

Integrating Entrepreneurial Ecosystem into Engineering Education: Driving Regional Economy in Tier-2 Cities

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Abstract: Industry expectations from the young engineering graduates are changing rapidly. There is also a growing need for employing a large number of graduates. This is particularly important in several Tier-2/3 cities in India where a large majority of students graduate in engineering hoping to make a career. Except for a few top institutes in the big cities, most of the engineering institutions are in the Tier-2 cities where there are hardly any industries that can offer jobs to so many engineering graduates. This, results in a large number of graduates with little opportunities for employment, hence forcing them to move to the Tier-1 or Metro cities leaving behind an Intellectual void and a broken and dysfunctional social setup. With globalization of opportunities, being strong in technology basics alone isn't just enough. Ability to think entrepreneurially, dealing with ambiguity, thinking out of the box, intrapreneurial approach at work, contributing to and helping to grow the local ecosystem, etc., are some of the competencies looked for by the employers. This paper shares some of the educational interventions undertaken at BVB College, Hubli to build business ecosystem on campus and to engage students as partners, to grow start-up culture.

Key Words: Entrepreneurship, Eco-system, Engineering education, Entrepreneurship curriculum, Entrepreneurial interventions.

1. Introduction:

Entrepreneurship is the key driver for development and job creation in any nation. Higher the entrepreneurship orientation of people, more can be innovative solutions, improved quality of life and better economic development of its citizens. This economic prowess contributes to the social well-being of people as a whole.

India has embarked on skills development and entrepreneurship building as its mantra in the proposed growth plans. The real fact is however that, India's record is at best poor at nurturing entrepreneurs and creating an entrepreneurial ecosystem. What once, India was known for quality goods using locally available raw materials; now the same India has forgotten its entrepreneurial prowess of the yester year. India's ranking on some global entrepreneurial benchmarking is pathetic and needs a holistic and an all-round plan, if she ever wants to regain the past glory.

The GEI (Global Entrepreneurship Index 2015) places USA in the first position and India is at a dismal 104th rank below all the BRICS economies. (China-61, Russia-70, Brazil-100). Another major study undertaken in 2013, on Indian entrepreneurship is by the Global Entrepreneurship Monitor (GEM). It

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pointed out that the entrepreneurial attitude (particularly on viewing entrepreneurship as a desirable career choice), relatively speaking, with other BRICS economies was low in India. Only 61 percent of the adults in the sample (in the age bracket of 18-64) looked at entrepreneurship as a desirable career option. The figure was 70 percent in BRICs economies and 77 percent in factor-driven economies.

Integrating Entrepreneurial ecosystem in engineering education has two major constituents. Presence of an entrepreneurial ecosystem and, a visionary institution offering engineering education. Both must be mature enough to grow on each other's strengths. An engineering institution can be established under the statutory guidance of a higher education body of any nation. It follows a standard process to get established, affiliated and recognized. On the other hand, establishing an entrepreneurial ecosystem does not have to follow any standard framework or guidelines. Entrepreneurial ecosystem is the outcome of a felt need for practice based education in an engineering institution.

Presence of entrepreneurial ecosystem enhances entrepreneurial education which can be defined as 'the process of inculcating individuals, with the ability to identify commercial opportunities and the much needed insight, self-esteem, knowledge and skills to act on them'. It includes instructions in opportunity recognition, commercializing a concept, marshalling resources in the face of risk, and initiating a business venture (Jones, et al. 2004). Both engineering schools and the established ecosystems need to play their role, to the best level of performance to sustain and grow. It is more imperative now in India that, such entrepreneurial ecosystems have to come up to enhance the quality of engineering graduates and the intellectual property they would create.

Indian higher education is at an exciting juncture with seemingly unending challenges on one side and enthusiastic youth who make over 50% of the India's population. The youth of India are willing to scale these challenges and move ahead. Some of the obvious challenges are, rapid social changes, volatile economy, unemployment and worldwide competition for talent. The expectations and aspirations of the young generation of India, which is by far the largest in the world, would like to see these challenges as opportunities of the new world order. Government has responded with a range of national policies and initiatives aimed at achieving a more competitive

economy in which enterprise, entrepreneurship and innovation are the drivers of growth. Graduates with entrepreneurial and innovative mindsets, behaviors and skills are vital to keep this synergy going. Here, the higher education sector, through entrepreneurship education, can play a crucial role.

