A Radical and Virtual Innovation Center (RVIC) for Human Resource Development (HRD)

-Case Study on Planning, Developing and Sustaining the Human Capital Development

Thanikachalam Vedhathiri

(**vthani2025@yahoo.in**)Former Professor and HOD,
Center for International Affairs,
National Institute of Technical Teachers Training and
Research, Chennai

Abstract

Under knowledge-based economy, there is a need for developing high-performing and self-managed faculty teams (SMFTs) for undertaking consultancy projects from the states, national and global organizations. In this research work, a case study has been presented on the initiatives of high-performing teams in undertaking diverse global faculty and executive development programs under various ministries and International Development Agencies (IDAs) like Asian Development Bank, UNDP, UNESCO, USAID and World Bank even though there is no formal consultancy center for undertaking Human Resource development Center. This resulted in engaging the faculty creatively, meeting the challenges, focusing on the real- world problems, advancing the personalized learning, developing interdisciplinary master and doctoral programs. This has capitalized in brining Industry-Institute- Government-Society (I-I-G-S) Partnership and improved the competitiveness of the nation. Even though there is Technical Teachers Training Institute (TTTI), Chennai was established in 1964 primarily for developing the polytechnics through faculty development in 1964. Under Quality Improvement Program (QIP) of the Government of India, Curriculum Evaluation, Improvement, and Development of new programs based on the emerging technologies have been undertaken. Further to assist the faculty, Instructional Material Production was undertaken. Long-term Programs like Diploma in Technical Teaching (Dip. T.T.), Diploma in Science Teaching (Dip. Sc.), and Bachelor of Technical Education (B. Tech. Ed.) were established. To meet the needs of many specializations, Certificate courses in Technical Teaching (Cert. T. T.), and Educational Technology (Cert. E.T.) were introduced. Based on the needs of various states, Extension Centers have been established in Kalamassery for Kerala, Hyderabad

neither an established Consultancy Center nor a Department for HRD, the Self-Managed and High-Performing Faculty Team established a Radical and Virtual Innovation Center (RVIC) for Human Resource Development with an ultimate global focus and interdisciplinary programs and diverse global human resource development programs. Some of these programs are not only helping the nation to achieve the sustainable goals identified by the United Nations, but also Peace Engineering Education. Ultimately the RVIC has to be institutionalized for harnessing continued benefit not only the institute but also to the diverse global participants.

Keywords: Radical and Virtual Innovation Center, Planning Diverse Global Faculty Development Programs, High Performing and Self-Managed Teams, Sustenance of Innovation.

Introduction

for Telangana, Bangalore for Karnataka, and Vijayawada for Andhra Pradesh. Further based on the suggestions from the Bhattacharyya Committee training programs for the Engineering College Faculty have been offered. The Institute has been selected by United Nations Economic and Scientific Cultural Organization (UNESCO) as an Affiliated Center of Asia and Pacific Program for Educational Innovation for Development (APEID) in 1978. The institute also became an Associated Center of Colombo plan for Technician Education (CPSC), Singapore. Further, based on the United Nations Development Program (UNDP) assisted Technical Education Research, Multimedia and Evaluation of Engineering Programs were included for teacher training. Most of state governments and local industries approached the Institute for training the employees. Till now there is neither an established

Center for Consultancy Works nor a Department for undertaking the Human Resource Development (HRD) programs. Even the Continuing Education Unit which was started in 1989 under the initiatives of MHRD was closed after six years.

Faculty Development under Various Schemes

Initially (1967-80) senior faculty members of TTTI have been trained by various education colleges in UK. Later under UNDP, UNESCO, Canada India Institutional Cooperation (CIICP) Scheme, Colombo Plan Staff College (CPSC), World Bank assisted projects, UNESCO's Asia Pacific Educational Innovation for Development (APEID) in technician education and bilateral agreements with various countries, many faculty members have been trained in many advanced areas. One member selected by the Fulbright Scheme of the USA and another by the International Rotary Club for developing educational aids.

Consultancy Works under Continuing Education Program

The Institute received funding under National Policy on Education 1986 from the Ministry of Human Resource Development (MHRD) for establishing a Continuing Education Center in1989 to assist the industries and Micro Small and Medium Enterprises (MSMEs). The Institute has been nominated as an Academic Consultant under World Bank assisted projects for technician education by MHRD. Many diverse international faculty developments have been undertaken by the high-performing faculty teams as ad hoc projects. There is neither an established department for HRD nor a Center Consultancy. The faculty members selectively approved to bid for many Diverse and Global Faculty Development and Research and

Development Programs under various IDAs. In due course many Radical and Innovative Projects have been successfully completed. This gave rise to a "Radical and Virtual Innovation Center for Human Resource Development (RVICHRD)". This Radical and Virtual Innovation Center undertook many global and national projects through bidding to meet the challenges in the Engineering Education.

Why should We Build an Innovation Center in HRD and Engineering Education? After globalization of Indian economy, Foreign Direct Investments (FDI) are pouring in many manufacturing sectors which demands Indian engineering education to meet the needs of India through training and developing engineering faculty members, executives of companies, and the polytechnic faculty members from more than 90 developing countries.

