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Transformation in Indian Engineering Education through Academic Autonomy to High Performing Faculty Teams

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Abstract : In the twenty first century, engineering education in India has to contribute to the fast developing economy through high end knowledge and human capital. The leaders need high performing faculty and staff teams for sustenance of excellence. The Board of Governors, CEO, administratorsand the faculty association have to support the high performers. Through research studies, it is found that thetransformation in engineering education is desirable only through cultural change and decentralization of administration. The sustenance of excellence is possible through delegation and empowerment with adequate accountability. The traditional water tight compartments and bureaucratic approaches would not support excellence. There is a need for multidisciplinary approach for solving many field problems, and the faculty needs of appropriate interdisciplinary teams. To develop industry relevant programs in engineering and technology, institute's vision and mission not only relevant but also essential for sustaining the initial efforts. Besides resources, faculty members need supportive leadership and linkages with the governments, industry and national laboratories. The institutes have to redefine the doctrines which would accelerate the growth. Excellence has to be recognized and supported. There is a need for periodical assessment of institute's culture and views of the faculty. Transformation and reengineering of the departments have to be undertaken periodically so that the faculty may be facilitated for growth

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1. Introduction

In the 21st Century transnational companies started utilizing open policies under the globalized economy and are moving to various fast developing countries based on the availability of resources, infrastructure, market, and human capital (Dr. James Gover and Dr. Paul Huvey). They expand their manufacturing activities and integrate the locally manufactured high quality ancillary products. Many MNCs started vertical integration by utilizing the locally available technical expertise and offer design and product development projects to the local universities. Many have offered research projects to local universities whenever they possess adequate high end experts. India has benefitted by globalizing the economy and the Government of India accelerated the quality of polytechnic colleges through World Bank assisted projects under Tech Ed I to III. In addition many bilateral agreements have been

implemented for providing opportunity for training the overseas teachers and executives through the Ministry of External Affairs and Ministry of Finance. Also the Quality Improvement Program(QIP) has been institutionalized for training the faculty of the polytechnic colleges and engineering institutes. Many Indian Institutes of Technology have started industrial consultancy and also have taken sponsored research. A few of the well-performing Indian Institutes of Technologies have established innovation centers where the MNCs would be bringing their projects and jointly utilize the resources and the expertise of these institutes. However, other national institutes, private deemed universities, autonomous colleges and state technical universities have enormous amount of potential to catch up with these Indian Institutes. The Government of India has implemented two World Bank assisted projects termed "Quality Improvement in Technical Education (TEQIP I and II)" and around 300 colleges benefitted. However, many other colleges have to transform the academic environment. According to Dr. Jayaraman (2009) the I.I.T system gained very much from the support from the Government of India. Such support is very required for all national institutes, state technical institutes and autonomous colleges.

2. Knowledge Economy

In knowledge economy, there is a great role for the engineering institutes to prepare the graduates to meet the global challenges. These institutes could develop relevant interdisciplinary graduate and postgraduate programs, could undertake sponsored research, and create innovation centers. Ministry of Science and Technology offers grants for undertaking faculty developments and research. It is assumed that all the engineering colleges would substantially contribute to the knowledge economy. However, there are many policies have to be taken to make these views to happen.

3. Objectives

The objectives of this research paper are as follows:

- To compare the positive academic environment in Indians universities and autonomous colleges with those universities in Canada, UK, and USA.\
- To evaluate the readiness of the Indian engineering institutes in creating conducive environment for the faculty to contribute to the knowledge economy by undertaking sponsored research and development projects.
- To suggest positive and inexpensive culturalchanges and initiatives in facilitating desired transformation in Indian Engineering Education.

4. Research Methodology

Since, knowledge economy centers on expertise of the faculty who can develop industry relevant graduate and postgraduate programs, conduct advanced research to undertake the design, product development and testing. It is essential to compare the administrative environment of well performing global institutes through the Indian origin faculty members who are working in foreign universities and compare the administrative environment here. The Indian origin faculty members who completed masters' degrees in Indiahave alone been considered.

Population

International: The population consists ofhigh performing Indian engineering faculty members who are working in various well established universities in USA, UK and Canada and also successfully completed development projects.

