Generating Smart Goals of Engineering Education Institutes in the Fast-Developing Countries

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Abstract

India is facing many critical issues in meeting the challenges of human resource needs due to the globalization of its economy. Hence Indian engineering institutions have to upgrade their programs through appropriate educational goals to reach excellence as suggested by the National Educational Policy 2020. These goals center around capacity development, quality improvements, and efficiency improvements which are to be linked to industrial needs. Further, these institutes have to develop strategic plans. The educational goals are to be developed to improve the skills of the faculty members who can develop industry-specific programs based on human resource forecasts to avoid failures. A research study reveals that around 3% of engineering colleges have improved their programs, offered multidisciplinary programs, established linkages with industries, and offered consultancy programs. Most of the institutes have to develop strategic plans to meet the human and knowledge capital and they have to create linkages with various companies. Faculty members have to plan to reach excellence and undertake consultancy works and train the graduates with needed attributes. The administrators have to support and scaffold the growth of outstanding faculty members. Tracer studies and impact studies are to be undertaken to check the growth and contribution to knowledge capital and human capital.

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I. Introduction

Fast-developing countries, such as India, Indonesia, Vietnam, South Africa, Brazil, Malaysia, etc. are facing many critical issues in meeting the challenges of human resource needs due to the globalization of their economies. Hence, engineering institutions have to upgrade their programs, and attributes of the graduates, implementing executive development programs, offering consultancy services to companies, and supporting the planned growth of well-accomplished faculty teams. These are to be linked to the transformation of the institutes with enabling goals, resources, faculty members, and support from various national councils/commissions and well-defined national policies. The engineering institutes have to develop goals that will guide them to prepare for capacity development, quality improvement, and efficiency development.

Suggestions of the Indian National Education Policy 2020

The government of India has prepared the National Education Policy 2020 to develop educational institutes, curricula, resources, and faculty members. Under Chapter 9. Quality Universities and Colleges: A New and Forward-looking Vision for India's Higher Education System has to be planned. "As India moves towards becoming a knowledge society and economy and keeping in view the requirements of the fourth industrial revolution, characterized by increasing proportion of employment opportunities for a creative, multidisciplinary and highly skilled workforce- the higher education system must, at the earliest, be re-adjusted, re-vamped, and re-engineered to meet these requirements. The following developments are needed: Multidisciplinary universities and colleges, faculty and institutional autonomy, industry-specific curriculum, student support for enhanced student experiences, reaffirming the integrity of the faculty, and institutional leadership positions, through merit-appointments career progressions based on teaching, research, and service". All these demand appropriate educational goals, resources, and linkages with industry, offering consultancy programs. Further, NEP2020 envisions a complete overhaul and re-engineering of the higher education system to overcome the challenges and thereby deliver high-quality higher education, with equity and inclusion, to all young people who aspire to it.

Due to the continuous support of state governments, state technical universities have a sustained impact on state, national, and global economies through their graduates and doctorates. The impact has been further due to the outstanding research they perform and develop innovative products. They are responsible for creating sustained partnerships with companies in solving critical problems. All these, center around the goals of the universities and colleges. All these-demand strategic planning.

1.1. Educational Goal

"An educational goal is a statement of a desired future of an educational institution wishes to achieve. It describes what the institution is trying to accomplish. Educational goals may be strategic (making broad statements of where the institution wishes to be at some future point) or tactical (defining specific short-term results for departments/centers within the institution). Educational goals serve as an internal source of motivation and commitment and provide a guide to action as well as a means of measuring performance" (Barton, 2000). Defining institutional goal as helps to conceptualize and

articulate the future direction of the institution, thus allowing those (president, chancellor, provost, directors, deans, etc.) responsible for setting that direction to develop a common understanding of where the institution is heading. Educational goals provide a way of assuring that an institution will get where it wants to go. Educational Goal Setting is one of the basic tools used by institutions to assist in setting a direction and achieving it. Successful educational institutions often set long-and short-term goals for engineering/science/liberal arts graduate, post-graduate, and doctoral program development, offer consultancy projects to companies, international development agencies (IDAs) undertake sponsored projects, collaborate with international universities, globalize engineering programs, create intellectual properties, jointly develop cutting-edge programs, place the graduates in well-paying companies, etc. Goals are broad, more long-term, general intensions, often intangible and difficult to measure. Whereas objectives are narrow, more short-term, precise actions, often tangible, concrete, and measurable (Texas Tech University). Goals are desired results that provide direction and guide decision-making. Educational administrators use goals to turn their mission into achievable results. Whereas objectives are specific, measurable steps that can be taken to achieve educational goals. Further, they use objectives to operationalize and measure achievement towards goals. Objectives provide specific tactics and are essential for evaluating educational progress. Both goals and objectives should be specific, measurable, achievable, relevant, and time-bound (SMART).

1.2. Linkages of Educational Goals with National and Global Economy

Since 1947, it is understood that educational goals in India are dependent on many factors. India globalized its economy in 1991. Due to this many foreign companies welcomed to India, to establish manufacturing companies, and recruited well-accomplished graduates. It is observed that the educational goals dependent on the growth of the national economy, gross domestic product (GDP), government policies, demand for graduates in cutting-edge technologies, students' motivation to join innovative programs, and parents' capacity to pay the fees or availability of students' educational loans. A qualitative analysis is presented in Table.1.