They need further assistance for implementing their models in their country. There is no dedicated and formal institute which can offer short-term courses, long-term training programs and undertake industry relevant curriculum development, instructional material development and interdisciplinary research in Engineering Education. Even though the institute was established for developing the polytechnic teachers, later due to the demands from industry and international agencies, the need for an innovation center in HRD and engineering education started growing. Due to the rigid policy of the administrators, the growth was very much constrained and the faculty faced innumerable problems. The following are some of the challenges arising due to knowledge -based economy:

Global Challenges

The following challenge is very much concerned by the Institutes:
- Advance Personized Learning

Sustainable Development Goals of UN which can be met by the governments:

1: No Poverty	10: Reduce Inequalities
2: Zero Hunger	11: Sustainable Cities and Communities
3: Good Health and Well-Being	12: Responsible Production and Consumption
4: Quality Education	13: Climate Action
5: Gender Equality	14: Life Below Water
6: Clean Water and Sanitation	15: Life on Land
7: Affordable and Clean Energy	16: Peace, Justice and Strong Institutions
8: Decent Work and Economic Growth	17: Partnership for the Goals
9: Industry Innovation and Infrastructure	

Some of the programs planned by the Institute and their relevance to meet the relevant goals of UN are presented in Table-1.

Table-1

No.	Goal	Advanced Certificate Courses offered for Diverse Global Participants
1.	No Poverty	Curriculum Design and Instructional Materials Development.
4.	Quality Education	Planning Technical Education Programs for Developing Countries; Modern Library Practices; Technical and Vocational Education and Training to meet the Sustainable Goals on UN; IT, WEB Designing, English Communication; Computer Application.
5.	Gender Equality	Women Empowerment through Technical and Vocational Education Training
8.	Decent Work and Economic Growth	Quality Assurance in Technical Education of Developing Countries
9.	Industry, Innovation and Infrastructure	Educational Media Production for E-learning; Design of Educational Applications using WEB Technologies; Information and Communication Technology in Education and Training; Skill Development in Electronics for TVET Trainers and Planners; Human Resource Development Program
13.	Climate Action	Environment Protection and Management.

National Challenges:

The following are the national challenges faced by the country after globalization.

- Can we transform a technical teacher training institute in to a center of innovation in human resource development and an engineering education institute to meet the challenges of developing engineering faculty through interdisciplinary master degree and multidisciplinary doctoral research programs?
- Can we offer executive development programs for various engineering department who are implementing various state development programs under the USAID, and World Bank Assistance?
- Can we assist various industries to establish high performing modules to produce cost effective and high-quality auto ancillary components?
- Can we bid for faculty development programs under Asian Development Bank (ADB), GIZ, UNDP, UNESCO and World Bank?
- Can we become an academic consultant to assist various state governments to prepare detailed project reports under World Bank to getting the soft loan for improving the capacity of engineering institutes by establishing new program, new labs and workshops and improving the existing programs to industry relevant ones?
- Can we offer diverse global faculty development programs under various Ministries through bilateral agreements?
- Can we meet the challenges of the competing organizations?

Institutional Challenges

Considering the above challenges, one can prepare relevant institutional challenges. They are presented below:

- How do we organize for speed, agility and adoptability?
- How do we organize for learning, innovations and client impact?
- How do we network high performing teams?
- How do we overcome the hierarchical cadres?
- How do we empower the team leaders?
- Can we create a structure based on work and projects which has to focus on products and services?
- Can we advance through many projects under international development agencies?

- Whether the faculty can create multifunctional high performing teams?
- Can we lead the young faculty through orchestration?
- Can the project team take risk-taking in completing the complex problems?
- Can we create human capital when our vision is not focused on global challenges?

The proposed Radical and Virtual Innovation Center for HRD has faced the following bottlenecks due to absence of policy and nominated faculty members.

Bottlenecks

- Problems due to lack of global vision,
- Discrimination based on extraneous factors.
- Systematic obstructions due to absence of growth policy,
- Rigid process in permitting the planning of innovative programs,
- Fixed mindset,
- Backward looking,
- CEO as only expert,
- Hostile environment for faculty development,
- Resistance to build an institution of the future,
- Too much of restrictions on the faculty development,
- Absence of strategic planning in creating human capital,
- Relatively small size of qualified and motivated faculty,
- Difficult to find faculty collaborators,
- Central facilities and resources are limited,
- Poor faculty engagement,
- Not having supporting staff,
- No guidelines for undertaking consultancy works,
- Absence of high- end development activities,
- Absence of faculty coaches and mentors, and
- The proposal for establishing a consultancy center was not cleared.

Objectives

This research work has been undertaken to study the problems and appropriate method of planning, inviting motivated and competent faculty members to form a virtual team based on the projects and benefits accumulated through such projects to the development of various curricula, faculty training, fostering relationships between the institute and the industries. The objectives of are as follows:

To plan various senior faculty members development programs in engineering education management by utilizing the available resource persons through existing resources at the extension centers.