National: Senior professors who are working in State Engineering Universities, NITs, private universities and autonomous colleges and who also successfully completed many consultancy projects and sponsored research programs fromCSIR, DST, and MNCs in India.

Sample

International: 10 senior faculty members, who completed engineering education up to master degree in India and later joined doctoral programs in well performing universities in Canada, UK, and USA and successfully completed research and development projects responded out of 15..

National: 20 senior faculty members responded out of 25 contacted who are working at national institutes of technology, private deemed to be universities, private & government autonomous colleges and state technical universities out of 25. They have doctorate degrees from India and undertook industry sponsored research and development projects were selected for responding to the questionnaire.

Naturalistic Evaluation Process

Since, the purpose is quality comparison between the educational environment in India and overseas universities.Ten questions were administered and the feedbacks were collected and compared though the Table-1 presented below

Table 1 : Qualitative Analysis

Sl. No	Item	Feedback from Indian Origin Professors who are working in overseas universities in Canada, UK, and USA	Indian professors who earned PhD in Indian universities and working in NITs, Deemed to be Universities , autonomous colleges and state technical universities
1.	Offering faculty development programs for overseas participants in their countries.	No difficulty, but approval has to be obtained. Alternate arrangements have to be done for completing assigned works of the university.	Possible only when the CEO, Board of Governors and Ministry of Human Resource Development (MHRD) approve the proposal. Usually ministry would take more time to approve. Also the empowered officer of the ministry has to be included in the team and his expenditure involved has to be met from the project.
2.	Offering industry relevant but flexible and credit based graduate and postgraduate programs in the institutes for the engineering students.	No difficulty, but the Chairman has to approve.	Very difficult, since, the Academic Council, All India Council for Technical Education (AICTE), MHRD, and University Grants Commission (UGC) have to approve. Sometime, it may take years. AICTE may reject the draft proposal if the program does not follow the AICTE norms. Hence, many innovative programs would be rejected. Possible in IITs only.
3.	Bidding for employee development programs for local industries.	No difficulty, since, policies and guide lines are available.	Possible in IITs but very difficult in many other institutes. If the CEOs are interested, it can be done. However, the Board has to approve. Most of the Institutes do not have guidelines and policies.
4.	Undertaking industry sponsored research projects from International Development Agencies (IDAs).	Yes. The Chairman can approve as per the norms. The project leader can select graduate students as project assistants and pay the tuition fees, medical insurance and assistantship. This is the major source of income for meeting the expenditure on assistanceship for postgraduate students.	Possible in IITs andNITs but in other institutes the Board and CEO have to approve. However, there is a need for guidelines. The coterie can undertake easily.
5.	Bidding fornational industrysponsored research projects.	Yes, as per the norms.	Difficult to get the approval within the deadline. The CEO has to be project head even though s/he may not be having expertise. Normally no senior faculty would be allowed in most of the institutes.
6.	Selecting external butlocal experts for the projects.	Yes, as per the norms.	Very difficult, the CEO is the decision maker. If s/he suggests additions who are not experts, they have to be included. If the qualified and high performing faculty is not approved by the CEO, then that person has to be deleted from the team.
7.		Possible but the department has	Not possible under any circumstance.

	experts for the projects under IDAs.	to send the essential certificate for getting visa.	
8.	Offering overseas faculty development programs in the institute.	Yes, as per the norms	Possible only when the CEO, Board and MHRD approve. Sometimes MHRD may withdraw the approval without assigning any reason.
9.	Selecting the developers from the consortium institutes.	Yes, as per the norms	Very difficult but if the CEO and Board permit this can be done. Normally consortium has to be formed and to be approved.
10.	Networking with other institutes for development activities under IDAs.	Yes, as per the norms	Very difficult unless CEO, Board and Ministry approve. Normally Ministry may take many months. The Ministry officials may have to be included in the project team.

It is seen that most of the institutes do not have norms and policies for development activities. For projects under IDAs the ministry has to issue the permission but it may take many months. By the time approval reaches, the dead line would have elapsed. There are no decentralization and guide lines for such activities. Normally the expertise of the faculty is not considered at all.