Table 1. Linkages of Educational Goals with Economy and National Education Policy

Factors	Type of Goal	Positive Impact	Negative Impact
Growth of the National Economy	Capacity Development (Introduction of new programs).	Higher Human Resource Requirement Demand for graduates with desired attributes as the economy increases. The introduction of growth policies is based on local needs and exports.	Saturation of industrial growth and Inflation lead to poor demand for graduates.
Gross Domestic Product (GDP)	Goals are based on the introduction of advanced programs at the graduate and postgraduate levels.	Introduction of advanced technology-based companies to meet the requirement of modern manufacturing units that are established due to foreign direct investment (FDI), low-cost laborers with high-quality skills, availability of quality and low-cost raw materials, state support for industrial development, port-linked industrial estates for imports and exports, and ancillary components. If GDP growth is less, demand for human resources will retard.	If GDP growth is less, then the demand for engineering graduates will also be less. Faculty limitations, Shortage of well-accomplished, achievement-oriented, and high-performing faculty teams; Low pay and less empowerment of faculty teams.
Quality Improvement	Faculty Development	Introduction of industry-specific training and development programs, Cooperation with companies, undertaking MSME- sponsored dissertation and project works.	Restrictions on innovations, shortages of funds and resources, centralized and bureaucratic administration.
Efficiency Improvement	Radical innovation in curriculum and program structure.	The institution's high reputation, and well-accomplished faculty with excellent skills in consultancy projects, created intellectual properties and patents.	Low-performing faculty members with fewer accomplishments.
Multidisciplinary Programs, Letters of invitation from multinational companies (MNCs) international development agencies (IDAs).	Global programs and networking with global universities.	Outstanding outcome due to consultancy projects, publications, highest return on investments (ROI), and recognized global leaders among the faculty members.	Limited faculty teams, moderate projects, less return on investments, unable to compete in the global market.

Hence, institutional leaders and administrators have to consider factors that cause demand for new and industry-specific programs, cooperative programs, the need for advanced faculty development programs, opportunities for undertaking sponsored dissertations, offering executive development programs, and continuous linkages with companies will assist to generate the need for capacity development, quality improvement, and efficiency improvement. These should reflect the goals.

1.3. Benefits of Setting Educational Goals for Institutional Success

Setting goals can help institutional planning, and motivate faculty members, students, and staff. The faculty members will be more engaged, create a feeling of greater connection to the institution, and encourages better faculty performance. Setting high-performing goals ensures faculty, students, and staff are working toward a shared vision. This can keep everyone accountable and quantify success. Further, it creates satisfaction and further intrinsic motivation. Goals give direction to optimally develop centers, units, departments, and resources, and plan for capacity development of various programs, new buildings, laboratories, workshops, etc. There is no room for wastage. Further, they give direction to recruit the best and outstanding faculty members, and staff, and admit well-qualified learners. For implementing educational goals, the institutions have to establish buildings, infrastructure, libraries, transport facilities, recruit qualified managers, funds for capital expenditures, working funds, etc. to meet the fast-growing needs as GDP increases.

1.4. Problems Faced in Capacity Development Goals without Assessing the Industrial Needs (Achieveit. Com, Core Academy, UK, Jag Gadi, 2022, Jessica and Nina, 2021)

When the institutes have invested in equipment, built up space, recruited faculty members, and started new programs without assessing human resource needs, the following problems arise:

- If the programs are not linked to industrial needs, they lead unemployment of graduates
- If it is not possible to arrange industrial training for the graduates, then they will have fewer attributes
- Difficult to train the newly recruited faculty teams in industrial processes
- Difficult to use the resources of the department for industrial services and consultancy programs
- Low return on investment (ROI)
- The program can't attract planned enrolment of the students
- Institute has to meet heavy maintenance cost
- Ultimately the institute will face unserviceable equipment

1.5. Strategic Planning (Teay Shawyan, 2012, Alea Whatson, 2022, Stephen and Mary, North Carolina State University, 2020)

A strategic plan is a document used to communicate an institution's goals, the actions needed to achieve those goals, and all of the other critical elements developed during the planning exercise. Educational institutions have to adopt strategic planning to achieve the identified goals to gain a competitive advantage and to be at the frontline of educational progress both at national and as well as at international levels. The fast-developing world is characterized by many threats, challenges, obstacles, turbulences, and opportunities. Most governments have educational policies, laws, rules, standards, and regulations which are adhered to by all educational institutions in offering the programs, recruiting faculty members, paying salary, and allowances, charging tuition fees, and laboratory fees, collecting caution deposits, fixing the duration of the programs and award of degrees, diplomas, and certificates. Strategic planning is an institutional

management activity that is used to set priorities, focus human resources, strengthen operations, ensure the faculty, staff, and students are working toward selected goals, establish agreement around intended outcomes, and assess and adjust the institution's direction to changing environment. It is a disciplined effort that produces fundamental decisions and actions that shape and guide what an institution is, who serves it, what it does, and why it does it, with a focus on the future. Effective strategic planning articulates not only where an institution is going and the actions needed to make progress, but also how it will know if it is successful.

1.5.1. Mission

An institution has been established, funded, and faculty members recruited to develop human resources and generate needed knowledge for the development of a nation. Needed academic tasks that are assigned, allotted, or self-imposed to develop skilled human resource and knowledge capital. An important goal or purpose is accompanied by strong commitment.

1.5.2. Vision

A vision statement describe why your institute's 'why', while mission statements describe the 'who' and 'what' of your faculty performance. A vision statement is essential to reveal generated goal and direction for faculty members, staff, and students. Faculty members and educational administrators develop vision statements by adding passion, crafting inspiration, and aligning with the institute's values and ultimate goals. In the next five/ten years, where will the institute be placed for developing the graduates and serving the society? Generally visualized as an imaginary institution with all infrastructure, resources, equipment, outstanding faculty members, and programs of excellence, that provides high-quality graduates, and outstanding services to society. It can be a learning organization that can develop continuously.

