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Research Article

Strategic Growth Models for Engineering Colleges: A Management Approach

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ABSTRACT

The background of this study evaluates certain domains of engineering education in India. This is because as per statastics report for the acadamic year 2023-24 provided by AICTE,India, it was seen that Karnataka has 512 engineering colleges, whereas there are a total of 5868 engineering colleges in India. The problem statement identified is low enrollment in engineering courses as it was seen that only 11.9% of students in India enroll for engineering courses. In addition, the problem statement was expanded to reflect the low employability rate of Indian engineers. The "Goal-setting Theory" was incorporated with the "Outcome-based Education" strategy of engineering colleges in Karnataka and the whole of India. Constructivism learning theory was also incorporated with upskilling courses for engineers. Secondary data was collected regarding the 6-year performance of 18 UG and 15 PG colleges across Karnataka from the NIRF e-portal. The Chart method growth function analysis provided the regression model with R2 values. It was seen that several colleges maintained a strong positive correlation with academic years. It was seen that the majority of colleges gained a "very weak" correlation with academic years regarding placements, which inaccuracy in their growth models.

Keywords: growth model, engineering colleges, academic year, college admission

BACKGROUND

This research aims to focus on the growth model and growth practices of engineering colleges in Karnataka, India. This research proposes to enlighten the growth of engineering colleges based on their performance overview over different academic years. Engineering is one of the most popular and major courses for Indian youths and the same goes for the state of Karnataka. As a result, the number of engineering colleges is increasing in India. This research evaluates the scenario of engineering colleges in Karnataka, India. The main focus here is to identify the growth in several students, their opportunities for creativity and achieving higher studies and placement are analysed in this research. This analysis enlightens these factors of engineering colleges in India with the recent academic years. Figure 1(Source: shiksha.com, 2024) reveals engineering colleges ownership type in India.

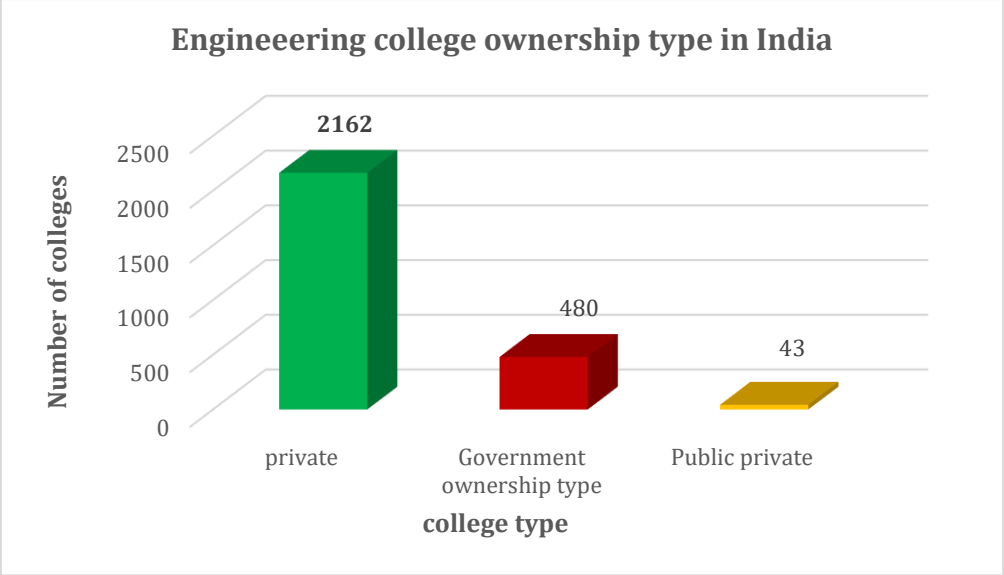

Figure 1 Engineering colleges in India

(Source: shiksha.com, 2024)

Many youths and school graduates are enrolling in engineering courses in India. As per reports, as of October 2023, there are a total number of 6078 engineering colleges registered in India (Geeks for Geeks, 2023). Out of these 6078 colleges, an estimated 4359 are private engineering colleges, followed by 1359 government colleges.