Higher education can enable entrepreneurship at the local level provided, they create the necessary business ecosystem for the start-ups to come up and flourish. According to Daniel J. Isenberg (2010), the entrepreneurship ecosystem is essentially made up of elements - such as leadership, culture, capital markets, and open minded customers—in complex culminations, leading to various combinations. In isolation, each is conducive to entrepreneurship but insufficient to sustain it. That's where many governmental efforts go wrong — they address only one or two elements. Together however these elements turbo-charge venture creation and growth. Integrating these essential elements at the local level can ensure sustenance of start-ups.

Recognizing this, BVB College of Engineering and Technology Hubli, has established a Centre for Technology Innovation and Entrepreneurship – CTIE. It is the CTIE's mission to create entrepreneurially oriented graduates for the real world.

This paper intends to cover the rationale for fostering entrepreneurial ecosystem in a tier-2 city, enabled through education and innovative programs. Curriculum interventions designed to develop critical skills and abilities, present a potential continuum model to develop entrepreneurial ecosystem in a tier-2 cities which can be adopted by various other educational institutions. The results of this initiative, along with the various strategies and metrics will be presented.

2. Contemporary Models of Entrepreneurship:

Joseph Schumpeter an Austrian economist propounded that the action of entrepreneurs, working their innovations and technology on the market, introduces a set of forces that shake the markets up (Banks et al., 1990). Schumpeter proposed that, 1) introduction of a new product or a new quality, neither of which the consumer is familiar with; 2) application of a new production method or process that relies on innovation, rather than invention; 3) opening up a new market; 4) a new or innovative servicing of material or components and 5) establishing a new organization,

either in structure or type - can lead to disequilibrium of the markets, thus leading new enterprises to spring up.

Essentially the contemporary models of entrepreneurship subscribe to Schumpeter's findings in one or the other way. Many models of entrepreneurs have worked on Human aspects that help mould an individual into an entrepreneur. Blake and Saleh (1992) propounded combining personality factors, knowledge, managerial mechanisms and environmental forces in a schematic that traces out the entrepreneurial process. The idea is that a person's characteristics will encourage risk-taking or networking and co-ordination to bring about a successful launch. Such conducive environment can help build and accelerate right behaviours.

Engineers are by profession trained to develop socially relevant solutions. In technology entrepreneurship, Roberts (1991), lists three primary aspects (a) Freedom to work, (b) challenging environment and (c) Financial gains as being critical to the high tech entrepreneur. According to Freeser and Dugan (1989), four factors, out of the eleven motivational elements proposed, are the key parameters that motivate an engineer to be entrepreneurially oriented: (a) feeling of frustration with the employer (b) desire to avoid working for others and be properly rewarded for one's own efforts (c) drive for challenge and advancement (d) intense drive to do one's own thing, to develop one's own ideas.

Given an ecosystem which supports and nourishes such entrepreneurially driven minds, entrepreneurs see an opportunity, and possibly use innovations to deliver products that are attractive in the market place.

3. Entrepreneurship in Curriculum:

Embedding entrepreneurship education in engineering is not a new concept. Most of the globally renowned business and technology institutions have been offering education in entrepreneurship in one form or the other. At least in the western world, integrating entrepreneurship education with engineering curriculum has shown some remarkable outcomes. Examples from universities like Stanford, which has enabled close to 40,000 ventures through students, alumni and a larger network. Success of MIT as being hub of practicing entrepreneurship is world

renowned. An entrepreneurial model of effectively connecting research driven technology solutions to mass markets and the resulting wealth accumulation that dwarfs the economy of some emerging nations is well known. So, can this startup culture be taught? If yes, then is it something that we can replicate everywhere else?

Integrating entrepreneurship in education is not like one size fits all. Cultural aspects, technology relevance, in house research base, commercialization support, funding availability - are some of the factors that make some models successful and some not.