II. Literature Survey

Jay Gadi (2022) suggested setting goals for high-performing teams to meet role-specific professional development. Pradeep and Mukund (2017) stated that faculty members have to discover their professional capabilities and interests, and their institution's aspirations, and formulate long-term goals that will optimally benefit them and their institutions. Faculty members are the most critical resources of educational institutions and ensuring their development and contribution to institution-building activities is the most important responsibility of leaders. Selected universities that have developed outstanding goals are selected for the study. Carleton University, USA, conducted a series of workshops on setting overarching goals. According to them good teaching should be about developing programs and courses where the focus is on student learning, not on teacher presentation and students must do their learning. Goals are to be concrete and measurable. Student-focused goals enable learners to evaluate an unfamiliar event in a profession and acquire needed competencies for analysis, design, prototype development, testing, improvement, mass production, marketing, and maintenance. Develop student-centered goals. Sufean Hussin, Aziah Ismail, and Jung Cheol Shin (2007) stated that universities employ strategic development planning to identify the specific goals, components, and factors of development.

Further, they concluded that a well-formulated strategic development plan will ensure synchronized development programs and activities throughout a university system. The University of Manchester, UK, stated that they are committed to empowering students with the knowledge, skills, and opportunities to provide an accessible education for local, national, and international communities. China's Zhejiang University has prioritized strategic global initiatives for fostering international engagement among students and academics. The Oregon State University, USA, has developed the following goals: 1. Preeminence in research, scholarship, and innovation, 2. Transformative education that is accessible to all learners, 3. Significant and visible impact in Oregon and beyond, and 4. A culture of belonging, collaboration, and innovation. College of Engineering of the University of Washington, USA, has set the following goals: 1. Provide an educational experience that prepares their students to be leaders, 2. Increase diversity, inclusion, and address to foster excellence, 3. Build interdisciplinary collaborations that inspire innovation, 4. Create industry and community partnerships to increase their impact, 5. Focus on key global challenges where they can achieve the greatest impact and excellence, and 6. Make a significant and visible social impact. The University of Maine, College of Engineering, USA, has developed the following goals: 1. Enhance cross-disciplinary, hands-on, learning opportunities for students in engineering and beyond, 2. Enhance student success by improving undergraduate advising, 3. Enhance learning opportunities for M.S. and Ph.D. students by offering a diverse range of 500 and 600-level courses, 4. Enhance the learning opportunities for undergraduate and graduate students by embracing flipped classrooms, active learning, hybrid delivery, experiential learning, and other innovative teaching methodologies, and 5.Increase funded research from a three-year average of $14 million per year to $ 28 million per year by Financial Year 2030. The University of Colorado, Boulder, USA, has developed the following institutional goals: 1. Vision, mission, and strategic planning, 2. The core initiative of flagship 2030, 3. The flagship initiatives, 4. Campus master plan goals, 5. Sustainability, and 6. Growth. This university further focused on enrollment and sponsored research. The University of North Carolina (UNCP) (2020) prepared the following five goals: 1. Promote student success through excellence and innovation in academic programming, 2. Enrich the student experience through engaged learning and enhanced student support services, 3. Expand institutional resources and enhance operational excellence, 4. Embrace and celebrate UNCP's unique identity, 5. Enhance and expand regional and community engagement. The North Carolina State University (NCSU) USA, (2020) has stated its mission as a research-extensive land-grant university dedicated to excellent teaching, the creation and application of knowledge, and engagement with public and private partners. By uniting their strength in science and technologies with a commitment to excellence in a comprehensive range of disciplines. NC State promotes an integral approach to problem-solving that transforms lives and provides leadership for social, economic, and technological development across North Carolina and around the world. According to them, their vision is: "As a preeminent public research university, NC State University will be increasingly recognized nationally and internationally for its innovation in education, research, scholarship, and engagement that solves the World's most critical challenges. NC State will be known as a diverse, equitable, and inclusive community that has a transformative impact on society and advances the greater good." They listed their values in terms of excellence, community, inclusion, freedom, integrity, collaboration, and sustainability. They have stated 2021-2030 strategic plan goals as follows: 1. Empower students for lifetime success and impact; 2. Ensure preeminence in research, scholarship, innovation, and collaboration; 3. Expand and advance their service to the citizens of the state and beyond-defining the standard for a 21st-century land-grant university; 4. Champion a culture of equity, diversity, inclusion,

belonging, and well-being in all they do; 5. Drive institutional effectiveness through transformative technologies, cutting-edge processes, and actionable data; 6. Be recognized as the leading university for innovative partnerships, entrepreneurial thinking, and applied problem-solving; 7. Evaluate the national and global reputation and visibility of NC State. The mission statement of UNC Charlotte North Carolina's urban research university is to offer internationally competitive programs of research and creative activity, exemplary undergraduate, graduate, and professional programs, and a focused set of community engagement initiatives. UNC Charlotte maintains a particular commitment to addressing the cultural, economic, educational, health, and social needs of the greater Charlotte region. To fulfill this mission, they envision a university that promises accessible and affordable quality education that equips students with intellectual and professional skills, ethical principles, and an international perspective. Goal 1 of the UNC system strategic plan is to increase access to a college education and to increase the proportion of adults in North Carolina with a bachelor's degree or higher. The vision of the University of North Carolina at Chapel Hill: It aspires to be the leading global, public research university in America providing an outstanding accessible, and affordable education; conducting game-changing research and undertaking innovation for the public good and bringing health and prosperity to the citizens of the state, nation, and beyond. Their mission is to serve as a center for research, scholarship, service, and creativity, and to educate a diverse community of leaders.

