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To study strategy and tactics for the effectiveness of institute-industry collaboration

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Abstract
Any nation's capacity to advance its culture, society, and individual citizens depends on its higher education system in particular. Economic progress and the improved quality of living it enables are both facilitated by education. In every nation, higher education has played a significant role in fostering good development and transformation for people as well as for society, the state, and the creation, growth, and dissemination of social, cultural, and economic values. A significant part of spearheading, defining, and implementing constructive change has come from higher education. Higher education institutions play a multifaceted role in serving and enriching society in numerous ways. Higher education establishments serve a student body that is constantly expanding and becoming more diverse while also serving as gatekeepers, inventors, and distributors of new knowledge. They serve as a hub for interactions between a wide variety of complicated local, regional, national, and international concerns.

Higher education is essential to the economic revival because it fosters societal advancement and individual well-being. Additionally, it is essential in helping students develop an inquisitive mindset and a strong sense of the value of learning; in fact, it is their positive engagement with higher education that inspires them to be innovative. The caliber of their educational experiences and the classroom setting will influence how our society develops in the future. The future leaders of business, legislators, social innovators, and job creators are those who will enroll in higher education in the ensuing decades. Along with being parents, teachers, and community leaders, they are also citizens who will enrich society. Through their chosen fields of expertise, they will build a thriving, dynamic economy.

Keywords: Higher education, social, cultural, economic, society

Introduction

One of the most unexpected areas where developing countries have jumped ahead is higher education, thanks to the impact of globalization. According to the most available data, the proportion of developing nations' students enrolled overall in postsecondary education increased from 54.4% in 1970 to 72.4% in 2006. This is unexpected given that, while making up 85% of the global population, emerging nations still trail behind in terms of commerce and economic production.

The developed world's image of the expanding knowledge empowerment in the developing world appears to have changed significantly as a result of globalization and the expansion of the knowledge economy. Trends starting in the 1970s indicate that while the number of students enrolled in higher education in industrialized nations nearly doubled to 26.6 million in the two decades leading up to 1990, the increases afterward slowed, with enrollment rising by just 46.6% to reach 39 million in 2006. On the other hand, during the course of two decades, the number of students enrolled in higher education in developing nations increased by nearly 1.5 times to reach 41 million in 1990. This number then skyrocketed to 102 million over the following 16 years. However, what makes the trends more intriguing is how highly skewed the gains and losses are, and how the majority of the significant shifts are confined to a small number of countries, including the US, China, and India.

The proportion of emerging nations, excluding China and India, in higher education enrollment was relatively constant between 1970 and 2006, slightly increasing from 45.6% to 46.8%. This is similar to the situation with developed nations excluding the US. On the other hand, China and India's proportion of the world's enrollment increased nearly thrice, from 8.8% in 1970 to 25.7% in 2006. However, China is the true achiever of these two nations; its percentage of overall enrollment increased from roughly 0.3% to 16.5%, making it the country with the largest number of students enrolled in higher education.

About one-third more Chinese students attended college in 2006 (23.4 million) than there were in the United States (17.5 million). Even while India's advances have been relatively modest-its percentage of adults enrolled in postsecondary education increased from 8.5% in 1970 to 9.1% in 2006-the country nonetheless managed to enroll an astonishing 12.9 million students, a third fewer than the United States. What is unexpected is China's victory against India. Up until the year 2000, there were much more people enrolled in higher education in India than in China (5 million Indians versus 3.8 million Chinese). However, throughout the past 16 years, the Chinese have increased the number of students enrolled in higher education by 19.6 million, while the Indian increase has been less than half that, at 7.9 million.