India with its emerging focus on skill building and, policy level push to develop entrepreneurial ecosystem has various challenges to deal with, than that of successful western nations. Especially talking about the tier-2 city engineering institutions in India, research is more of an academic activity than something that generates commercial interest. For the tier-2 city institutions, possibly technology integration makes a great sense than developing research based product offerings. If India wants to be in the forefront of new entrepreneurial paradigm, it has to focus in the short to medium term, on innovations in technology integrated products that are socially relevant than innovations through research.

Two important aspects to be considered here are the –i) the role of innovations that are relevant to the local/global needs which drive new product development, and in turn new entrepreneurs. ii) using these new product ideas, building of a collective vision for the start-ups of the region.. Universities must focus on building a conducive entrepreneurial ecosystem where in, students find an opportunity to test their innovations through developing concepts, and the value proposition. Entrepreneurship education, if offered, shall help entrepreneurs to learn how to avoid mistakes made by ventures before them. The academic program in entrepreneurship must mimic the real-life entrepreneurs to help students learn experientially.

4. Business Ecosystem:

According to J F Moore (2006), business ecosystems are defined as intentional communities of economic actors whose individual business activities, share in some large measure the fate of the whole community.

Business incubation is a business support process that accelerates the successful development of start-up and nestling companies by providing entrepreneurs with an array of targeted resources and services. These services are usually developed or orchestrated by incubator management and offered both in the business incubator, and through its network of contacts. A business incubator's main goal is to produce successful firms that will graduate out by becoming financially viable and freestanding. These incubator graduates have the potential to create jobs, revitalize neighborhoods, commercialize new technologies, and strengthen local and national economies.

Some key elements that help build the business ecosystem on a campus are,

4.1 Focus on local needs: Universities intending to integrate entrepreneurship through building the enabling ecosystem need a strong local focus. This helps to stay relevant for a longer period. Natural resources, talent and need of the local people can help enhance the scope of the existing business ecosystem.

4.2 Engage external entrepreneurs to kick start the ecosystem: This is a quick way to build credibility and possibly works well where, private businesses are willing to come together to help build the much needed business environment. This is especially of great advantage if the institution wants offer a formal entrepreneurship curriculum. Alumni, serial entrepreneurs who can be engaged on certain commercial terms can start their ventures on campus thus can fulfill the need of role models for students to emulate.

4.3 Support deserving enterprises to showcase early winners: By offering all possible amenities and facilitation on campus, companies can quickly scale up. Not all may take the advantage of this, but the institution must be choosy in offering all possible support to build winners. Funding is a big bottleneck for many starters and having some kind of tie up with governmental funding agencies can help accelerate the start-ups.

4.4 Connect the start-up success to develop a culture of entrepreneurship on campus: Involving students at various levels - internships, live projects, jobs – can help build the much needed connection in the mind of students. The success story of a few can strengthen the entrepreneurial mindset of students. Also, holding

events and activities that mimic the start-up process helps students to take part without inhibition.

4.5 Nurture and strengthen Entrepreneurial culture through curriculum interventions: This is the ultimate step where in entrepreneurship education can be formalized in the form of minor programs or value added credit based programs. A systematic engagement of students who have some interest in entrepreneurship can be guided and mentored with the help of the business ecosystem on campus.

4.6 Go global and benchmark: Establishing entrepreneurial process that focuses on the local needs but can be benchmarked against the global practices can bring credibility.

This can further help in establishing collaborations with other educational institutions, industries and even foreign universities.

Recent studies as noted by Knight (1987), believed to have shown a strong correlation between educating students in entrepreneurship and they becoming entrepreneur over their career. It has been determined that 1) potential entrepreneurs can be encouraged through university-based entrepreneurship programs 2) entrepreneurship within an established definition can be taught and 3) entrepreneurial alumni do succeed and they themselves provide further insights and educational materials for dissemination in the classroom (AUTM Licensing Survey, 1999). At BVB college of engineering and Technology, all three research findings mentioned above have been considered to develop entrepreneurship programs. These include culture building non credit activities and more formal education about finance, markets and legal matters through credit courses.