To organize executive and employee development programs which are demanded by the state engineering departments under various on-going development projects.

To bid for diverse global faculty development under on- going projects of International Development Agencies like Asian Development Bank (ADB), Swedish International Development Agency (SIDA), United nations Development Program (UNDP), United Nations Educational Scientific Council (UNESCO), United States Agency for International Development (USAID), and World Bank.

To develop innovative and interdisciplinary Master of Technology Degree Program in Human Resources Development [M. Tech. (HRD)] to meet the needs of fast developing Indian industries and MNCs.

To offer interdisciplinary Ph.D. program which will create more talented faculty members for meeting the challenges of fast- growing manufacturing industries due to globalization of Indian economy.

Research Questions

The research work centers around the following questions:

- Are we serving the nation through the qualified, competent and motivated faculty members?
- Are we engaging the faculty through creative problem- solving activities?
- What are the best faculty engagement processes?

- Can we encourage the faculty to be Challenged, Creative and Caring?
- Can we create start-up as a spin-off from the consultancy projects?
- How does the real-world environment enable learning?
- Can we provide an opportunity for advance personalized learning?
- Can we establish intentional space for creativity and collaboration?
- Can we develop interdisciplinary programs through consultancy projects?
- Can an innovation center promote multi-disciplinary learning?
- Can an innovation center foster industry partnership?
- Can an innovation center drive intrapreneurship?
- Can we create societal engineers through diverse global faculty development?
- Can we achieve global impact through an innovation center in HRD?
- Can we assist the faculty through learning in social spaces?
- Can we provide an opportunity for experiential learning?
- Can we bring effective team management and innovation to our institute through global projects?
- Can we sustain innovation in engineering education through diverse global faculty development?
- Can we meet the global challenges through continuous process development?
- Can we develop and sustain high-performance work teams in engineering education?
- Can we lead a self-managing team through complex consultancy projects?
- Can we build accountability in the consultancy projects?

The answers for the research questions are presented under the benefits accumulated-resources and improved competencies due to the projects (Table-8).

Literature Survey

In the 21st Century most of the fast- developing nations in Asia and developed nations like EU, UK and USA have focused on the cooperative problem solving through dedicated innovation centers.

Vanessa Urch and Jane Wheeler (2004) 79% of companies in the Fortune 1000 and 81% of manufacturing organizations deployed such "empowered", "self-directed" or "autonomous" teams. The external leaders have brought have built relationships between the self-managing teams and the organization. The external leaders sought information from managers, peers and specialists; diagnosed member behavior; and investigated problems systematically. Further the external leader effectively persuaded, obtained information and influenced the team. Also, the external leader delegated authority, exercised flexibility regarding team decisions and coaching.

The U.S. Department of Commerce (2013) has focused on the innovative and entrepreneurial university since innovation is a key driver of economic growth in the United States. Hence, it nurtured innovation which enabled advanced manufacturing and increasing exports to the world. It recommended to facilitate university-based technology commercialization, mobilized the higher education community. It provided strategic framework for universities, colleges, and its partners in government, philanthropy, and business to advance university-based innovation and entrepreneurship.

Peace Engineering Education

According to Ramiro Jordan et al. (2018) "Peace Engineering is the intentional application of systemic-level thinking of science and engineering principles to directly promote and support conditions for peace. Peace Engineering works directly towards a world where prosperity, sustainability, social equity, entrepreneurship, transparency, community voice and engagement, and a culture of quality thrive. Engineers have power to play a vital role in the creative solutions that can radically transform and improve the wellbeing of people and other living systems, day to day". A trans-disciplinary emerging field is emerging by integrating stem, arts, social and financial sciences, leadership, innovation,

creativity, entrepreneurship, trust and accountability and the motivated high performing faculty teams. It is possible to create trans-disciplinary programs and courses for the diverse global participants by planning various faculty development programs by utilizing the available resources and the dedicated faculty teams. This will ultimately create an innovation center in human resource development (WEEF-GEDC 2018, New Mexico, USA)

Brad Lukanic (2016) identified three types of innovations:

- Innovation centers promoting multi-disciplinary learning
- Innovation centers fostering industry partnership
- Innovation centers driving entrepreneurship

The University of Utah (2017) specializes engineering services for advanced technologies. The Center for Engineering Innovation (CEI) is prototyping, advanced engineering services, and technical education center for the University of Utah. They serve industry and public/government collaborators as well as supporting Utah's academic institutions (faculty, staff, and students). It is an integral part of the Utah Nanofabrication Laboratory and Micron Microscopy Core recharge/service centers, and offers capabilities that are unique for the state of Utah. The Center for Engineering Innovation (CEI) has density of unique and complex tools, integrated processes and knowledge base in highly advanced technologies and their respective application fields and markets that make it easily accessible for users.

Vasu and Bruce (2017) have focused on the development of entrepreneurial mindset, employee motivation, and interpersonal communication skills to improve the company's performance. They conducted organizational development interventions which improved employee motivation, interpersonal communication skills, entrepreneurial mindset and team performance.