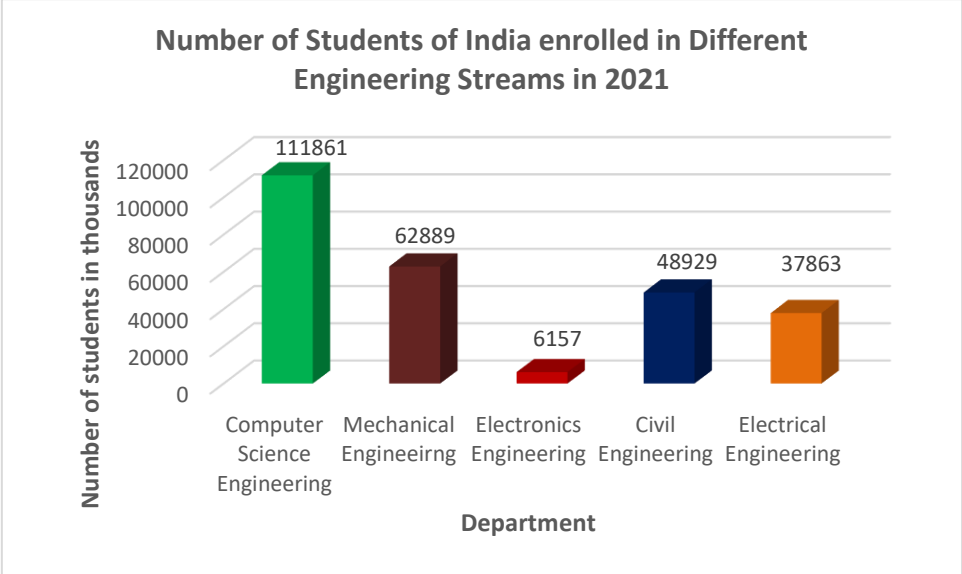

Figure 2: Number of Students of India enrolled in Different Engineering Streams in 2021

(Source: Rathore, 2023)

Figure 2 demonstrates the number of engineering students in 2021 by discipline. It was seen that 1,118.61 thousand students were enrolled in computer science engineering in 2021, followed by 628.89 thousand in mechanical engineering (Rathore, 2023). In addition, the background of this research also focuses on engineering colleges in Karnataka. As reported, in 2023, there are 611 engineering colleges in Karnataka (Department of Technical Education, 2023). The number of students and demand for engineering colleges and courses has increased in Karnataka over the academic years.

PROBLEM DEFINITION

The problem lies in the lack of data evaluation and data analytics from the engineering colleges. According to Nassa *et al.* (2021), there is a lack of standardisation process applied by engineering colleges in India. Although the Government has made some efforts to implement a core curriculum for academics and other standards to be

followed in Engineering colleges, there is a decentralised approach from the authorities to comply with the curriculum. As a result, the background of this research determines a lack of standardised infrastructure and management in engineering colleges in Karnataka. On another hand, the lack of estimation of intake capacity is another issue faced by these colleges. According to Dustker *et al.* (2021), engineering colleges in India are often unable to estimate the correct intake capacity and as a result, seats are often left vacant for the academic year. This is a critical issue faced by these colleges which needs to be addressed in this research.

Comparatively lower student enrolment ratio in engineering and technical courses is another issue which needs focus. As reported in January 2023, the student enrollment in undergraduate courses in the entire country is only 11.9% in engineering and technical streams (Press Information Bureau, 2023). This is a relatively low enrollment ratio for engineering colleges in India compared to other streams. Nagabhushan & Sohoni (2020) stated that a low enrolment ratio can be a result of inefficient intake capacity analysis from colleges. This research proposes to find a solution to this defined problem statement.

AIMS AND OBJECTIVES

Aim

This research aims to evaluate the growth model in engineering colleges in Karnataka based on total admissions placements and opportunities for higher education over the years.

Objectives

The objective of this research is to identify the growth model of engineering colleges in Karnataka based on the number of students admitted over the academic years. In addition, this research focuses on analysing the potential variance and growth model of several students selected for higher studies in engineering colleges in Karnataka with academic years. Furthermore, this research interprets the growth model of several students getting placements over different academic years in Karnataka engineering colleges.

LITERATURE REVIEW

The growth model of engineering courses in India has a vast scope of research on previous research. The journal article enunciated by Jadhav *et al.* (2020) opined that the growth model of any college or university or course curriculum is a combined result of numerous factors such as demand and capacity, management with proper infrastructure along with implementing creative objectives in vision and mission statement and applying those practically. This research has implied that the growth model of engineering education in India is "Outcome-based Education" (OBE). In addition, the main factors contributing to the growth of this model include curriculum "design", "assessment", "delivery", "evaluation" and "reflection."