2.1. Georgia State University's Goal

Achieve distinction in globalizing the university. The following initiatives have been taken by Georgia State University, USA: 1. Enhance the global competency of students, faculty, and staff; 2. Expand Study abroad opportunities for all students; 3. Create a larger international education footprint; 4. Create an international consortium of universities for critical issues challenging cities; 5. Promote externally funded research on the challenges facing emerging nations; 6. Establish a Georgia State University International Center. The University of North Carolina established institutional goals centered around 1. Expertise, 2. Accountability, 3. Customer-Centered, 4. Team- Oriented, 5. Compliance and Integrity, 6. Leadership. Further, they created appraisal tools to check the implementation.

2.2. Synthesis of Initiatives

Most of the stated goals of various universities are synthesized and presented in following three groups:

Table 2. Synthesis of Initiatives in Setting Goals in various Universities

Area	Institutional Goal	Faculty Goal	Student Goal
Expertise	Plan for community engagement, resource-based, and new interdisciplinary graduate programs. Utilize emeritus, part-time, and adjunct faculty members.	Support preeminence in research, scholarship, and innovation through advanced graduate and research programs.	Students with the knowledge, skills, and positive attitudes are to be counseled, coached, and mentored.
Transformative Education	Offer systematic transformative education based on the upcoming disruptive technologies.	Exposure to cutting-edge technologies	Fostering international engagement thorough systematic planning.
Accountability	Conduct performance audits every year and improve the performance of the faculty	Address and improve the foster experience. Introduce self-evaluation and improvement	Outcomes, employment, and research projects will be accounted for ROI

	members and graduates.	introduce self-evaluation and improvement.	will be accounted for ROI.
Customer-Oriented	Make a significant and visible social impact. Encourage consultancy work.	Increase diversity, and inclusion, involve in program development to meet disruptive technologies.	Inculcate needed educational experiences to become world-class leaders.
Institutional Resources	Add systematically modernized resources and up-to-date graduate programs. Generate internal revenue and grants-in-aid from the government.	Encourage faculty members to add, utilize and maintain the resources. Improve services to MSMEs and the government sector. Support intrapreneurs.	Advisors and mentors are essential for developing nontangible resources. Inculcate entrepreneurship.
Team-Oriented	Facilitate team development for planning interdisciplinary programs and research projects.	Encourage high-performing teams to bid for global projects under IDAs and MNCs. Plan royalty through intellectual properties.	Enhance opportunities for graduates and postgraduate scholars to become active team members, and problem-solvers.
International Consortium	Focus on key global challenges and plan for the international consortium.	Encourage faculty to get global internships.	Develop opportunities for sponsored research projects from MNCs and offer graduate assistantships.
International Education Footprint	Plan for global impact through outstanding research and development projects.	Develop global seminars, and conferences, and offer diverse faculty and global executive development programs.	Open signature programs for foreign university graduates to enroll in graduate and Ph.D. programs.
Study Abroad Opportunities	Encourage joint global graduate programs, and faculty exchanges and create consortiums.	Encourage faculty members to study postdoctoral courses through sabbatical leave.	Develop collaborations through foreign universities and propose credit transfers.
International Collaborations	Encourage a culture of belonging, institutional collaboration, and innovation.	Facilitate to enroll in MOOCs offered by global universities and educational associations.	Recognize MOOCs and plan to transfer credits. Try to get fellowships for the students.
Globalizing the University	Build interdisciplinary collaborations for interdisciplinary research programs.	Encourage faculty members to offer innovative programs in emerging technologies.	Plan joint degrees in selected areas. Encourage self-directed learning.
Global Competency	Approve joint research and faculty exchange. Open research parks and encourage joint programs.	Check the 'h' and 'I' index of the faculty members.	Encourage graduates to acquire needed competencies in analysis, design, prototype development, testing, refining the products, manufacturing, and maintenance.
Externally Funded Projects	Create MNC industry-institute-community partnerships. Develop a set of consortiums of universities to jointly plan and bid for projects.	Prepare bid documents and form a team. Make sure that you have prepared winning technical and financial proposals.	Involve senior students in externally funded projects. Develop case studies.
Promoting Student Success	Plan student exposures and offer on-the-job training.	Plan semester class schedule. Prescribe a suitable set of learning materials. Include pretests and quizzes, assignments, and a research paper.	Enhance cross-disciplinary, hands-on learning opportunities
Scholarship and Innovation	Focus on industry and IDA-sponsored projects	Develop research papers and present them. Indicate the embedded innovations.	Include selected innovations
Compliance and Integrity	Follow the national norms and global standards.	Follow the financial rules diligently. Maintain a copy for future needs.	Train the graduate students in compliance and integrity
Ethics	Systematically follow ethics.	Always follow ethics in all activities. Develop materials in the case study.	Include ethics as a course, provide case studies
Leadership	Scaffold, assist, mentor, and reward for excellent performance. Be an encouraging leader, servant leader, and super leader.	Encourage self-leadership. Encourage participation in global leadership competitions.	Train the students in leadership development
Culture and Economy	Cultivate supportive culture.	Make faculty members part of the cultural development process. the faculty.	Train them to inculcate in culture and economy
Diversity	Recruit diverse faculty teams.	Encourage acquiring additional credentials in related branches.	Recruit diverse students
Integrity	Always needed	Check integrity.	Develop integrity in students' activities

2.3. Reasons for Failure to Achieve Institutional Goals

Setting goals alone will not lead to success in institutional growth. The University of Miami identified the following four reasons for failures: 1. Procrastination, 2. Psychology of fear, 3. Unclear goals, and 4. Multitasking. All these are to be avoided. Simon Mathews (2017) suggested the following methods to achieve the goals: Self-motivation, Identification of root cause, Action plan and Implementation after completing the neutral analysis, and Execution. These suggestions can be followed. Amy Edmondson (2009) identified the following reasons for failure: Deviance, Inattention, Lack of ability, Process inadequacy, Task challenge, Process complexity, and Uncertainty. It is better to build a learning culture in the institutions. Teay Shawyun (2012) stated that higher education institutions move forward on quality drives which are turbulent and never-ending journeys of continuous improvement. According to him, these journeys can be managed, and the goals of the position the institution's intention to achieve and sustain.