Grand Valley State University (2017) established an Innovation Design Center for Engineering (IDCE)which is the primary talent pipeline for engineers in West Michigan. Community demand has led to a 40% growth rate in Grand Valley's

engineering program. The significant facilities are product Design Studio, Digital Design Studio, Machine Shop, Rapid Prototype Lab, Graduate Student Project Space, Industry-based Project Space, and Unique K-12 Outreach Space.

Ohio State's Engineering Education Innovation Center (EEIC) is a focal point for the college's innovative instructional programs, building upon their outstanding reputation for commitment to creative undergraduate education. The EEIC provides academic, personal and professional activities designed to enrich students' experiences both inside and outside the classroom. It also creates new courses and programs and strengthens existing ones to ensure that students are well-prepared for an ever-expanding range of career and entrepreneurship opportunities in a changing, global employment environment. Key EEIC programs include are:

- Multidisciplinary capstone programs
- Core and multidisciplinary engineering courses and programs
- Technology literacy courses and minors for non-engineers
- Professional development and enhancement
- Faculty professional development and scholarships for teaching and learning
- Development of technologically enhanced and enabled instruction.

Josh Bersin, Tiffany McDowell, Amir Rahnema and Yves Van Durme (2017) found that high-performing organizations operate as empowered networks, coordinated through culture, information systems, and talent mobility. Companies are focused on redesigning the organization itself, with nearly half actively studying and developing new models. And many organizations are not only designing but also building new organization. As networks and ecosystems replace organizational hierarchies, the traditional question "For whom do you work?" has been replaced by "With whom do you work?"

SHRM (2018) explored the factors required for a high-performance work team, the common stages of team development, causes of team dysfunction and the primary types of team's organizations establish to achieve specific work goals. According to SHRM a 'high-performance work team' refers to a group of

goal focused individuals with specialized expertise and complementary skills who collaborate, innovate and produce consistently superior results. The group relentlessly pursues excellence through shared goals, shared leadership, collaboration, open communication, clear role expectations and group operating rules, early conflict resolution, and a strong sense of accountability and trust among its members. According to SHRM, a high-performance team need:

- A deep sense of purpose and commitment to the team's members and to the mission.
- Relatively more ambitious performance goals than average teams.
- Mutual accountability and a clear understanding of members' responsibilities to the team and individual obligations.
- A diverse range of expertise that complements other team members' abilities.
- Interdependence and trust between members.

The Key Reasons Why Teams Work is Essential:

- A group of faculty members brings complementary skills and experience that exceed the abilities of a single individual.
- Teams support real-time problem-solving and more flexible and responsive to changing demands.
- Teams provide a unique social dimension that enhances the economic and administrative aspects of work.
- High-performance teams generally have more fun at work than low-achieving teams or individuals.

External Leadership for Autonomous Teams:

According to SHRM, High-performing leaders generally accompany high-performance work teams. Essential leadership qualities include the ability to:

- Keep the purpose, goals and approach relevant and meaningful;
- Build commitment and confidence;
- Ensure that team members constantly enhance their skills;

- Manage relationships from the outside with a focus on the removal of obstacles that hinder group performance;
- Provide opportunities for others without seeking credit; and
- Get in the trenches and do the real work required.

Joseph Folkman (2016) identified the following factors that describe the behaviors of leaders of high performing teams:

- Inspire more than they drive
- Resolve conflicts and increase cooperation
- Set stretch goals
- Keep vision on goals
- Are trusted

Common Barriers Faced by High-Performance Work Teams (SHRM)

- Nonparticipating leadership
- Poor decision making
- Infrequent communication
- Diversity not valued
- Lack of mutual trust
- Lack of goal clarity
- Poorly defined roles and responsibilities
- Relationship issues
- Negative atmosphere

Barriers at NITTTR Chennai

The following barriers have been identified for undertaking projects in human resource development:

- Applied Mathematics, Applied Science, Communication Departments were closed;
- Workshop has been closed;
- There are no multidisciplinary technology departments like Chemical Technology, Textile Technology and Mining Engineering;
- Letters of Invitation (L. O. I) from the MNCs were not circulated to the faculty;
- Project proposals from the faculty were withheld and never forwarded for no reason;

- Project gains were not shared as per the norms;
- Project leaders had been compelled to include unrelated external members.