5. Integration of entrepreneurship ecosystem at BVB College of Engineering and Technology:

Though Karnataka has witnessed a globally acclaimed IT revolution, most of the tier-2 cities of Karnataka have become mere manpower supplying sources, than anything else. With a combination of less than adequate infrastructure and lack of local leadership, tier-2 cities have become mute spectators in this exciting IT phenomena. Hubli-Dharwad held quite a promise for the IT business leaders few years back (with STPI in Hubli) however, the dream of being 2nd Silicon Valley of Karnataka, did not materialize.

B.V. Bhoomaraddi College of Engineering and Technology, Hubli, established in 1947, has been a key contributor to the business growth and education in Karnataka and beyond. In 2015, it was conferred a deemed university status. This has strengthened the resolve of BVB College to put entrepreneurship as one of the top priorities. Realizing that the time has come to reverse the brain drain by building entrepreneurial ecosystem - the only panacea for the regional socio-economic woes - a Center for Technology Innovation and Entrepreneurship (CTIE) has been setup. The objectives of the CTIE is to set up a platform to,

- 5.1 Develop entrepreneurial thinking and liking in the mind of students
- 5.2 Excite students to take on socially relevant challenges and help build solutions
- 5.3 Develop ability to build business around tech. solutions
- 5.4 Engage entrepreneurially aligned people to come together to be a part of the business ecosystem

Engineering campuses need entrepreneurial ecosystem as a test bed to put their innovative technology ideas to work. The ecosystems allow entrepreneurially aspirant students and graduates to test their ideas and assumptions. Though most of the start-ups end in failures, the ecosystem provides a strong mentor base and support, making failures a part of the learning process.

Engineering institutions are also a great place to start business ecosystems because, they provide most of the startup requirements. Access to working space, labs, library, students and faculty makes it a lucrative destination.

BVB College realized the potential of setting up an entrepreneurial ecosystem in 2012, a formal launch was made with many eminent industry and academic personalities as its governing board members. CTIE –Centre for Technology Innovation and Entrepreneurship was started with a vision 'To be a Pioneer, Foster, Enable and Grow the Innovation and Entrepreneurial Ecosystem in Tier-2 Cities'.

CTIE, in collaboration with department of MSME, Government of India, has taken on a mission to connect students, businesses and community to drive local entrepreneurship. CTIE's technology focus and build up of mentoring resources has helped young

entrepreneurs to incubate their ideas at CTIE. With over 18,000 sqft of incubation space which is by far the largest an educational institution has given away in the region. An additional 20,000 sqft of proposed Tech Park shows the commitment to the vision of CTIE.

6. CTIE Strategy:

To help build up a technology entrepreneurship ecosystem, CTIE followed a two pronged approach as shown in Fig no. 1. The first is to encourage external entrepreneurs with a good business plan and cultural fit to start their business on BVB campus. This enabled quick ramping up of companies with commercial interest that served as a beacon to engage students in a variety of collaborative activities. Alumni of BVB responded to this call effectively and many businesses made CTIE as their home. Simple and no-strings-attached policies of CTIE helped to attract serial entrepreneurs and young engineers to build their ventures.

The second path focused on building the pipeline of eligible students who are open enough to experience career of an entrepreneur. A good mix of credit based and non-credit activities were undertaken as a part of this approach.