5. Significant Findings

The following are the significant suggestions to improve the academic environment:

- Policies for undertaking projects under MNCs' sponsorship
- Approval for project leaders to prepare bids, developing technical and financial proposals
- Norms for offeringindustry relevant but flexible graduate and postgraduate programs
- Norms for collaboration with other institutes
- Norms for selecting external and internal experts who are essentially required for successful completion of the projects
- Norms for undertaking global projects under IDAs
- Norms for undertaking executive development programs in overseas locations.
- Norms for appointment of technical staff for projects
- Academic autonomy to the outstanding faculty members with detailed accountability
- Funds for getting the bank guarantees for the projects
- Utilization of Corpus fund for development
- Norms for sharing the project gains after meeting the direct expenditure and remitting the sum towards corpus fund
- These are all cost effective suggestions which would further supplement the modern resources procured under the project. Also,there will be adequate return on the project investments made. Further, the faculty would realize the needs of the global industries which impact on the curriculum improvements. The engineering students would gain more industry specific skills which enable them to get high paying employments.

Hence, there is a need for transformation of the engineering institutes.

6. Transformation in Engineering Institutes

The basic principles for transformation center on empowering the outstanding faculty. Unless they are empowered, they will not be able to achieve academic excellence. The Ministry of Human Resource Development (MHRD) could implement the policy of elevating all centrally funded institutes as deemed to be universities instead of affiliating them to traditional arts and science universities. Most of the timesthese institutes do not get approval from AICTE, since, various experts commissioned by them do not have the adequate expertise to evaluate the interdisciplinary programs and projects.

Also, there is a need for creating dean posts for Industry-Institute-Partnership, Academic Affairs, Faculty Development and Research. In the absence of these elevated faculty posts, the administrative officers take undue importance without any expertise.

Desired Performance of the Faculty under Academic Autonomy

The following Table. 2depict the desired performance under academic autonomy for undertaking sponsored research work and industry relevant interdisciplinary programs in engineering.

Table 2 : Desired Performance Under Autonomy

Authority	Long-term Industry Relevant Programs	Short-term Courses for Executive Development	Development of Technical and Financial Proposals	Interdisciplinary and Sponsored Research Projects
Chief Executive Officer [CEO : Director /Principal/Dean-Administration]	Could be based on the guide lines of AICTE / UGC and approved vision and mission of the institutes.	Could be based on the demands made on the institute by the industries who will accept agreements.	Policies could be based on the excellence, and value analysis and return on investments.	Norms could be based on the industry needs and success factors.
Dean(Curriculum/ Faculty Development / Student Services)	Academic dean has to evaluate the needs of the industries in the region and suggest solutions.	Could develop faculty teams with adequate industry exposure.	Could provide needed assistance and clarifications.	Could facilitate in preparing agreements / contracts.
Head of the Department (HOD)	Has to take responsibility and plan the programs in close collaboration with the industry, faculty, and external resource persons.	Should take full responsibility for quality, viability, and sustenance of the excellence.	Should analyze the terms of reference, should plan the technical proposal carefully, and estimate the cost of the project in a competitive way.	Should develop many faculty teams through appropriate programs in collaboration with industries; should assist the faculty to implement.
Faculty associates	Should specialize in the interdisciplinary areas and advances in the industrial practices.	Should acquire expertise in the instructional design, case study preparation, and advances in the uses of IT enabled tools.	Should prepare the estimates based the prevailing norms and market; Should conduct value analysis; Should be free from errors.	Should be capable of conducting research, analyses, interpretation of results, drawing conclusions and suggestions for implementation.
Technical support staff	Should prepare the documents, minutes of the meetings, maintain the records, time tables, progress reports etc.	Should prepare the course materials, evaluation materials, accounting, and communications.	Maintain the agreements, placing before the audit committees.	Should prepare the testing samples, calibrate instruments, organize and maintain the experimental setups and assist in conducting the tests.
External experts	Could assist the teams with the latest developments.	Could assist the teams with the modern trends and follow ups.	Could provide more assistance in preparing the proposals and edit them.	Could bring more reliable and valid testing methods.