Academic Freedom and Scholarly Community

A college is a dedicated social place where a variety of competing claims to trough can be explored and tested, free from political interference. The faculty members who drive the production of knowledge and the process of education are highly trained faculty members, and they, through an elaborate process of review by professional peers, take responsibility as a community for their scholarship, teaching and student learning. Board of governors, administrators, MHRD, University and other stakeholders also have important roles to play, but the faculty and their students stand at the center of the enterprise (Association of American Colleges and Universities, 2006). Academic freedom is protected by society so that faculty and students can use that freedom to promote the lager good. Various American Universities are committed to equal treatment and opportunity to faculty members and the students, to maintaining an environment that is free of bias, prejudice, discrimination, and harassment and established complaint procedures for allegations. Hostile Work Environment in USA is covered under the federal antidiscrimination laws and is defined as conduct that has the purpose or effect of unreasonably interfering with an individual(s) work or academic performance or increasing an intimidating, hostile, humiliating, uncomfortable, or offensive working or academic environment based on any characteristic protected by law. The faculty are protected under Equal Employment Opportunity/ Affirmative Action Plan. All the universities cannot discriminate and harass the faculty. David Raths (2016) stated that creating a physical hub of innovation on campus can support creativity, collaboration and entrepreneurship. Technical Teacher Training Institute, Chennai, carved out international spaces for creativity and collaboration with many international development agencies like Asian Development Bank, Danish International Development Agency (DANIDA), UNDP, USAID, UNESCO and World Bank. Driven in part by rapidly changing needs of employers, engineering education is seeking to make its spaces more reflective of a work environment that places premium on intrapreneurship. This innovation center focused on the faculty development not only at national level, but also at global level.

MIT (2019) is conducting a certificate course on 'Systemic Innovation of Products, Processes, and Services'. The goal of this program is to help participants become systematic about innovation in order to create value for their business and their customers in the globally connected market. This program blends the perspectives of marketing, design, and engineering into a systematic approach to delivering innovation, and presents methods that can be put into immediate practice. Wharton (University of Pennsylvania) (2019) conducts a certificate course on creating and leading high-performing teams. The course centers around gaining hands-on experience in building, participating in, and leading teams in diverse contexts; understanding how team leadership resides in action rather than position; managing strong individual players within a team and draw out the best from everyone- so that the team is more than the sum of its parts; building a peer network of fellow leaders for sharing challenges, insights, and perspectives. Maria Waida (2019) researched on the impact of employee engagement on productivity, retention and more. William Kahn (1990) brought human centered focus on three psychological factors on employee engagement:

- Contributions made to something bigger than oneself.
- Sufficient safety from potential negative consequences of inspired actions
- The ability of an employee to share their physical and mental capabilities with their work.

Maria Waida (2019) suggested the following employee engagement activities:

- Make employee happier or more fulfilled which will enable the company outperform competitors.
- Demonstrate an active mindset across the board which will produce positive mindset.
- Put people first which will produce consistency.

- Creatively encourage better habits which will enable employee wellness.
- Improve quality of life which will improve employee well-being.

She further suggested the following:

- Ask for feedback and apply it.
- Let employee make their own hours
- Host weekly or monthly get to gather
- Allow employees to work from home
- Establish transparent goals and specify how each employee helps support them
- Make planning easier
- Help get employees more involved
- Make working conditions more please and comfortable
- Create a new accountability strategy
- Establish work-life balance as a key part of your organizational values

Ellie Bothwell (2019) concluded that South Korean campuses lead world in innovation and industry ties. Government and universities' commitment to working with business cited as key factors for success. Yonsei University (Seoul campus) earned a score of 98.8 and reached the first rank in the university impact rankings. Korea Advanced Institute of Science and Technology [KAIST] earned a score-95.9), Sungkyunkwan University [SKKU] (score-95.4), Hanyang University (score-91.8) and Kyung Hee University (score-91.8). KAIST launched the idea of "the C3 Spirit"-encouraged students to be challenged, creative and caring. LG Electronics lunched a new collaboration with KAIST to take the lead in the 6G communication market. The Korean government has consistently emphasized industry-university-institute collaboration as driving force for innovation growth in response to rapid social changes such as the Fourth Industrial Revolution. The Korean Government provides funding to universities for industry collaborations and established a "Campus Innovation Park" plan to "develop idle sites in universities into high-tech industrial complexes" which are expected to become "innovation infrastructure hubs. They are also expected to provide quality jobs for students. Hanyang University has introduced problem-based learning programs and management consulting projects to help meet the needs of the industry.

Further, 70% of Korean Universities have introduced start-up related courses to promote students' entrepreneurship.

Research Methodology

Research methodology is based on survey method, and largely using naturalistic evaluation method advocated by Guba. Identifying the opportunities and planning for bidding, negotiation, entering into contract, and successfully implementing the projects. It is also focused on developing high performing project team.

Project Formulation Strategies:

- Assessing the needs of contextual knowledge and competence of the key performing faculty members
- Evaluating the context, competitors, project period, resources needed, adjunct faculty, possible networking with national labs.
- Developing a balance between scheduled institute work and the project work
- Planning to get the needed approval from the Board and the Government
- Establishing a project management
- Critical and value analysis on the possible outcome.

