment, which includes students, parents, faculty, alumni, industry, and society. Hence, it is necessary to measure perceived quality from the other stakeholders' point of view as well. A number of researchers have measured service quality from different stakeholders' perspectives [9], [10]. Many of these researchers believe that the quality of education largely depends on dimensions like teaching, campus facilities, reputation, physical evidence, administration, urriculum, responsiveness, and recognition [11], [12]. Ahuja et.al. [13], view that curriculum development based on emerging technologies is equally important like faculty development, modernization, and better utilization of infrastructural facilities. They suggest that enhanced exposure of students to industries, feedback system, networking between institutions and institution-industry interaction is crucial dimensions to the overall quality of a program.

This is the point that we also would like to focus. Other authors highlighted that due to high comparative environment surrounding, engineering education institutions need to have a better understanding of the nature and quality of service, they offer. Adee [14] recommended several university characteristics, which, may be useful in explaining the perceived quality among students and emphasis on competent teaching, the availability of staff for student consultation, library services, computer facilities, recreational activities, class sizes, level and difficulty of subject content, and student workload. However, few researchers have viewed that the students' satisfaction is not only influenced by the physical facilities, provided by the educational service providers but a well-balanced approach is required towards this direction. Lau [15] suggests a conceptual framework consisting of three factors based on learning, teaching, and resources (Institutional administrators, faculty, and students) which are considered to influence student involvement and satisfaction. Abdullah [16] used HEDPERF instrument consisting of forty-one statements to assess service quality in higher education sector. His study confirmed that students' perceptions of service quality consist of six identified dimensions: non-academic aspects, academic aspects, reputation, access, program issues, and understanding. These methodologies we have adopted in case of present research.

Al though previous researchers have pointed out several dimensions for quality in higher education, but most of them emphasized on curriculum or program as one the vital dimension for overall quality of an educational institution [17], [18]. We also support this proposition that curriculum should be focused in education institution to provide better service to the students. However, the collaboration between academia and industry is important for determining the quality of an educational institute [19]. Further, it is important to validate and review the existing program of an educational institute time to time to keep pace with the changing technology [20]. Mandal et.al [21] has developed a reliable and valid construct for measuring the quality of engineering and technology program in the Indian context by using the confirmatory factor analysis. The researchers have identified degree of industry focus ness of the program, quality related to program and pedagogy and degree of industry readiness of the program as three important dimensions for measuring the quality of an academic program.

A thorough study on the existing literatures regarding this issue exposes that the dimensions of a quality engineering program has never been identified from the academia and industry point of view but empirically not tested, even though they are the principal stakeholders of engineering education. Therefore, there is a necessity to conduct further investigation in order to get other dimensions or more complete academia and industry perceived quality dimensions regarding an ideal engineering program. However, in this research we are employing the reliable and valid construct of Mandal et.al [21] to investigate the dimensions of an ideal engineering program from academia and industry viewpoint and find out the perceptual gap between these two stakeholders regarding the quality of an engineering program, which eventually inform us about the gap in performance of the service providers.

3. Research Problem and Hypothesis

In this research, we are intended to examine the perception of performance between academia and industry regarding the performance of an ideal engineering program. For these purposes, we have used the construct proposed by Mandal and Banerjee [21], because construct developed are confirmatory in nature and it adequately validates the construct. This construct reveals three important factors, related to the performance of an academic program, which we have mentioned earlier (Table 1).

As per the construct developed by Mandal and Banerjee [21], each of these factors consists of some items. We have recorded the responses of industry executives and faculties of the engineering institutes for each of the item. For analysis, we have considered responses for all items under each of the factors as a vector combination and thus treat each factor as a vector for each group of respondent i.e. executives and faculties. Hence, we were in a position to compare the vector means between the said two groups. This research query helped us to develop three hypothesis, all of these three hypothesis we can write in a general format of hypothesis entry notation, which are as follows:

H_0: There is no difference between the perception of industry executives and faculty members of the institutes in terms of vector means of the recorded responses of the ι^{th} factor of the academic program performance construct (Mandal and Banerjee, 2012).

H_A : There is difference between the perception of industry executives and faculty members of the institutes in terms of vector means of the recorded responses of the ι^{th} factor of the academic program performance construct (Mandal and Banerjee, 2012).

Where, ι^{th} factor is any one among the i) Degree of industry focus ness of the program, ii) Performance related to the program and pedagogy and iii) Degree of industry readiness of the program

However, we have to test and satisfy two important conditions for carrying out these hypotheses. Despite of the fact, that when the original construct have been developed, the researchers extract factors from the item, based on their inter correlation, still we have to check empirically that whether the items under each factor is correlated ideally to be used as vector combinations or not. If the result is positive then only we can proceed further for any hypothesis, which refer for multivariate'tʼ test. Subsequently, we have to be sure about the performance of variance-covariance matrices of the two populations considered in the present study. If these conditions are satisfied then only we proceed for mentioned hypothesis, which is dealing with variables with multivariate nature.