2.4. Growth of Engineering Institutions in Developing Countries

Initially, most of the developing countries had a few governments, and governments assisted private engineering colleges only but after getting independence, they started planning many industrial ventures and also globalized their economies. A few countries have collaborated with advanced countries and established high-performing engineering colleges and technical universities. Multinational companies have started their manufacturing companies in host countries which demanded skilled workers, technicians, and engineers. A few developing countries in Asia, Africa, and South America have also established needed institutes of technology. Some countries liberalized their rules and permitted private universities. In the 21st century, the need for high-performing engineering graduates who can undertake analysis-design-develop prototypes-test-improve- manufacture- market- maintenance- and scrap old and outmoded products have increased. Now they classify the colleges into three different terms, viz, tier I, tier II, and tier III colleges. Tier I colleges offer degree programs and a few offers postgraduate programs they were affiliated to state technical universities which offer curricula, and conduct examinations and offer degrees. Tier II colleges offer degrees, postgraduate, and doctoral programs. Many of them are autonomous colleges and they prepare their curricula and conduct examinations but the state universities offer degrees. Tier III colleges offer all types of programs and are very well-established with significant well-accomplished faculty members. They offer Ph.D. programs, collaborate with companies, and undertake sponsored research and development programs.

2.5. Human Resource Forecasting

Human resource forecasting is essential for fixing the goals in capacity development in each branch of engineering. The following methods could be used to predict the human resources in the next three years (Topper-HRF)

Table 3. Forecasting Methods

Forecasting Method	Background	Shortcomings
Managerial Judgement	Suitable for an existing company. Experienced managers are required to estimate the human resource requirement and are based on the future workload, and skills of the employees.	May not be useful when new products are to be designed and manufactured.
Work-Study Method	Uses time and motion study to analyze and measure work. Useful for repetitive and manual work and set standards and fixed jobs.	Will not be useful for modern manufacturing methods and Industry-4.0
Ratio-Trends Analysis	This method helps to calculate the ratios based on past data. The future ratios could be calculated using the time series analysis.	When job and technology change in the organization, this method may not predict future needs.
Mathematical Models	Optimization and probabilistic models can be used to predict future human resource needs.	The human resource assessment has to be done for all branches so that capacity development can be prepared.
National Institute of Labor Economics and Development. (Institute of Applied Manpower Research) New Delhi	Forecasting the human resource requirement due to the expansion of industries, new projects, etc.	The reports are to be published as early as possible so that the Ministry of Education take necessary follow-ups.

Most of the countries have national institutions for manpower prediction and they systematically complete the analysis and publish their reports. The federal and state governments can use the data for preparing capacity development and quality improvement goals. This should be followed by funding through detailed project proposal.

2.5. Review the Draft Goals

Even though goals have been planned by following priorities, many changes would have occurred in industrial needs, human resource needs, and invasion of many disruptive technologies. Hence it is essential to review the identified goals. Form an interdisciplinary committee of expert faculty members and review the draft goals generated. Edit, add, and discard obsolete goals. Ensure the availability of resources, market opportunities for the graduates, and readiness of the faculty members to implement the revised programs.

2.6. Identify Priority Goals

It is essential to identify the most needed goals to implement in the current academic year. It may be planning new technology-based programs, courses, or research works. Then radical planning process has to be undertaken.

Brainstorm and list a set of priority goals.

Specific goals are identified based on the mission of the institutes and they can be accomplished if the following questioning is answered:

Who is involved? Federal/State Government/National Commissions/National Councils/Board of Governors/ University/ Institution/ Department/ Faculty Members/Students/Employers/ Society at Large?

What does the university/institution want to accomplish in the plan period (5 years)?

Where? Identify the departments/centers/laboratories/workshops/fields/industries.

When? Establish a time frame. Current academic semester? Academic year? Next year?

Which? Identify the requirements, bottlenecks, and obstructions.

Why? The specific outcome, gains due to accomplishments.

Measurable: Establish ultimate criteria for measuring progress toward the success of each goal that is set. Several degrees program? Several postgraduate programs? Several doctorates? Several papers to be published? Amount of internal revenue to be generated? Stay on track, reach target dates, and experience the success of achievement. Quantify the success. Measure the outcome.

A: Attainable. Plan the identified goals to reach a successful end. It is desirable to check at the middle and end of the project completion. If the goals are not attained, check the shortcomings like allotted resources, abilities of faculty teams, changes in the government policy, revised norms of the councils/commissions, and changed needs of the students.

R: Relevant. Are the goals relevant now? Are they based on the technology standards? Whether the employers have revised the prescribed entry qualifications for the graduates? Whether curricula incorporated the current standards? Whether the resources are adequate?

T: Time-Bound. Can you achieve this at the end of the prescribed period, viz, three years or five years? Check the progress. Conduct audits every year.

Plan for Implementation of Priority Goals

Identify the needed human resources, equipment, capital funds, and working funds, plan to avail leases from equipment producers, and generate a strategy for donations from philanthropes. Systematically implement the priority goals.