It can be connected with the experiential learning theory applied by engineering colleges in Karnataka. As commented by Swanson *et al.* (2020), OBE is often associated with "Goal Setting Theory" as students are only focused on availing and nurturing relevant skills for professional placement. This can be a barrier to the growth model for education and engineering colleges in Karnataka. This is because only purpose-driven learning for placements could create a gap in the strategic learning process. Bandi & Naik (2021) supported this argument and stated that the "strategic knowledge management" theory must be implemented in educational institutions to assess the overall growth of students. However, strategic implementation of OBE in developing certain relevant skills can also be useful for engineering students.

This is because engineering colleges of Karnataka can use this method of OBE to increase critical thinking, creativity and problem-solving skills in their students. This will be a positive aspect for the students as it satisfies the basic norms of "Constructivism" learning theory. The journal article enunciated by Gaurav (2020) opined that a significant challenge faced by engineering and other colleges in India was during the outbreak of covid-19 pandemic as colleges have to shift their focus and attention to online learning and digitalisation of education. It is argued that the growth model of engineering education in India has foreseen a fourfold growth in e-learning mode which evaluates the implementation of "Change Management Theory."

This change of shift to online and e-learning models has a significant impact on this growth model. Darius *et al.* (2021) suggested that e-learning scopes support massive growth in educational sectors as course instructors benefit from enhanced communication opportunities, better design of scopes and better scope management. This would be beneficial in removing infrastructural gaps and management inefficiency in engineering colleges.

In addition, employability and placements are another factor that needs to be evaluated in this literature review section. Employability of graduates from engineering colleges in India shows a substantial and consistent fluctuation as employability was constantly decreasing from 2015 to 2017 (Tilak & Choudhury, 2021). However, an increase was shown in 2018 and 2019, followed by a massive decline in 2020 as employability hit only 49% in 2020. This huge decline can be reasoned by the outbreak of covid-19 pandemic. In addition, this article has evaluated change in employability in different sub-streams of engineering. It was noted that the highest drop in employability was seen for civil engineers as employability went down from 50% (2019) to 26.5% (2020). Furthermore, in 2020, 38.4% of computer science engineers were employed.

Higher studies in engineering branches and departments are another performance metric for this growth model. The study published by Bandi *et al.* (2021) identified that successful course curriculum and completion imply admission to higher studies and pursuing higher education on that subject. Again, it also implies that placements also play a great role in determining the growth model. As reported, while enrollment has declined by 13% in undergraduate (UG) engineering courses, the same for post-graduate (PG) engineering courses has declined by 34% in 2021 (Factly, 2021).

METHODOLOGY

In this case, the "interpretivism" research philosophy was used. Interpretivism philosophy, rather than considering any previously established theoretical norms and assumptions, relies on rational interpretation and logical understanding behind specific actions of entities to establish a new scope of understanding, based on a "subjective" interpretation of factual knowledge (Junjie & Yingxin, 2022). Social interactions are considered in this case which is beneficial in understanding the external situations of education in India and Karnataka.

It is followed by selecting a descriptive research design. A descriptive design is often useful in interpreting situations where factors can be answered in the simple form of "when", "where", "why", "what" and "how" (Doyle *et al.* 2020). On another hand, descriptive design has helped this research to describe the phenomenon of growth model in engineering based on logical interpretation of the collected data. This research was based on the educational perspectives of Indian engineering colleges and understanding the demographic and psychographic population associated with this study was essential in terms of accurate interpretation. This was made easier by the use of this research design.

The data collection method was followed as secondary quantitative data collection. Secondary data collection is a useful and reliable data collecting method provided data is gathered from authentic, reliable and relevant sources (Tang *et al.* 2022). Here, data was collected from the NIRF e-portal regarding the performance of 18 Undergraduate (UG) and 15 Post-Graduate (PG) engineering colleges in Karnataka. Using government sources is a critical strategy in secondary research as it increases the credibility and validity of findings (Maida *et al.* 2022). Quantitative data collection was beneficial here as it presented the whole scenario of the growth model of the colleges. In addition, statistical data from quantitative analysis are often unbiased, increasing the reliability of the findings. Colleges, taken from 4 regions of Karnataka were coded as the following.