4. Sample Designing

We have selected the state of West Bengal for conducting present research, because, in the recent past the state has experienced enormous growth of private engineering colleges and the performance of the education service, provided by these colleges is in question. As we would like to focus only on private engineering education, we have chosen WBUT for determining the population, from which we selected the each sample unit randomly. We have used pack of card; each has been specified with identification of private engineering colleges under WBUT. We have chosen 12 private engineering institutes randomly. Then, we prepared a single list of faculty with more than 10 years of experience from the pool of engineering institutes. We have contacted with 150 faculties and finally received responses from 129 faculties. In the same way, we have randomly selected 11 industries from the pool of industries, who frequently visit the college campuses of these private engineering colleges for selecting students through campus interview. We have prepared a final list of executives with more than 10 years of experience from the pool of industry. Out of 200 executives, whom we have contacted, we have collected responses from 131 executives. Hence, a total of 260 (129+131) valid responses are taken into consideration for further analysis.

5. Statistical Tools Used To Study the Hypothesis

In the present research, we have dealt with a hypothesis and two generalized conditions. These two conditions are used as necessary conditions for carrying out the hypothesis. For testing the hypothesis, we may use any of the multivariate't' test, like Hotelling's trace, Wilks' lambda, Pillai's trace, Roy's largest root (definitions are given in the appendix). All of these are used for comparing vector mean between two populations. However, for carrying out the hypothesis we need to satisfy condition 1 and 2. For checking condition 1, we have to run 'Barlett's test of spherecity' and for satisfying condition 2, we have to carry out Box's M test statistics (see appendix for description).

6. Analysis & Findings

We have carried out various multivariate tests to identify whether the views of two stakeholders are different in the case of each of the dimensions of an ideal engineering program or not.

Table 1 provides a summary of the group profiles on each of the items of performance dimension between the faculty and industry executives. A quick visual inspection in Table 1 reveals that there is a difference in mean scores among item of each performance dimension between the two groups of stakeholders.

In Table 2, we can observe the results of Barlett's test of sphericity. We use Barlett's test of sphericity to determine whether the dependent variables are significantly correlated or not. Otherwise, it is not practical to carry out multivariate exercise. This test checks the correlation among all variables and review whether, in combination, significant inter-correlation exists or not. In this present research for each factor, we have seen the probability value of significance is 0.000 (See Table: 2). Hence, it is sensible to consider items under each specified factor that are having multivariate character. As a result, they should not be treated marginally; rather they should be expressed as vector combination.

Table 3, shows the results of the Box's M test. This test is carried out to examine whether variance – co-variance matrices between two populations i.e. faculty and industry executives, are same or not. For each of this factor we have executed the test separately and in almost al the cases, except one, the probability value is found greater than 0.05. In the case of second factor, the probability value is less than 0.05, which is below the acceptance level. The Probability value > 0.05 indicates the acceptance of the null hypothesis that assuming no difference in variance covariance matrices for two populations. For almost all the factors, same results are found. Therefore, we conclude that condition 2 is satisfied for carrying out multivariate tests for vector means of two populations.

Table 1: Descriptive Statistics

Academic program performance construct (Mandal and Banerjee, 2012)	Description	Type of Industry	Mean	Std. Deviation	N
Degree of industry focus ness of the program	V8) Only practical hands on training/project based learning supported by as less as possible lecture should require for Engineering course.	Executives	4.0458	1.72253	131
		Faculty	5.0233	1.59817	129
		Total	4.5308	1.72955	260
	V12) Engineering course should have more focused on basic sciences even Biological sciences.	Executives	4.7786	1.50532	131
		Faculty	6.0853	1.29922	129
		Total	5.4269	1.54921	260
	V6) Two month practical training is sufficient for course like Engineering.	Executives	3.4809	2.10622	131
		Faculty	5.3721	1.76808	129
		Total	4.4192	2.16082	260
Performance related to program and pedagogy	V3) A good course of Engineering should impart 'On-Job training' to the students.	Executives	6.1832	1.14221	131
		Faculty	4.9147	1.68649	129
		Total	5.5538	1.56980	260
	V9) Performance in the practical training should be evaluated by persons of the industry concerned and should be credited in the scorecard.	Executives	5.2061	1.41268	131
		Faculty	5.1550	1.76975	129
		Total	5.1808	1.59694	260
	V10) An ideal engineering course should have an understanding of professional and ethical responsibility.	Executives	5.9924	1.10590	131
		Faculty	5.3411	1.52836	129
		Total	5.6692	1.36921	260
Degree of industry readiness of the program	V4) Course should be designed to match with entry level requirements in the industry.	Executives	5.7328	1.27596	131
		Faculty	6.3721	1.17307	129
		Total	6.0500	1.26483	260
	V2) A modern updated course of Engineering should arrange global training of the students.	Executives	5.6336	1.55517	131
		Faculty	6.0233	1.46023	129
		Total	5.8269	1.51850	260

Table 2: Bartlett'S Test of Sphericity

	Degree of industry focus ness of the program	Performance related to program and pedagogy	Degree of industry readiness of the program
Likelihood Ratio	0.000	0.000	0.000
Approx. Chi-Square	76.278	71.946	38.126
Degree of Freedom	5	5	2
Probability of Sig.	0.000	0.000	0.000