Preparing to Meet the Challenges of the Project:

1. Scanning the newspapers for project announcement
2. Getting the permission from the institute authorities to bid for the project
3. Sending the Institute profile, previous success stories and relevant expertise of the proposed team
4. Preparing the letter of request and including the key skills and competence of the team leader
5. Getting the project details, terms of reference

Immersing in the Project:

6. Establishing an autonomous, self-managed, and multidisciplinary project team
7. Developing the best possible technical proposal and viable financial proposal

8. Negotiating with the project authorities with the project bid documents
9. Preparing the agreement
10. Create agile network
11. Discuss, formulate a shared subgroup, create accountability, inculcate risk taking ability and with professional ethics
12. Share the assignment, bring diverse experience, create a dedicated work culture
13. Resolve the conflict
14. Empower the team leader
15. Prepare the story board for video program
16. Get the approval for field shooting from the nominated organization
17. Plan the training objectives, schedule and invite the executives

Getting the Approval from the Project Implementation Plan:

18. Implement the participative training schedules, self- instructional modules, case studies and assignments/ project work
19. Encouraging mid-term feedback
20. Training the trainers as per the agreed schedule

Finalizing the Project Documents:

21. Preparing multiple copies of the modules, learning aids, video cassettes and feedback questionnaires
22. Submitting them to the authorities, and getting the acceptance.
23. Settling the account, getting the funds, and bank guarantee.
24. Reporting to the Board of Governors.

The details of various projects completed since 1980 till 2011 are presented in the following tables:

- **Training programs offered to state engineering departments based on the letters of invitation**:

Table-2. *Training and Development Programs Completed for the State Government*

Region	Program	Outcome
Metropolitan City of Chennai	Training the employees of Auto ancillary component Manufacturing Companies	Lucas TVS, Sundaram Clayton, Brakes India, Ashok Ley Land
Metropolitan City of Chennai	Training the executives of CMWSSB in establishing Staff Training College at Kilpauk Water Works, Chennai	A Staff Training College was established and training programs for various cadres have been planned and conducted year after year under British Common Wealth Scheme.
Tamil Nadu State	Training the Irrigation Engineers, Agricultural Scientists in planning farm development programs	Irrigation Management and Training Institute has been established in Tiruchirappalli under USAID scheme.
Tamil Nadu State	Tamil Nadu Water Supply and Drainage Board	The senior engineers have been trained under World Bank assisted Project.
Tamil Nadu State	The engineers of TNEB have been trained.	They formulated training programs for the skilled workers.
Tamil Nadu State	Training of Sugar Technologists and Engineers	The Cooperative Sugar Mills Research Station in Vellore further continued in implementing the training programs

- **Academic Consultancy offered based on the nomination by the Ministry of Human Resources for assisting the Project Polytechnics, State Project Implementation Unit and National Project Implementation Unit.**

Table- 3. *Regional Programs under World Bank Assisted Projects (Tech Ed I to III)*

Region Covered	Program	Areas	Outcome

Tech Ed I: Kerala and Karnataka States.	Academic Consultancy: Faculty Development	Curriculum Revision, Developing New Curriculum in Emerging Areas, Equipment Specification, Research	Capacity Development, Quality Improvement, and Efficiency Improvement, Tracer Studies
Tech Ed II: Tamil Nadu and Andhra Pradesh States.	Academic Consultancy: Faculty Development	Curriculum Revision, Developing New Curriculum in Emerging Areas, Equipment Specification,	Capacity Development, Quality Improvement, and Efficiency Improvement, Tracer Studies
Tech Ed III: North Eastern States, Jammu and Kashmir, Andaman and Nicobar, and Sikkim.	Academic Consultancy: Faculty Development	Curriculum Revision, Developing New Curriculum in Emerging Areas, Equipment Specification, Establishing Continuing Education Centers, Learning Resource Development Centers, Autonomy,	Capacity Development, Quality Improvement, and Efficiency Improvement, Continuous Process Improvement in Teaching and Learning; Impact Studies; Resource and Space Utilization Studies, Tracer Studies, and Tracer Studies.

Table-4. *National Programs under World Bank Assisted Projects (TEQIP I and II)*

Region	*Program*	*Areas*	*Outcome*
Nation	Academic Consultancy	DPR, Faculty Development, Tracer Studies, Research Methodology, Institutional Development, Developing Industry Relevant Graduate Programs.	Internal Revenue Generation, Consultancy Services to MSMEs, Establishing Centers of Excellence

Table-5.

- *The following projects have been implemented through successful bidding and getting the award of the project.*

Global Programs won through Bidding under International Development Agencies

Sl. No.	*Asian Development Bank (ADB) Assisted Program*	*UNDP*	*UNESCO's APEID*
1.	Training the vocational teachers in 15 areas: Agriculture Machinery Repair, Animal Science, Air Conditioning and Refrigeration, Business Management, Computer Science, Diary Technology, Electronics, Fisheries, Fruit Processing, Hotel Management, Skill Testing, Trekking, and Video Programs.	Bhutan Technical Faculty Development; Establishment of Learning Resources Development Center.	Asian Region: Curriculum Development; Distance Education; Planning Mathematics and Science Education Programs for Skilled Workers Education, Technicians and Vocational Students; and Non- Formal Training Programs. Training in Biochemistry for CTEVT-Nepal
2	Swedish International Development Agency Sponsored Program for Balaju Technical Institute, Kathmandu: Training of Staff in Financial Management		

Table-6. *Diverse Global Faculty and Executive Development Programs through Government of India through Bilateral Agreement*