Next the critical factors which are essential for developing needed educational environment have to be investigated. The following critical factors are identified from various senior faculty members and presented in

Table-3 : Critical Success Factor

Critical Success Factors	Do the institutes have appropriate enabling factors?
Transformational leaders	Still many institutes need transformational leaders but a few of them consider status quo.
Enabling culture for high performance	Only a few institutes have created enabling culture for high performance. Even after capacity building, a few institutes have not reached excellence.
Decentralized administration	Some of the administrators still believe only in centralized administration and a few CEOs never exhibit interest in decentralization of educational administration.
Sustenance of excellence	A few of the CEOs of the engineering institutes do not believe in sustenance of excellence. They do not maintain their reputation gained in the first set of projects.
Interdisciplinary and multidisciplinary approach	Still a group of national institutes are affiliated to the traditional arts and science universities and the Academic Council of the universities are dominated by the members from non-engineering branches but they do not normally support innovative interdisciplinary programs.
Successful leaders	A few leaders are not successful in planning and developing the institutes and transform themas high performing institutes.
Enabling vision and mission of the institute	Even though almost all institutes prepared strategic planning but they yet to operationalize them.
High performing faculty	Even though most of the faculty members have undergone faculty development programs in educational planning, research, content updating, educational management, but a few of them yet to exhibit their expertise.
Doctrine of the institute	Considering the context, the institutes could update the doctrine which would give direction for planning vision and mission statements.
Recognition of the excellence	The higher education system in India has to go a long way in recognizing the excellence in the faculty.

These ten factors are considered for further deliberation in the following section:

Transformational leader

From the above Table 3, there is a need for transformation leaders in Indian engineering institutes.

The following are the desired transformations:

- Ability to maximize the contributions of the high performing faculty in science, engineering, human resource development and technology.
- Fixing the goals and objectives on faculty initiative to plan new interdisciplinary programs in cutting edge technology which will contribute to Indian economy.
- Empower key faculty members who have taken technology development under sponsored research in pursuit of excellence in product planning, design and prototype development.
- Minimize the internal bureaucratic controls which would destroy the creative thinking of the project teams.

The University- Industry collaboration should result in high return to both (UIDP Projects 2014). Principles and guidelines for large scale collaborations between the university and industry, and industry and government and foundations have been developed by the U.S Senate Task Force. Such approaches would enhance the performance of Indian universities and create a high level involvement of industries. Network of Academic Corporate Relations Officers (NACRO) Writing Team and Benchmarking Committee (2011) have identified the following five elements for Successful Twenty-First Century University –Corporate Relations:

- Institutional Support
- Mutual Benefits
- One-Stop shopping

- Integrated Research Development
- Campus Coordination

All these elements are relevant to Indian institutes, technical universities and autonomous colleges. The Deans in charge of Industry-Institute Partnership have to discuss the above issues with the project teams.

Roger Geiger has evaluated the success of sponsored research at Penn State University and these factors are equally applicable to Indian Universities. According to him, American Corporates have been procuring increasing amounts of research from China and India. If Indian universities establish centers of excellence, the universities could attract many industries for product development.

U.S Department of Commerce in consultation with National Advisory Council on Innovation and Entrepreneurship has brought out the critical process for the success of innovation and entrepreneurship.

Mark Gordon recommended proper commercialization of university owned technology for the benefit of the industry. Indian technical universities could focus on the industrial relevance of their research studies and plan for commercialization.

Julio Pertuze, Edward Calder, Edward Greitzer and William Lucas of MIT suggest that universities have to understand the industry project's strategic context work with the boundary-spanning project managers who have in-depth knowledge needs, and ability to make linkages with the research teams.

Renu Khator (2013) described the process of forging business partnership with industry to develop the 21st century workforce for petroleum industry in USA. Such business relations are very much desirable for various programs in India.

Cultural Change

A synthesis of the problems faced by the faculty indicates the need for cultural change.The institute authorities have to bring needed cultural changes inencouraging the faculty irrespective of gender (Institution of Engineers Australia, 1996). There is a need for benchmarking the cultural change in engineering institutes (University of Newcastle,2004). Every high performing engineering institutions in India have to build appropriate institutional culture which will enable the faculty to contribute to the ever growing knowledge capital.