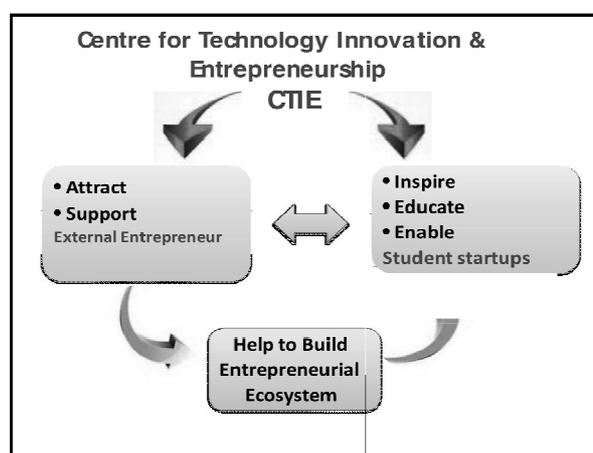


Fig.No. 1. CTIE two pronged approach towards building entrepreneurship

The entrepreneurship interventions designed at BVB focused mainly on,

1. Building entrepreneurship culture on campus
2. Opportunity identification and technology solutions

3. Commercialization strategies

These are achieved using a 7 step Strategic Development Framework for New Ventures model as shown in Fig no. 2. This is a modified version of the model originally developed at the Rensselaer Polytechnic Institute (RPI) New York. This modified and localized model essentially aims at empowering students to experience all that a real entrepreneur experiences but in a less intimidating and more supportive environment.

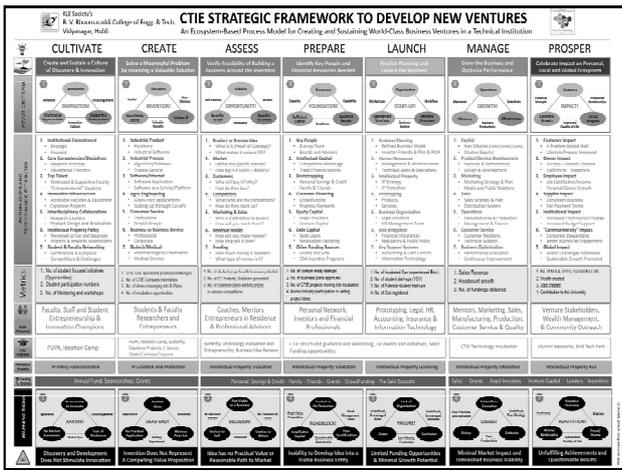


Fig. No. 2 – CTIE Strategic Framework to develop new Ventures.

BVB's initiatives to drive through the 7 stages of Strategic Framework are designed to ensure students move from one phase to another at their own pace. This self pace setting increases the comfort level and reduces anxiety in the mind of students.

Interventions undertaken as a part of the 7 step process are as follows.

6.1 PUPA - It is an Accelerated Entrepreneurial Experience for students. Under this program, students are encouraged to take up any product idea, build it and sell it. All participating student teams are given seed funding to develop and build their product. This event is open for all engineering and management students in the region. PUPA has a time line of 4 weeks and at the end of it, teams would demonstrate their products and share their experiences with local community invitees.

PUPA aims to harness the raw energy and enthusiasm of students, and to connect intellectual ideas to monetary gains. It also helps develop team participation, negotiation skills, thinking out of the

box, facing ambiguity, and eventually, selling a product! This is an annual event.

6.1.1 Type of Products made under PUPA: Bean Bag, Car Sun Screen, LED Footwear, Fruit Plucker, Cake Board, Solar Mobile charger, Corn peeler, Banner Stand, Safe cracker igniter, Glass cleaner, LPG cylinder carrier, Software solutions for businesses..

PUPA has grown over a period of 3 years. Following is the snapshot of student participation.

PUPA	2013	2014-I	2014-II	2015
	20 teams	32 teams	72 teams	233 teams
	80 students	129 students	350+ students	750+ students
Participants	BVB only	BVB and other institutions	BVB only	BVB and other institutions

Table No.1. – PUPA activities over the years.

6.2 Ideation Camps: Intel Youth Enterprise program is a globally accepted workshop format for developing and scaling ideas. The program consists of an ideas framework that helps participants, through the stages of ideation, validation, development and lastly, testing in a real world environment. All through the workshop, there are Buddy sessions, energizers, peer-coaching, mentoring and many such fun and exciting activities. Student teams make B-plans and present them to win cash prizes. This is program usually is oversubscribed as the upper limit on participation is 72.

6.3 Butterfly: It is a business plan competition open for all students of BVB. The pitch contest is held with external entrepreneurs as judges. Selected business plans are qualified to take part in CTIE capstone project track for one year. During this one year, students are expected to conduct literature survey, and competitive analysis of the proposed solution. Eventually they make the proof of concept ready for field demonstration. Capstone projects go through intense reviews 3 times during the year by external entrepreneurs as judges.