Table 1: Regions of the Colleges Selected and their Codes

Regions	***Code***
Bangalore	01
Mysore	02
Mangalore	03
North Karnataka	04

The following data and criteria were collected from the NIRF e-portal for each college for 6 academic years.

Table 2: Main Criteria of Data and Statistics Collected for Data Analysis

1.	Number of Students Intake
2.	Number of Admissions in First Year
3.	Number of Students Admitted through Lateral Entry
4.	Total Number of Admissions
5.	Number of Students Graduated in Minimum Stipulated
6.	Number of Students Engaged

7.	Number of Students Failed to Graduate in Minimum Stipulation
8.	Number of Students Selected for Higher Studies
9.	Number of Students Got Placement

Data was collected individually for each college to run a comparative and detailed analysis. It resulted in a definite interpretation based on "quantitative data analysis" to identify the regression model and interpret the R^2 value. The regression model establishes a linear relation between the dependent variable (DV) academic year and independent variables (IV) number of student admissions, number of students selected for higher studies and their placements, to analyse the slope, skewness and proportional variance between the variables in form of a graphical interpretation (James *et al.* 2023). Data collection in this research was done to understand the target population and evaluate the performance metrics of engineering colleges. The total number of intake of each college per year, how many of them were able to graduate and the number of students who got placements were valuable for this study as they added new dimensions and value to it.

The quantitative analytical method was used for data analysis. Quantitative analysis relies on data and statistical figures rather than any theory (Bakkar *et al.* 2021). The collected data was put into MS Excel and analysed using "the chart method growth function in the excel sheet. The "chart method growth function" can plot the exponential graph of a function, which can predict and forecast future values (Bornmann *et al.* 2021). Here, analysis was done based on the R^2 value obtained from the chart method growth function which gave a proper idea of the characteristics of the graphs of the variables. Thus, the chart method function was used for analysing the linear regression between the variables.

ANALYSIS AND DISCUSSION

7.1 Relation Between Academic Year and Students Admitted in the Engineering Colleges

Table 3 Growth model of academic year vs student admitted for UG College of Engineering - Karnataka with very strong R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-J	$214.19e^{0.2053x}$	0.889	very strong

Table 4 Growth model of academic year vs student admitted for UG College of Engineering - Karnataka with strong R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-A	$y = 884.16\ e^{0.0333x}$	0.77	strong
2	02-C	$y = 586.9\ e^{0.0127x}$	0.7264	strong
3	01-G	$y = 969.89e^{0.0124x}$	0.6274	strong

Table 5 Growth model of academic year vs student admitted for UG College of Engineering - Karnataka moderate R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-B	$y = 837.02\ e^{0.0521x}$	0.58	moderate
2	01-D	$y = 965.52\ e^{0.038x}$	0.4149	moderate
3	01-E	$y = 880.5\ e^{-0.021x}$	0.5457	moderate
4	01-F	$y = 419.12\ e^{0.0583x}$	0.5441	moderate
5	02-B	$734.74e^{0.0224x}$	0.4642	moderate
6	04-1	$y = 255.52e^{0.2632x}$	0.4063	moderate
7	02-A	$Y=616e^{0.0392x.}$	0.548	moderate
8	01-I	$y = 755.51e^{0.0433x}$	0.4982	moderate

Table 6 Growth model of academic year vs student admitted for UG College of Engineering - Karnataka with very weak R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-C	$y = 1065.3\ e^{0.0003x}$	0.1304	Very weak
2	03-A	$y = 814.57e^{0.0054x}$	0.15	Very weak
3	01-H	$y = 1731.4e^{-0.103x}$	0.226	Very weak

Table 7 Growth model of academic year vs student admitted for PG College of Engineering – Karnataka with very strong R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-A	$y = 417.82e^{-0.046x}$	0.9249	very strong
2	01-B	$y = 417.82e^{-0.046x}$	0.9249	very strong

Table 8 Growth model of academic year vs student admitted for PG College of Engineering – Karnataka with strong R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	03-B	$y = 44.728e^{0.1562x}$	0.721	strong