Needed Changes in the Institute's Administrative Process

Most of the institutes supposed to enjoy appropriate administrative, academic and financial autonomy but for all key changes they depend on the approvals from AICTE, Ministry of Human Resource Development and other ministries like Ministry of External Affairs and Ministry of Finance. Empowered autonomy with appropriate accountability would enable institutes to reach excellence. Also the Chairman, Board of Governors could nominate certain Board members to assess the needed changes through consultation with the faculty.

Decentralization of Administration

Tamil Nadu Agricultural University has instituted decentralization of administrationin early 1970s which helped the faculty to undertake appropriate research in agriculture and development projects. In other institutes, most of the Board of Governors accorded needed autonomy to the CEOs but not to the Heads of the departments and faculty members (Table.1).Also there is a need for establishing the post of Deans for suggesting appropriate decisions so that they can guide the departments in planning various innovative programs and projects. If the institutional administrators do not decentralize the project based decision making, they have to frame appropriate guidelines, and they have to read more files which are far beyond their areas of expertise. Also there are many traps which may enablethem not to deviate from implementable solutions. In many institutes they recruit the CEOs from open market who may not have expertise in planning and implementing sponsored research. They depend on the administrative officers who may have required expertise. The problem gives rise to coteries who dominate the decision making process.

Sustenance of Excellence

The engineering institutes at state, national and international level have to continuously evaluate the achievement and contribution. In addition they have to continuously monitor their enabling administrative processes through evaluation. If the barriers and bottlenecks are eliminated, then only sustenance of excellence could be maintained.

Interdisciplinary and Multidisciplinary Approach

21stcentury industries need high end employees who can provide consultancy and undertake sponsored research. This demands interdisciplinary and multidisciplinary approach. Most of the departments do not open their resources to other departments. This forces the faculty members to create duplicate resources at very high cost.The efficiency also reduces. Hence, similar to Industry-Institute-Partnership, there is a need for Departments-Institutes- University- National Laboratories Collaboration for overcoming the bottle necks and barriers. The Board of Governors could approve such collaboration and cooperation for the projects under IDAs.

Mc Kinsey and Company identified the following factors for the failure of leadership:

- Overlooking context
- Decoupling reflection from real work
- Underestimating mind-sets
- Failing to measure results

All these factors are applicable to Indian engineering system also. Hence, the institutes have to accelerate the effectiveness of leadership by focusing the globalized Indian economy, assessing the needs of MNCs, change the mind sets of educational administrators and measure the impact of the contributions made by these Indian engineering institutes.

Vision and Mission of the Institute

Most of the institutes prepare strategic planning and create vision and mission statements but in practice they could not follow since there is no effective delegation. Even the Boards are constrained and the representative of the ministry is not able to offer his/her views and demands the ministry would take up further discussion. In many programs, the AICTE has to approve the program structure based on the norms. The draft curriculum documents are returned without approval. These acts hamper innovations.

Needs of High End Faculty

High end faculty not only needs more empowerment and delegation for bidding for the projects under International Development Agencies but also resources, infrastructure and project based external consultants. It appears most the institutes did not approve these due to tunnel vision of the CEOs. Hence, the Board has to evaluate the problems and rectify the shortcomings.

Redefining the Doctrine of the Institute

Most of the institutes need to have doctrine from which strategic vision, mission, goals, and objectives could be realistically prepared. Otherwise, the strategic planning would be weakened.

Recognition of the ExcellenceMost of the institutes do not evaluate the achievements and contribution of the faculty. There are no proper instruments for evaluation and qualified evaluators. The faculty needs appropriate recognition for their contribution and achievements which are based on the realistic evaluation and appraisal process. At present, there is a big gap. Many institutes do not even take these into the service registers of the faculty members. Hence, all the institutes could come out with a reliable performance appraisal and recognition for high achievement of the faculty members irrespective of the social status. The faculty role in excellence has to be recognized (Wraren Jonathan 1982, and Paul Lingenfelter, Richard Novak, and Richard Legon , 2008).

8. Conclusions

Indian engineering institutes are expected to provide many innovative programs which will enable them to supply needed human resources for the fast growth of the Indian economy. This demands the complete transformation of culture, decentralization and empowerment of the high performing faculty. From the research work the following suggestion are offered:

- Cultural change in the institute's administration,
- Positive changes in the administrative process,
- Decentralization of administrative process, and
- Delegation of needed authorities and empowerment of the faculty members.

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