Engineering education in India

India possesses a broad network of advanced engineering education. Technical education is provided by government-run, government-aided, private, or self-financing institutions that are recognized as universities under a government university umbrella. During the first few decades of technical education in India after independence, government institutions like the Indian Institutes of Technology and National Institutes of Technology dominated the field. However, a new era of technical education system expansion was brought about by the government's policy shift in the 1980s toward allowing private and voluntary organizations to establish technical institutions on a self-financing basis. This led to an abrupt increase in the number of private or self-financing engineering institutions, particularly in the southern states. These self-financing colleges' primary goal was to give students a degree at first, and then, through campus placement programs, to get jobs for the graduating students. These engineering schools are connected to a government-run university. In the beginning, there was no focus on expanding research efforts or collaborating with industry. Due to the fierce competition amongst the self-financing institutions, some of them have improved their departmental offerings by bringing in guest lecturers, arranging for student visits to businesses, and doing more than just placing students on campus. Even at this early stage, each of these programs was offered on an individual basis based on the faculty members' professional contacts. A concerted attempt was lacking to unify industry-related activities under a single roof.

Engineering Education System in India

Since higher education is a potent instrument for creating the knowledge-based society of the twenty-first century, it is essential for the nation. In this perspective, the two main types of institutions that make up engineering education, which is a part of higher education in India, are as follows.

1) Institutions at the university or university level
2) Engineering colleges and other university-affiliated institutions

Universities and institutions at the university level make up Higher Engineering Educational Institutions (HEEI).

University/University Level Institutions

A "university" is defined as an institution that was founded or incorporated by a Central Act, a Provincial Act, or a State Act under the University Grants Commission (UGC) Act, 1956. It also includes any other institution that the commission may, after consulting with the university in question, recognize in accordance with the regulations made in this regard under this Act (Ministry of Human Resource Development, 2012) [2]. Thus, this category includes the following universities that grant degrees:

1. A university created or incorporated by a Central Government Act is known as a central university.
2. A university created or incorporated under a provincial or state government act is referred to as a state university.
3. A private university is one that was founded by a sponsoring authority, such as a State or Central Act. a public trust, a company registered under section 25 of the Companies Act, 1956, a society registered under the Societies Registration Act 1860, or any other applicable statute currently in force in a state.
4. National institutes, like the Indian Institute of Technology (IIT) and the National Institute of Technology (NIT), are establishments designated as institutions of national importance by an Act of Parliament.
5. Deemed to be university: A high-performing institution that has been designated as such by the Central Government in accordance with Section 3 of the UGC Act, 1956 is referred to as a "deemed university."
6. Institute under State Legislature Act: A State Legislature Act is the legal framework that governs an establishment or incorporation.

Engineering Colleges/Institutions Affiliated with Universities

These are organizations that are capable of managing degree programs, but they lack the authority to grant degrees on their own and must partner with another university in order to do so. These engineering colleges are either self-financing, government-funded, or government-aided institutes. Self-financing institutions are run by individuals, trusts, societies, or other private organizations and are not dependent on government funding. Instead, they run their courses through student loans and fees. These institutions are affiliated with government-run universities and must adhere to all rules and regulations set forth by those universities in order to maintain their affiliation.

The programs that these institutions offer are broken down into several levels below

1. **Undergraduate Programs:** These courses last four years. Students are admitted to undergrad programs after completing 12 years of education.
2. **Postgraduate Programs:** These courses last for two years. Following their undergrad, students enroll in these programmes.
3. **Doctoral (Ph.D.) Programs:** Scholars enroll in these programs following graduation. The time span is three to six years.

Need for the study

A lot of emerging nations are attempting to switch from resource-based to technology-based economic growth. Their aim to lessen their economy's reliance on natural resources and other growth-stifling issues is driving this transition. Economic growth driven by technology is determined by several elements and how well they are integrated into an economy. Investing in the creation of information and using that knowledge to create novel goods is a feature shared by highly industrialized economies. Mass production has given way to product differentiation-that is, making inventive additions to already-existing products or developing whole new ones-in highly industrialized nations. Formal and informal networks between different actors are increasingly important to the process of innovation. The cooperation and collaborations between the companies and HEEI and R&D institutes, which are quickly emerging as the engines of innovation, can be credited for many of the innovative products. HEEI is being encouraged to play a more active part in the innovation process in highly industrialized nations due to the emergence of high-tech enterprises.