Table 3: Box's Test of Eperformance of Covariance Matrices

	Degree of industry focus ness of the program	Performance related to program and pedagogy	Degree of industry readiness of the program
Box's M	11.789	48.517	2.522
F Ratio	1.940	7.984	0.834
Degree of Freedom 1	6	6	3
Degree of Freedom 2	481964.597	481964.597	12072453.986
Probability of Sig.	0.070	0.000	0.475

Table 4 explains the four most commonly used multivariate tests for comparing vector means of two populations (Pillai's trace, Wilks' lambda, Hotelling's trace & Roy's largest root). The criterion of significance of each of these tests is assumed 0.05. If probability value is less than 0.05 then the null hypothesis is rejected. The results of multivariate tests show that all the probability value is less than 0.05 (< 0.05). Thus, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_A), which assumes difference in vector mean scores between the faculty and the executives, are accepted. It indicates that the group differences present between faculty and industry executives.

Table 4, describes that all the three performance dimensions of an ideal engineering program i.e. Degree of industry focus ness of the program, Performance related to the program and pedagogy and Degree of industry readiness of the program are holding the significant probability criterion in relation to an ideal engineering program. Each of these four tests indicates that for these three factors there is a significant difference between the faculty and industry executives regarding the performance of an ideal engineering program. The result of the test confirms that the perceptual gap exists between the two groups, faculty, and industry executives, regarding all these three dimensions of performance of an ideal engineering program.

Table 4: Multivariate Tests

Dimensions of program performance	Tests	Value	F	Hypothesis df	Error df	Sig.	Remarks
Degree of industry focus ness of the program	Pillai's trace	0.266	30.898	3.000	256.000	0.000	**Gap exists**
	Wilks' lambda	0.734	30.898	3.000	256.000	0.000	
	Hotelling's trace	0.362	30.898	3.000	256.000	0.000	
	Roy's largest root	0.362	30.898	3.000	256.000	0.000	
Performance related to program and pedagogy	Pillai's trace	0.176	18.240	3.000	256.000	0.000	**Gap exists**
	Wilks' lambda	0.824	18.240	3.000	256.000	0.000	
	Hotelling's trace	0.214	18.240	3.000	256.000	0.000	
	Roy's largest root	0.214	18.240	3.000	256.000	0.000	
Degree of industry readiness of the program	Pillai's trace	0.066	9.114	2.000	257.000	0.000	**Gap exists**
	Wilks' lambda	0.934	9.114	2.000	257.000	0.000	
	Hotelling's trace	0.071	9.114	2.000	257.000	0.000	
	Roy's largest root	0.071	9.114	2.000	257.000	0.000	

7. Conclusion and Recommendations

The most significant contribution of this paper is to explore the perceptual gap between the two crucial stakeholders of education sector, faculty, and industry executives, regarding the performance of an ideal engineering program. In this research, we have found that there are significant gaps between these two groups of stakeholders regarding the essential performance dimensions of an ideal engineering curriculum. Though the model proposed by Mandal and Banerjee [21] require more customize application for the better implementation of this model still it is a landmark in this segment to measure the performance of an academic program. However, this research reveals that there are few significant differences between faculty and industry regarding the performance of an engineering program. This paper suggests following recommendations to bridge the gap between these two groups of stakeholders, faculty, and executives in order to strengthen the bonding between academia and industry as a whole: a) Industries should participate actively in the workshop, laboratories and practical program of engineering institutes to enhance the performance of engineering program. b) Academia-industry cooperation in the areas of research and development of engineering program is needed which can help both the students and faculties to get the experience of establishing turn key projects, plants etc. which in turn will enhance their practical knowledge as well. c) Implementation of the two-way training program for both faculty and industry executives is necessary for better understanding of engineering program.

8. Appendix: Description of Statistical Tools used:

Box's M test statistics: Box M test statistics is used to measure whether variance-covariance matrices of the two or more than two populations are equal or not. If they are found to be unequal, multivariate test procedure is become inoperative. Therefore, it is imperative to check the eperformance of variance-covariance matrices for two and more than two populations (Andy Filed 2009).

Barlett's test of spherecity: Barlett's test of spherecity tests whether residual covariance matrix is different from identity matrix or not. Identity matrix is the symbol of perfect multivariate nature. If the matrix is not different from matrix, it means that the data is multivariate in nature (Andy Filed 2009).

$$\textbf{Pillai's Trace} = \textbf{V}= \sum_{i=1}^{n}\frac{\lambda_i}{1+\lambda_i}, \textbf{ Wilks' Lambda} = \Lambda = \prod_{i=1}^{n}\frac{1}{1+\lambda i},$$

$$\textbf{Hotelling's Trace} = \textbf{T} = \sum_{i=1}^{n}\lambda_i, \textbf{ Roy's Largest Root (RLR)} = \textbf{R} = \lambda_{\max},$$

Where, λ_i is the eigenvalue of the i^{th} discriminant function. λ_i can also be written as the ratio of explained to unexplained variances and n is the total number of discriminant functions (Andy Filed 2009).

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