Table 9 Growth model of academic year vs student admitted for PG College of Engineering - Karnataka with moderate R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R2)	Remark
1	01-C	y = 237.71e-0.023x	0.4726	moderate
2	01-C	y = 403.38e0.0366x	0.5344	moderate

Table 10 Growth model of academic year vs student admitted for PG College of Engineering - Karnataka with very weak R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R2)	Remark
1	02-C	y = 122.78e-0.011x	0.0241	Very weak
2	01-D	y = 159.39e-0.119x	0.3778	Very weak
3	01-J	y = 70.393e0.0402x	0.1471	Very weak
4	01-I	y = 243.62e-0.087x	0.1614	Very weak
5	04-1	y = 63.208e0.0682x	0.2263	Very weak

Data interpretation from the above Table 3 to Table 10 shows the relation between students taking admission to engineering colleges of UG and PG of Karnataka as the academic years progressed. Here, only college with code 01-J from Bangalore of UG had a "very strong" correlation with this factor with academic years. 3 colleges had reported a "strong" relation in this case. According to Chicco *et al.* (2021), regression analysis interpreting the R^2 value defines a proportional level of variance of the dependent variable due to the independent variable. Here, 88.9% of the variance can be explained for college with code 01-J of Bangalore. Whereas, colleges having "very weak" relations such as 01-C, 03-A, 01-H only explain less variance.

Thus, this analysis shows that the majority of the UG colleges have a strong or moderate relationship between academic year and student admission. However, for PG colleges, the majority of colleges have a “very weak” correlation with academic year in terms of student admission. This shows that the growth model of UG colleges is more advanced than that of PG colleges. According to an analysis, from the last 3 years, the average rate of vacant

seats in Master in Technology courses (M.Tech) in engineering colleges and universities was estimated at 60% to 65% (Hindustan Times, 2022). This can be reasoned with the outbreak of covid-9 pandemic. However, Jadhav *et al.* (2020) argued that due to an "unsynchronised admission" method from most IITs and NITs in India and other universities as well, the admission rate of students is declining in Indian engineering courses.

As a result, a moderate impact was seen in the majority of UG colleges also in terms of admission. Geetha Lakshmi & Thomas (2021) countered that engineering colleges in India often have a hefty fee structure which causes vacant seats. This is a result of students and parents pulling out from admission to engineering courses. A Journal article enunciated by Joshi & White (2020) enlightens that M. Tech in Indian colleges does not offer much scope for research which results in lower rates of admission in M. Tech courses. This argument describes why PG colleges have a weak reaction to the academic year in students' admission.

7.2 Relation Between Academic Year and Number of Students Selected for Higher Studies

Table 11 Growth model of academic year vs No. of students selected for Higher Studies of UG College of Engineering - Karnataka with very strong R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-F	$y = 58.806e^{-0.117x}$	$R^2 = 0.1959$	very strong
2	01-I	$y = 656.3e^{-0.431x}$	$R^2 = 0.8213$	very strong

Table 12 Growth model of academic year vs No. of students selected for Higher Studies of UG College of Engineering - Karnataka with strong R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-E	$y = 100.75e^{-0.265x}$	$R^2 = 0.6636$	strong
2	01-J	$y = 17.825e^{0.3126x}$	$R^2 = 0.7029$	strong
3	03-A	$y = 125.01e^{-0.182x}$	$R^2 = 0.7284$	strong

Table 13 Growth model of academic year vs No. of students selected for Higher Studies of UG College of Engineering - Karnataka with moderate R^2 value.

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-D	$y = 69.795e^{0.1482x}$	$R^2 = 0.5935$	Moderate
2	03-B	$y = 40.663e^{0.2775x}$	$R^2 = 0.4872$	Moderate
3	01-H	$y = 152.66e^{-0.162x}$	$R^2 = 0.4789$	Moderate

Table 14 Growth model of academic year vs No. of students selected for Higher Studies of UG College of Engineering - Karnataka with very weak R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-A	$y = 68.564e^{0.0156x}$	$R^2 = 0.0479$	Very weak
2	01-B	$y = 100.97e^{0.0215x}$	$R^2 = 0.0637$	Very weak
3	01-C	$y = 136.47e^{0.0642x}$	$R^2 = 0.2$	Very weak
4	02-C	$y = 125.15e^{-0.12x}$	$R^2 = 0.2969$	Very weak
5	01-G	$y = 100.49e^{0.0079x}$	$R^2 = 0.0435$	Very weak
6	02-B	$y = 64.877e^{0.0639x}$	$R^2 = 0.0648$	Very weak