Industry collaboration ought to be a key component of HEEI development. Building strong working relationships may help academic institutions attract a diverse range of practitioners, which would be advantageous to both parties. It can also increase the significance of higher engineering education by giving graduates employable skills. Given the differences in HEEI and industrial culture and values, this type of interaction is difficult to establish.

The aforementioned findings have spurred the researcher to conduct a study aimed at evaluating the efficacy of industry-institution collaboration in HEEI. The research study's findings will be very helpful to HEEI in its ongoing efforts to raise educational standards.

Research Objectives

1. To determine the key elements that both increase and decrease the effectiveness of institute-industry collaboration
2. To provide a suitable strategy and tactics for productive industry-institute collaboration.

Research methodology

The conceptual framework that guides research is known as research design. It serves as a guide for pre- and pilot study planning, as well as the arrangement of parameters for data collection, measurement, techniques, and analysis in a way that combines relevance to the research goal. During the research period, there were 22 deemed universities in Kolkata that offered engineering education programs. Purposive sampling was used to choose nine colleges that met the criteria. Purposive sampling's primary objective is to concentrate on certain, interesting features of a population that will best help the researcher address the study questions.

Data analysis and findings

Testing associated hypotheses and an analysis of the Institute-Industry Collaboration's efficacy are also included. The techniques employed to identify the limiting and boosting aspects that significantly affect the efficacy of the industry-institution collaboration are highlighted, along with the outcomes that were obtained. This chapter concludes with a presentation of the basic model for Institute-Industry Collaboration and a description of the tactics that have been shown to be beneficial.

Students' Profile

Table 1: Profile of the students

Profile		Frequency	Percentage (%)
Department	Civil Engineering	94	22.1
	Mechanical Engineering	71	16.7
	Electronics & Communication Engineering	78	18.4
	Computer Science Engineering	90	21.3
	Electrical & Electronics Engineering	92	21.5
	Total	425	100.0
Years of study	II year	152	35.8
	III year	142	33.4
	IV year	131	30.8
	Total	425	100.0
Gender	Male	307	72.2
	Female	118	27.8
	Total	425	100.0

Table 4 displays the department, years of study, and gender of the students. Of the students, 72% were men. Over the course of the three years of study, there was a balanced distribution of students among the following engineering programs: computer science, electrical and electronics, mechanical, computer science, electronics and communication, and civil.

Table 2: Faculty members' assessments of the effectiveness of parameters of institute–industry collaboration

Type of Collaboration	Parameters	Very Low (%)	Low (%)	Moderate (%)	High (%)	Very High (%)	Mean	SD
Category1 (C1) General Collaboration	C1.1:Participation of industrial personnel in workshops	6.82	14.95	36.37	30.61	11.20	3.22	1.03
	C1.2:Participation of industrial personnel in conferences	5.42	15.97	39.43	29.57	9.50	3.20	1.03
	C1.3:Participation of industrial personnel in seminars	5.42	13.93	38.12	28.93	13.63	3.33	1.03
	C1.4: Participation of industrial personnel in guest lectures	5.74	13.25	38.12	27.53	15.33	3.31	1.05
	C1.5:Participation of industrial personnel in committees	7.80	22.77	37.05	24.47	7.84	3.00	1.03
Category 2 (C2) Academic Level Collaboration	C2.1: Participation of industrial personnel in teaching process	8.82	26.55	36.03	19.03	9.50	2.92	1.07
	C2.2:Conduction of continuing education for industries	13.25	22.13	34.67	24.13	5.74	2.85	1.12
	C2.3: Involvement of industrial personnel in curriculum design	7.12	21.45	35.03	23.45	12.91	3.12	1.13
	C2.4:Joint publication of papers with the industries	23.11	32.33	26.85	10.22	7.44	2.45	1.15