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JEET

Advanced Certificate Programs	Ministry of External Affairs and ICCR	Ministry of Finance
Curriculum Design and Instructional Materials Development	Developing countries under ITEC and SCAAP schemes: Developing Countries in Asia, Africa, Central and South America, Europe and Oceania	Under TCS under Colombo Plan: Mostly Asian and Selected African Countries
Environmental Protection and Management	Do	Do
Human Resource Development	Do	Do
Developing Technical Education	Do	Do

Table-7 *Innovation Growth Trajectory*

Year	Focus	Learning	Significant Outcome
1964-1977	Faculty Development for Polytechnics in the southern states. Faculty developed through British Council Assistance.	Objective based Curriculum Design, Instructional Materials Development, Improvements in measurement and evaluation helped in Examination Reform. Educational Technology added focus on the student learning.	Cert. T.T. Cert. E.T., Dip. T. T., B.Tech. Ed., Dip. Sc., Short-term Courses and the First Extension Center for Kerala were established. Polytechnics have become well stabilized to meet the employers 'demands. The products were well received by the companies. In country programs under CPSC Singapore. The faculty started specializing in the educational transformation and extended to Service Sector.
1977-1987	MMLP, Research and Evaluation were focused on the transformation of technician education under UNDP.	Institute has become an associated center of UNESCO's APEID program. Faculty were trained in MMLP, Research, and Evaluation through three universities in USA.	Three more extension centers were added (Hyderabad, Bangalore and Madurai). More learning packages were added. Books have been Published through reputed publishers. Local auto ancillary companies utilized the expertise of the faculty and the resources of the institute. Diverse Global Faculty Development programs were conducted under Ministry of Finance, and Ministry of External Affairs and UNESCO's APEID.
1987-2000	Capacity Development, Quality Improvement and Efficiency Improvement through World Bank assistance. Strategic plan for the institute.	Well trained and motivated faculty undertook academic consultancy under World Bank assisted projects. Faculty members have been trained under the project through various American and British Universities	Faculty undertook consultancy projects under ADB, CIICP, SIDA, UNDP, UNESCO and World Bank. Master degree programs and interdisciplinary Ph.D. in engineering Education have been established. Institute has become a leader in developing diverse global faculty and executive members under the Ministry of Finance, Ministry of External Affairs and IDAs.
2000-2010	Engineering Colleges. Diverse Global Faculty Development. Interdisciplinary Research in Engineering Education. Sponsored	M. Tech. (HRD) and Ph.D. have been well established. Many innovative diverse global programs have been established. National and international conferences were conducted. Leadership Development Programs have been well established.	Interdisciplinary doctoral programs have been well stabilized. Engineering college faculty members have been benefitted very much. Leadership development programs for the heads of departments have been well subscribed. Tech Ed III transformed the human resources of the North Eastern States. Institute has been well recognized by IDAs for its contribution. Video cassettes for the technical education supplied to the states.

	research programs have been completed.		
2010-2020	Focus on the MOOCs. Research under GIAN and India-USA-21st Century Knowledge Initiatives.	New postgraduate program in Civil Engineering.	Diverse Global Programs have been well received by the least developing countries as well as fast developing countries. Customized faculty development programs for Bangladesh., and Sri Lanka.
2020-2030	Modernizing Engineering Programs to meet the challenges of digital technology, and Industry-4; Transformation of the Institute to Deemed University in Engineering Education	Developing new digital technology- based faculty development programs to meet the needs of Industry-4. Strengthening the Extension Centers to meet the needs of engineering colleges. Offer Massive On-line Open courses (MOOCs), Blended Programs, and MMLP.	Creating knowledge capital and human capital for the knowledge- based economy; Interdisciplinary Research in Engineering Education; meeting the sustainability goals; meeting the grand challenges; creating an active consultancy and radical innovation center for undertaking diverse global projects under IDAs and MNCs.

Benefits Accumulated

Table-8 This part of the paper is due to the feedback from the team members of the various projects.

S. No.	Research Question	Finding
1	*Serving the nation through the qualified, competent and motivated faculty members.*	*Yes, undertook substantial faculty and executive development programs.*
2	*Engagement of faculty through creative problem-solving.*	*Yes, the faculty contributed to solutions through creative problem solving.*
3	*Best faculty engagement process*	*Planning technical and financial proposals; developing learning modules; conduct of executive development programs; preparing reports, etc.*
4	*Encouraging the faculty to be challenged, creative and caring.*	*When they are challenged, they became creative and caring for the best human relations.*
5	*Creating start-up as a spin-off from the consultancy projects.*	*Around 40% of the faculty have undertaken consultancy projects after retirement.*
6	*Real-world environment enabled learning.*	*The project faculty focused on the real-world problems and created a number of case studies for the M. Tech. (HRD) students*
7	*Opportunity for advanced personalized learning.*	*Many faculty members mastered the instructional design for the continuing education.*
8	*Establishing intentional space for creativity and collaboration.*	*Many faculty members undertook many consultancy projects and collaborated with many organizations.*