7	04-A	$y = 58.42e^{-0.086x}$	$R^2 = 0.2332$	Very weak
8	02-A	$y = 36.39e^{0.0577x}$	$R^2 = 0.0321$	Very weak

In this case, from Table 11 to Table 14 , it was seen that the R^2 was "very weak" for 8 out of 18 UG colleges in this research. This shows that the number of students selected for higher studies has a weak correlation with academic years. R^2 when close to 1, represents a strong positive R^2, a moderate R^2 when close to 0.5 and a weak or very weak correlation when it is close to 0.1 or 0 (Shrestha, 2020).

Table 11 depicts that only 2 colleges shared “very strong”, 3 have “strong R^2 ”, 3 are “moderate” and 8 have “very weak” positive R^2 with academic year. Kaplan *et al.* (2021) opined that selection for higher studies from specific colleges depends on various factors such as quality of education received, curriculum and depth of the course, future opportunities and placements in the higher course and financial support of the student along with merit-based categorisation based on the demand-availability criterion of seats. This is a critical argument that indicates that academic quality and the quality of faculty play a pivotal role in this case. This analysis indicates that 8 colleges have several areas to improve including faculty improvement, educational quality enhancement and developing better infrastructure to attract meritorious students. Tilak (2020) countered this argument and stated that there is a significant drop in enrollment of students in higher education courses overall in India in almost every course.

Thus, this performance of low R^2 value can be related to the academic and educational trend across India. Archana *et al.* (2022) stated that the lack of resource availability in terms of social and financial security during the post-pandemic era caused a severe downfall in education quality in students and institutions as well. However, the growth model was intact in colleges offering a balanced curriculum with quality education. This suggests the importance of a high level of educational content and infrastructure in engineering colleges to promote internal scopes for higher studies.

7.3 Relation Between Academic Year and Number of Students Getting Placements

Table 15 Growth model of academic year vs No. of students placed at UG College of Engineering – Karnataka with very strong R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	03-C	$y = 193.09e^{0.2007x}$	$R^2 = 0.807$	very strong
2	01-D	$y = 7.6182e^{0.8365x}$	$R^2 = 0.8447$	very strong
3	01-F	$y = 289.3e^{0.1027x}$	$R^2 = 0.8354$	very strong
4	01-G	$y = 704.85e^{0.0514x}$	$R^2 = 0.8526$	very strong

Table 16 Growth model of academic year vs No. of students placed at UG College of Engineering – Karnataka with very strong R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R2)	Remark
1	01-K	y = 16.971e0.7316x	$R^2 = 0.7321$	Strong
2	01-J	y = 52.57e0.2781x	$R^2 = 0.7535$	Strong
3	01-I	y = 384.25e0.065x	$R^2 = 0.7315$	Strong

Table 17 Growth model of academic year vs No. of students placed at UG College of Engineering – Karnataka with moderate R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R2)	Remark
1	01-E	y = 648.71e0.0271x	$R^2 = 0.5695$	Moderate
2	03-B	y = 423.97e0.0803x	$R^2 = 0.4801$	Moderate
3	04-A	y = 628.49e0.0238x	$R^2 = 0.5915$	Moderate
4	03-A	y = 406.66e0.0553x	$R^2 = 0.5625$	Moderate

Table 18 Growth model of academic year vs No. of students placed at UG College of Engineering – Karnataka with very weak R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R2)	Remark
1	01-A	y = 762.67e-0.002x	R^2 = 0.002	Very weak
2	01-B	y = 605.91e0.037x	R^2 = 0.3314	Very weak
3	01-C	y = 878.97e-0.005x	R^2 = 0.0443	Very weak
4	02-B	y = 502.56e0.0408x	R^2 = 0.1897	Very weak
5	03-A	y = 628.61e0.0129x	R^2 = 0.2132	Very weak
6	01-H	y = 1399.3e-0.117x	R^2 = 0.1787	Very weak

Table 19 The growth model of academic year vs No. of students placed at PG College of Engineering – Karnataka with very strong R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R2)	Remark
1	01-F	y = 15.331e-0.107x	R^2 = 0.8526	Very strong