III. Objectives of Research

The following are the objectives of this research:

1. Suggest a process of generating smart goals for engineering institutes in fast-developing countries based on the human resources requirement.
2. Validate the draft goals through a senior-professors, administrators, and the members of the governing council.
3. Identify the resources, faculty members, and desired approvals from the national counsels/commissions for the implementation of planned goals.
4. Check the adequacy of precautions to be followed for the successful implementation of goals.

5. Assess the impact of planned goals on human capital and development.

3.1. Population

Senior faculty members (associate professors and professors) of arts, applied science, applied mathematics, engineering, technology, management, and computer science from universities, autonomous engineering colleges, and polytechnic colleges from four southern states of India. Faculty members with a minimum experience of 15 years and minimum educational qualification of master's degrees in their field of expertise have been prescribed for this research. 70% of them have undergone institutional development workshops under quality improvement courses.

3.2. Sample

Purposeful sample of 803 has been selected from four southern states (201 from Andhra Pradesh [164 male, 37 female], 324 from Tamil Nadu [265 male, 59 female], 196 from Karnataka [153 male, 43 female], 151 from Kerala [123 male, 28 female], and 21 from Puducherry [17 male, 4 female]). 75.09% with masters' degree and 24.91% with Ph.D. 119 are professors and 684 are associate professors.

8 questions were prepared based on the near future needs of India. Likert's 5-point scale has been used to rate the feedback. The feedback has been analyzed and inferences were drawn. Seven areas of goal preparation were selected for questionnaire development and presented in Table 4.

Table 4. Questionnaires and Feedback

3.2.1. Goals Related to multidisciplinary programs

Qn. Whether your institute has introduced multidisciplinary programs?

Excellent	Very good	Good	Fair	Poor
19/803	62/803	321/803	329/803	72/803
2.37%	7.21%	39.98%	40.97%	8.97%

Only 2.37% of the participants state that their institutes have introduced multidisciplinary programs.

3.2.2. Goals related to industry-specific undergraduate programs

Qn. Whether your institute have any industry-specific undergraduate programs?

Excellent	Very good	Good	Fair	Poor
31/803	57/803	298/803	332/803	85/803
3.86%	7.10%	37.11%	41.34%	10.59%

Only 3.86% of the participants state that their institutes have introduced industry-specific undergraduate programs.

3.2.3. Goals related to linkages with industries in the state

Whether any of your departments created an active linkage with any company in the state?

Excellent	Very good	Good	Fair	Poor
27/803	49/803	287/803	312/803	128/803
3.36%	6.10%	35.74%	38.85%	15.94%

Only 3.36% of the participants state that their institutes have created linkages with companies in the state.

3.2.4. Goals related to linkages with industries in the country

Whether any of your departments successfully introduced any active linkage with any company in the country?

Excellent	Very good	Good	Fair	Poor
22/803	39/803	258/803	279/803	205/803
2.73%	4.85%	32.13%	34.74%	25.52%

Only 2.73% of the participants state that their institutes have developed linkages with the companies in the country.

3.2.5. Goals related to linkages with any MNCs

Whether your institute has created a linkage with any multinational corporations (MNCs)?

Excellent	Very good	Good	Fair	Poor
17/803	31/803	187/803	253/803	315/803
2.12%	3.86%	23.29%	31.51%	39.23%

Only 2.13% of the participants state that their institutes have created linkages with multinational corporations (MNCs).

This low percentage indicates that previous National Policies of Education have not suggested introducing multidisciplinary programs, industry-specific undergraduate programs, or creating linkages with companies in the state, country, and multinational companies.

3.2.6. Goals related to capacity development in all branches of engineering

Whether your institute has planned capacity development in the last five years?

Excellent	Very good	Good	Fair	Poor
201/803	309/803	67/803	75/803	151/803
25.03%	38.40%	8.34%	9.34%	18.80%

25.03% of the participants stated that their institutes planned capacity development. Since Technical Education Quality Improvement Program (TEQIP I and II) under the World Bank were implemented, they established new programs, laboratories, workshops, new buildings, and staff quarters under capacity development. This has improved the massive employment of engineering graduates.

3.2.7. Goals related to quality improvement of faculty skills, curriculum, instructional design, and delivery.

What are the initiatives that your institute took in efficiency improvement in the last three years?

Excellent	Very good	Good	Fair	Poor
253/803	267/803	78/803	67/803	138/803
31.51%	33.25%	9.71%	8.34%	17.19%

31.51% of the participants have stated that their institutes have planned efficiency improvement.

Under the same World Bank-assisted programs, quality improvement has taken place. Quality improvement of the faculty members has been achieved. Based on the needs analysis, short-term faculty development in content updating, and Ph.D. programs were offered.

3.2.8. Goals related to efficiency improvement in planning industry-specific courses, adding additional courses under finishing school courses, introducing cooperative courses, facilitating solving live cases on improving the productivity, quality of products, and optimum use of energy.