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9	*Development of interdisciplinary programs through consultancy projects.*	*M. Tech. (HRD)&Advanced Certificate programs have been planned based on the real-life experiences.*
10	*Promotion of multidisciplinary learning through innovation center.*	*Interdisciplinary Ph.D. program is an outcome of the innovation center.*
11	*Innovation center fostered industry partnership.*	*All the M. Tech. (HRD) students undertook dissertation works in MSMEs. Many companies cooperated in curriculum revision.*
12	*Innovation center drove intrapreneurship.*	*Many creative faculties planned consultancy projects and substantially brought internal revenue.*
13	*Creation of societal engineers through global faculty development.*	*The faculties offered around 12 programs per annum to develop diverse global participants in emerging technologies.*
14	*Achievement of global impact through the innovation center*	*NITTTR Chennai has been recognized as a successful planner of diverse global faculty developer. All the projects completed under IDAs and Government of India have been impacted on the growth. Around 1500 global faculty and executives have been developed.*
15	*Assisting the faculty through learning in social spaces.*	*Many faculty members offered advanced programs through Academic Staff Colleges and ISTE.*
16	*Providing opportunity for experience learning.*	*Around 65 interdisciplinary Ph.D. scholars have been guided by the faculty who are from polytechnics, engineering colleges, industry and Iran.*
17	*Bringing team management and innovation to NITTTR-Chennai through global projects.*	*The faculty members of NITTTR-Chennai have formed high-performing teams and successfully completed all the projects.*
18	*Sustenance of innovation in engineering education through diverse global faculty development.*	*NITTTR-Chennai demonstrated its capacity to plan and implement many diverse global faculty development programs through various IDAs. This has attracted many countries like Bhutan, Bangladesh, and Sri Lanka for customized programs for the faculty members. Further, the needed funds are to be provided by the Ministry of Finance, and Ministry of External Affairs or by the IDAs whenever they utilize the services.*
19	*Meeting global challenges through continuous process improvement.*	*This is possible through updating the courses and training the new faculty members. Continuous process improvement based the feedbacks from the participants and their officers.*
20	*Sustaining high-performance work teams in engineering education.*	*Sustenance is possible by delegation and empowerment of the project teams. The impact on the user institutions are to be evaluated and periodically submitted to the funding ministries and MHRD. The project gains have to be shared between the Institute and the team members. There is a need for auditing the outcome of the projects so that improvements could be affected.*
21	*Leading Self-managing team through complex consultancy projects.*	*This is the best strategy. All the self-managing teams need administrative support and timely reimbursement of expenses incurred as per the project agreement.*
22	*Building accountability in consultancy projects.*	*The team leader and the team members have to follow the general financial rules and maintain accurate documents. There is no discretion. They have to submit all the accounts to the audit.*

A Radical Model in Engineering Education and HRD

Since there is no established department/ center/unit, it is concluded that the key performing

teams have virtually established a radical model for an innovation center in Human Resource Development and engineering education.

" An innovative virtual model for planning various human resource development (HRD) programs utilizing the existing resources both for industries and engineering institutes, offer short-term courses and long-term programs for engineering faculty members through the main institute and its extension centers based on the MHRD funding, offer diverse global faculty development courses either through bidding, or through sponsored programs by various governments, plan innovative interdisciplinary postgraduate programs in HRD, offer multidisciplinary Ph.D. programs for the faculty members and industry executives, undertake research and development programs under many Agencies (IDAs) and plan for sustenance".

This innovation is possible due to the dedication of high-performing team members of the Institute. It is hoped that continuous process improvement in planning and implementing the innovative global projects will enhance the leadership and reputation of the institute.

Conclusions

For undertaking innovative consultancy programs under various projects, there is a need for high-performing team of faculty are required. The team has to be empowered and supported with initial funds to start. The planned senior faculty development programs are based on the existing resources and infrastructure. Further, the needs of engineering college faculty members were met through the customized courses. All the global faculty development programs under various IDAs were successfully completed. M. Tech. (HRD) program was stopped due to the paucity of faculty in 2015. All the employee development programs have been completed as per the needs of the sponsoring organizations. The interdisciplinary Ph.D. program has been well received.

There is a need for agile project specific multidisciplinary teams with contextual competencies, critical skills and achievement motivation.

The institute has to agile, embrace the speed of change, make mobility a core value, organize high performing groups, followed by continuous learning, fuel collaboration with national labs,

grow through many global assignments create followers and lead by orchestra and high performing culture os sharing the resources and offer needed services under knowledge based world economy.

Even without any organized center or department or unit, it is possible to establish a virtual innovation center in human resource development center.

This is essential for surviving under fast changing knowledge based global economy. Autonomy has to be ensured to self- supporting and self-managed faculty teams. The closed departments of applied mathematics, applied science, humanities, and sociology could be opened. Further there is a need for interdisciplinary technology department (Textile, Chemical, Mining, and Management) are essential to train the faculty of mining engineering, wood technology, chemical technology, textile technology and ceramic engineering.

Interdisciplinary postgraduate departments are very essential to redesign the existing programs to meet the needs of Industry-4.

There is an urgent need to establish a Global Consultancy Center for HRD, and an Innovation Center to offer high end programs to meet the knowledge economy and add to peace engineering education.

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