	C2.5:Representation of industrial experts as external examiners for students	21.41	32.97	27.57	10.84	7.12	2.47	1.13
Type of Collaboration	**Parameters**	**Very Low (%)**	**Low (%)**	**Moderate (%)**	**High (%)**	**Very High (%)**	**Mean**	**SD**
Category 3 (C3) Institutional Support Type Collaboration	C3.1:Participation of industries in research fellowships	18.73	26.17	28.25	19.37	7.44	2.73	1.17
	C3.2:Contribution of funds to attend workshops by the industries	15.97	21.75	28.92	25.53	7.84	2.85	1.17
	C3.3:Donation of instructional resource materials by the industries	13.63	22.13	34.67	21.75	7.84	2.84	1.15
	C3.4: Donation of laboratory equipments by the industries	17.33	26.17	31.65	15.33	9.54	2.71	1.17
	C3.5:Contribution for infrastructure development by the industries	23.15	27.23	27.53	14.61	7.44	2.53	1.27
Category 4 (C4) Service Type Collaboration	C4.1: Utilization of specialized laboratory equipments of the institute by the industries	11.92	16.65	32.33	30.25	8.82	3.05	1.12
	C4.2: Conduction of training programmes for the industries	11.20	24.17	30.63	27.23	6.82	2.92	1.13
	C4.3: Participation in consultancy assignment of the industries	15.33	27.21	33.35	18.35	5.74	2.70	1.13
Category 5 (C5) Cooperative Type Collaboration	C5.1:Participation in joint project with the industries	20.05	22.15	34.03	15.63	8.13	2.72	1.17
	C5.2:Participation in joint research with the industries	20.05	28.93	28.93	14.95	7.12	2.62	1.15
	C5.3:Participation in joint patent with the industries	30.97	29.57	22.77	11.92	4.73	2.32	1.13

It is clear from the preceding table that

1. The faculty members evaluated the efficacy in each of the five general collaboration parameters in the range of Moderate (Mean 3) to High (Mean 4). The participation of industrial personnel in guest lectures had the highest mean value.
2. The faculty members have evaluated the efficacy of each of the five parameters under Academic Level Collaboration in a range from Low (Mean 2) to High (Mean 4). The involvement of industrial personnel in curriculum design has the highest mean value.
3. Faculty members have evaluated the effectiveness in all five categories under the Institutional Support Type Collaboration in the range of Low (Mean 2) to Moderate (Mean 3). The industry donation of instructional resource materials has the greatest mean value.
4. The faculty members have evaluated the efficacy in each of the three parameters under Service Type Collaboration, ranging from Low (Mean 2) to High (Mean 4). The industry use of the institute's specialized laboratory equipment has the highest mean value.
5. The faculty members have evaluated the effectiveness in each of the three parameters under the cooperative type collaboration in the range of Low (Mean 2) to Moderate (Mean 3), with the participation in joint projects with the industries receiving the highest mean value.

Conclusion

The academic community has come to place a greater emphasis on institute-industry collaboration, and this appreciation has grown over time. However, institute-industry collaboration in HEEI in India is still mostly unexplored, with the probable exception of a few studies. To fully grasp the pattern of collaboration, a thorough examination is necessary. In this regard, the National Steering Committee on TEQIP, which was established by the National Project Implementation Unit (2013), voiced concerns regarding the underutilization of the interface between academic institutions and industry and the pressing need to fully utilize it within the framework of TEQIP.

While government spending on education and training as a percentage of GDP rose, the National Knowledge Commission's working group on engineering education (2008) found that the effort fell short of meeting the direct demands of the business sector. This necessitates cooperation between academia and business. The 2012 AICTE-CII survey report paints an unfavorable picture of industry–institute engagement in Indian engineering schools.

During the session focused on collaboration between academia and industry, the Union Minister for Human Resource Development, Shri. According to Pallam Raju (2013), industry-academia links in India are now occurring piecemeal and ought to be the subject of a long-term, sustainable plan.

This prompted the researcher to thoroughly examine the efficiency of industry-institution collaboration in HEEI. Higher education institutions teaching engineering will find great value in the study's conclusions as they work to replicate the proposed model and execute recommended techniques for Institute-Industry Collaboration.

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