Area	Excellent	Very good	Good	Fair	Poor
Industry-specific courses	321/803 39.98%	245/803 30.51%	34/803 4.23%	33/803 4.11%	170/803 21.17%
Finishing school courses	142/803 17.68%	321/803 39.98%	67/803 8.34%	87/803 10.83%	186/803 23.16%
Cooperative courses	46/803 5.73%	54/803 6.72%	89/803 11.08%	325/803 40.47%	289/803 35.99%
Solving live cases on productivity	34/803 4.23%	65/803 8.09%	79/803 9.84%	324/803 40.35%	301/803 37.48%
Improving the quality of products	48/803 5.98%	98/803 12.20%	153/803 19.05%	432/803 53.80%	72/803 8.97%
Optimum use of energy	78/803 9.71%	206/803 25.65%	321/803 39.98%	65/803 8.09%	133/803 16.56%

3.3. Analysis of Feedback

Industry-specific courses were planned under the World Bank-assisted project (TEQIP I and II). Similarly finishing school courses were also introduced to close the gap between the industry and institution. Only a few institutions that are located in metros could offer cooperative courses. Since many institutes have not launched consultancy centers, they couldn't achieve significant success in improving quality of industrial products, productivity and optimum use of energy. Most institutions that have not participated in the World Bank-assisted technical education quality improvement project have not developed and it is better to organize faculty development programs to improve the quality of graduates as desired by the NEP 2020. There is a need for providing tax remission to companies for the funds invested in training the faculty and students.

3.4. Open Feedback

The faculty members have indicated the following four issues in their open feedback:

1. Introduce the Bottom-up Approach: The faculty members are interested in participating in all institutional development projects. This will improve their attitude and ready to offer many cutting-edge programs.

2. Establish Academic Council and Audit Committee: For establishing curriculum development in all engineering programs, there is a need for an academic council that can plan and develop up-to-date programs. The audit committee will analyze the success and failure of the academic activities and facilitates to solve the problems.

3. Establish Institute-Industry Collaboration and Cooperation Council: This council is required to establish effective linkages with companies, national research labs, and other leading institutes. This will facilitate the modernization of interdisciplinary programs and sponsored research projects.

4. Establish Institutional Development Council: Institutional development council is very much required to plan capacity development, quality improvement, efficiency improvement, introducing interdisciplinary graduate and postgraduate programs, arranging campus placement, and consultancy works.

3.5. Strategic Management

Strategic management is the comprehensive collection of ongoing activities and processes that institutions use to systematically coordinate and align resources and actions with the mission, vision, and strategy throughout an institution.

3.6. Creating Linkages with Companies

The Engineering Institutes have to prepare effective and efficient linkages with the companies to harness needed benefits that are based on the purpose of institutions. This is presented in Table-5.

Table 5. Creating Industrial Linkages

Sl. No.	Purpose	Industry location	Type of linkage
1	Industry-Specific Curriculum	Major companies within 100 km	Collaboration (Long-term)
2	Adjunct Faculty	Major companies within 50 km	Cooperation (Short-term)
3	Industrial Exposure	Major companies within 1000 km	Cooperation (Short-Term)
4	Faculty Training	Desired companies within 2000 km	Cooperation (Medium-Term)
5	Formative Evaluation of the Curriculum	Desired companies within 500 km	Cooperation (Short-term)
6	Industry Sponsored Dissertation	Desired companies within 500 km	Collaboration (Medium-Term)
7	On-the -Job Training	Desired companies within 1000 km	Collaboration (Long-term)
8	Executive Training/ Workshops	Desired companies within 2000 km	Collaboration (Medium-Term)
9	Consultancy Programs	Desired companies within 3000 km	Collaboration (Medium-Term)
10	Conferences/Seminars	Desired companies	Cooperation (Short-Term)

The above suggestions are based on the available transportation facilities, resources of the institutes, and some of the successful projects completed. However, the institutions can approach Associations of the Industries that can support the initiatives. Alumni can also help the institutes. Cooperation is for the short term only. Collaboration is based on mutual needs and usually for two years. Based on the success, it can be continued for a further period.

3.7. Faculty Members, Industry Programs, Resources, and Outcomes

Newly recruited faculty members need more mentoring and scaffolding for acquiring professional skills. As they accumulate professional skills, they can contribute to the development of industry-specific curricula and implementation. They need to have industry-specific managerial skills and competencies. The Chairpersons have to plan appropriate industrial training. This development process is presented in the following Table 6.

Table 6. Faculty members, industry programs, resources, and outcomes

Sl. No.	Faculty Member	Program	Industrial Resources	Desired Outcome
1	New Recruit	Exposure	Modern resources	Orientation to advanced technologies, Faculty training programs in upcoming technologies
2	Junior	Training for one month	Manufacturing processes	Cognitive skills in curriculum design, Internship in industry-sponsored project works
3	Middle	Training for two weeks	Analysis, design, and product development	Gaining skills in analysis, product design, prototype development, testing, improving, manufacturing, marketing, and maintenance
4	Senior	Training for one week	Industry-specific research	Problem-solving, critical analysis, value engineering.
5	Chairman	Planning	Collaboration and linkages	Planning collaborative programs, cooperative programs, and joint research
6	Program Executive	Research Problems	Needs-based Executive training	Executive development, human resource planning, establishing training centers
7	Senior Researcher	Sponsored Research	Research problems on productivity	Product design, prototype development, testing, and improvement
8	Dean	Long-Term Cooperation	Strategic planning, Establishing new centers for production	Establishing cooperative programs, planning conferences, and adjunct faculty
9	Director	Collaboration	Long-term collaboration, executive development, R&D centers, & innovation	Sponsored research and development, In-house training programs, and research park

3.8. Status of Accomplishments of Institutions and Performance Appraisal

The engineering institutes need to check the accomplishments periodically and conduct appreciative appraisals. This will help to improve the performance of the faculty members and the departments. Further, they have to check the goals developed and the accomplishments. The needed funds and resources are to be acquired without leaving any shortage.

3.9. Transformation and Redesigning the Institutions as Learning Organizations

There is a need for continuous consultation with all departments. A time series analysis will help to overcome the shortages and provide needed inputs. Learning organization will help to improve overall performance continuously.