Table 20 The growth model of academic year vs No. of students placed at PG College of Engineering – Karnataka with strong R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R2)	Remark
1	01-D	y = 53.538e0.0735x	R^2 = 0.7732	Strong
2	01-G	y = 463.75e-0.583x	R^2 = 0.7319	strong
3	03-C	y = 20.517e0.4013x	R^2 = 0.7478	strong

Table 21 The growth model of academic year vs No. of students placed at PG College of Engineering – Karnataka with moderate R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-J	$y = 30.113e^{0.1065x}$	R^2 = 0.4084	moderate
2	03-A	$y = 264.59e^{0.0777x}$	R^2 = 0.5613	moderate

Table 22 The growth model of academic year vs No. of students placed at PG College of Engineering – Karnataka with very weak R^2 value

Sl No.	College Code with Region	Exponential equation value	Regression value(R^2)	Remark
1	01-A	$y = 166.64e^{0.0074x}$	R^2 = 0.0216	Very weak
2	01-C	$y = 134.4e^{-0.002x}$	R^2 = 0.0047	Very weak
3	02-C	$y = 32.897e^{0.0943x}$	R^2 = 0.2223	Very weak
4	03-B	$y = 44.196e^{-0.069x}$	R^2 = 0.067	Very weak
5	01-I	$y = 29.321e^{0.1053x}$	R^2 = 0.3871	Very weak
6	01-L	y = -0.5357x + 5	R^2 = 0.158	Very weak
7	01-C	$y = 134.4e^{-0.002x}$	R^2 = 0.0047	Very weak

It is seen from Table 15 to Table 22 of the selected UG colleges reported a "very strong" R^2 with the academic year in placements for students, followed by"very strong", "strong", "moderate" and "very weak" R^2 by 4, 3, 4 and 6 colleges respectively. Whereas for PG engineering colleges in Karnataka, placements correlation at "very strong", "strong", "moderate" and "very weak" are obtained at 1, 3, 2 and 7 colleges respectively. This shows that placement opportunities are better at UG colleges than that at PG. The exponential equation from regression analysis transcripts the scale of the function with its monotonic increasing or decreasing character (Ghosal *et al.* 2020).

Most of the engineering colleges suffer from lack of development opportunities from infrastructure and education. Here, the same can be stated for these colleges in Karnataka. Singh & Rawani (2022) enunciated that engineering colleges in India lack focus on personal and professional building scopes for students which causes skill gaps in students, causing a lack of placements. As mentioned, engineering students suffer from poor assessment of "soft skills" and "communication skills" despite having excellent problem-solving and critical-thinking skills. This argument was countered by Loyalka *et al.* (2021) as it was opined that due to the pandemic. Most companies are decreasing their workforce by laying off employees and not accepting many freshers. This can be a critical reason behind the poor performance of engineering colleges in Karnataka in terms of placements over the years.

This results section shows that certain colleges such as college "01-J" and "01-F", Bangalore" have performed well in all three cases such as student admission, selection in higher studies and placements for students in the UG section. Whereas, "01-G" of banglore (PG) recorded a strong or very strong correlation to students' admission and placements. Thus, this analysis highlights that colleges having a consistent growth model and sustainable planning for better "value proposition" of education to students are unaffected by the situational complexities (Srivani *et al.* 2022).

Thus, it can be stated that engineering colleges and universities must focus on their internal management and strategic implementation. Gurumoorthy & Kumar (2020) argued that engineering colleges must focus on self-development goals in students, by engaging them in several campaigns and training sessions to enhance skills such as collaboration, communication, leadership, negotiation, creativity, risk mitigation, problem-solving and emotional intelligence. This is because improved strategic implementation of educational curricula increases the validity of a course and its acceptability to students. As reported, in 2019, employability in Indian engineering graduates was estimated at 57.09%, which dropped to 46.82% in 2021 (Rathore, 2023).

CONCLUSION

The above analysis shows that the growth functions of engineering colleges have a significant R^2 with the academic years. However, it was also shown that internal management, infrastructure and course curriculum of the college also play a key role. This research concludes that engineering colleges must apply more skill enhancement programs to input skills and employability of their graduate engineers, This is because proper upskilling courses and orientation sessions can help mitigate the risk of low employability rates in engineers, as seen in this research.

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