3.10. SWOT Analysis: SWOT Analysis has been carried out in fixing various goals for expansion and

capacity development

Strengths: Institutes have successfully managed the available resources, and funds received under grants-in-aid from the state and central governments, and recruited well-qualified and motivated faculty members. Received certain amounts of donations from philanthropies. Institute earns substantial internal revenue through consultancy services offered to local companies. Completed all the revised graduate and postgraduate programs successfully and placed the graduates through campus interviews. Institute has created linkages with manufacturing companies in the state. Alumni Association is supporting all initiatives in upgrading the curricula and industrial training of the students. The Board of Governors is very much supportive of expanding the educational programs and starting new programs through collaboration. A large number of research papers are being published by faculty members in reputed foreign journals and international conferences. Institute has hosted many state and national conferences in the last ten years.

Weaknesses: Only a few research projects received funds from various national councils, development organizations, and the Ministry of Science and Technology. Institute could not attract highly qualified, well-accomplished, intrinsically-motivated faculty teams focused on creating knowledge capital. Could not get sponsored research and development projects from international development agencies.

Opportunities: Foreign direct investments in product development, manufacturing, local markets, export, and maintenance. Admitting foreign students in engineering and technology. Undertaking consultancy projects under MSMEs, Training the employees in advanced technologies. Planning part-time cooperative programs. Interdisciplinary graduate and postgraduate programs. Research funds from national councils and commissions. Developing multidisciplinary programs. Implementation of massive online open programs.

Threats: The graduates may not get plum jobs. Institute may not attract the executives for training. Learners may not get on-the-job training. Postgraduates may not get sponsored topics for dissertations. Departments may not get cooperative programs. The gap between theory and industrial practice will increase. Industry-specific innovative product development will decrease. Well-performing institutes will grow at a faster rate and the graduates of the average institutes will be left out of the race.

3.11. Goals of the Institutions

The goals of institutions have to be expanded based on the planned growth. A few centrally funded institutes can rapidly grow and the goals can be accelerated.

Table 7. Stages of Growth of the Institutes

Stage	Years	Early Stage of Development	Grown-up	Stabilized Institute
Nascent Institute	Up to 5 years	Up to 10 years	Up to 15 years	Beyond 15 years
Development Goals Getting approval for buildings, programs, faculty, technical support staff, equipment purchase, furniture, quarters, roads, sports field, canteen, etc.	Establishment, Faculty recruitment, Institutional building Focused programs Pre-service training, academic council, counseling, coaching, mentoring, instructional resources, etc.	Establishing postgraduate programs, consolidation. Advanced training, Consultancy center, linkages with local companies, MSME-specific consultancies, and Research programs.	Fine tuning of the courses, faculty development, Employees training under continuing education	Offering consultancy programs, Intellectual property development, patents, more collaborative projects
Continuous process improvement	Auditing	Time series analysis	Launching major consultancy projects	Review of achievements and impacts
Linkages with companies	Cooperative programs	Continuing education programs	Industry-sponsored dissertations	Collaborative programs
Outcome	Successful starting	Graduates with desired attributes	Knowledge capital	Human capital

3.12. Goals of the Faculty Members

Faculty members are to be mentored and scaffolded to plan their cognitive growth to meet the challenges of knowledge capital development. They have to be empowered to plan for consultancy projects. They can be encouraged to undertake internships and bid for complex projects. They can also be encouraged to participate in international conferences.

3.13. Goals of the Students

Students have to be counseled for developing their personal goals, planning career paths, undertaking postgraduate programs, planning entrepreneurship, and undertaking research and development works. They need mentors who suggest areas, courses, and internships in appropriate universities or industries.

3.14. Implementation Strategies

There is a need for action plans, resources, mentors, academic auditing, and time series analyses of the progress of capacity development. Quality improvement has to be linked to institutional planned growth. The faculty members have to self-evaluate and plan for better faculty development programs.

IV. Discussion

Every institute has to prepare an institutional development plan with needed capacity development based on the vision, mission, linkages with industries, and desired human capital and knowledge capital. Further, they have to review the

achievement every six months and take steps to improve as per the plan. The faculty development, curriculum development, and instructional resources have to be synchronized. The outcome has to meet the planned development. Necessary tracer studies are to be conducted and improvements in the curriculum have to be affected. Impact studies are essential at the end of the project. Feedback from the faculty and employers is essential to effect changes.

V. Suggestions

First prepare a strategic plan and relate it to the employer's needs. The curricula and instructional packages are to be developed based on the needs of newly developed strategic plan. There should be sufficient funds for implementation. Faculty development programs are to be planned based on the needs analysis. Once the institute reaches stable condition, advanced programs, consultancy projects, and interdisciplinary research projects have to be commissioned.

VI. Conclusions

The institutional development should be based on the National Education Policy. All the capacity development goals, quality improvement goals, and efficiency improvement goals are to be linked to the strategic plan of the institute. Ultimately the graduates have to be industry ready with all desired attributes. A well-developed institute has to contribute to human capital and knowledge capital. Mentoring the faculty and students is essential. Their accomplishments will have to be evaluated and further industry-specific developments are to be carried out to meet the fast-changing industrial advancements.

6.1. Shortcomings of the Research

The research is based on the planning and implementation of the World Bank-assisted projects in Polytechnic colleges and the growth of government-aided colleges. Further refinements are essential for accelerating the planning and developing the institutions to meet the fast- growing disruptive technologies.

6.2. Suggestion for Future Research

Rapid developments are needed to plan and establish high-performing engineering colleges to supply highly skilled graduates and indu stry- ready graduates.

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