Students learn building value proposition, through their novel products and learn the challenges associated with it. It teaches how important it is to keep the customer at the centre while making business decisions. It is an experiential learning where in they get to interact with mentors and technology guides to solve the problem undertaken. Butterfly progression over the 3 years is given in Table No. 2.

BUTTERFLY	2012	2013	2014	2015
	7 teams	12 teams	13 teams	14 teams
	37 students	49 students	53 students	51 students
	0 startups	0 startups	2 startups	In progress

Table No. 2 – Butterfly activities over the years

6.4 Product Design and Realization- (PDR) Summer term course

Product design and building is a complex process requiring cross-functional teams from design, manufacturing, financing, marketing and many more. PDR as head start course provides an opportunity for the students to experience the complete product design and realization process, working in teams comprising of students from different disciplines of engineering.

PDR essentially intends to achieve two things – first is, to collaborate with engineers from other disciplines to achieve a common goal, second is, to understand the design/product hand off stages between various development phases.

6.5 Global Immersion in Innovation and Entrepreneurship: This is a multi-disciplinary and multi-cultural team activity, where in students from University of Massachusetts and BVB Hubli come together to build a business model for a chosen technology solution. The two week residential course emphasizes on literature survey, global business standards and regulations, competition evaluation, financial and market viability of the chosen solution. Students develop a business model and eventually pitch it to an external jury panel. Teams comprises of students from engineering, business, economics, health sciences and nursing. Since 2014 the emphasis of this program is on a multi-nation experience, wherein students from Japan, China, Thailand and Guyana, US and India have taken part. Till date over 150 students from BVB have graduated out and remarkably many have started their ventures at BVB

Student Exchange Program with University of Mass. USA	2014 January at Hubli	2014 June at UMass Lowell, USA	2015 January at Hubli	2015 June at UMass Lowell, USA
	30 BVB + 9 US	14 BVB + 16 US	33 BVB + 17 US	17 BVB, 14 US, 5 Japan, 5 China, 4 Thailand, 2 Guyana

Table no. 3. – Student Exchange Program participation details.

7. Impact of Technology Incubation at BVB College:

Since its inception in 2012, CTIE has undertaken some nascent entrepreneurship initiatives that have shown great promises. The incubator has 34 companies and has created over 230 jobs at Hubli. CTIE has now given away over 18,000 sqft of incubation space at absolutely no cost to the participating companies. Noteworthy aspect of these incubating companies is that 23% of them are started by students and recent graduates.

LabInApp – an educational software product company has recently been the recipient of Rs. 1 crore funding from Unitus Seed Fund and is first of its kind in North Karnataka. This start-up with four fresh engineering graduates of BVB utilized their expertise in Image processing to develop a real-time animation engine to deliver laboratory setup on demand for school students.

Kooki consumer Electronics Company which was started by an electronics and communication graduate of BVB of 2012, is now valued at over Rs. 3.5 crores. Kooki caters to security systems for automobiles using smart phones. In another successful venture story, HiWi communications a mobility based geriatrics health care company recently garnered VC funding of over AUS\$15 million.

Women entrepreneurs aren't much behind in these exciting times on campus. 3 companies at CTIE are co-founded by women thus becoming role models for women engineers graduating from BVB College.

In some of the initiatives like PUPA, Ideation camps and Butterfly, average women student participation is now more than 40% and the overall registrations have been consistently going up since their inception.

8. Conclusions:

The Entrepreneurship initiatives at BVB College, with both credit and Non-credit courses in technology entrepreneurship have really changed the entrepreneurial landscape of Hubli City. The outcomes are impressive in both quality and quantity. BVB campus now has a changed culture where in students are willing to come forward to experience entrepreneurship on campus. They have also realized the connection between entrepreneurial thinking and its implications in successfully getting placed on

campus. This culture has helped in creating technology entrepreneurship with a growth rate of over 700% in just 40 months. The growth of start-ups is depicted in Fig 3 below. CTIE had 4 companies in 2011 and by middle of 2015, it reached 34, an increase of over 700%.

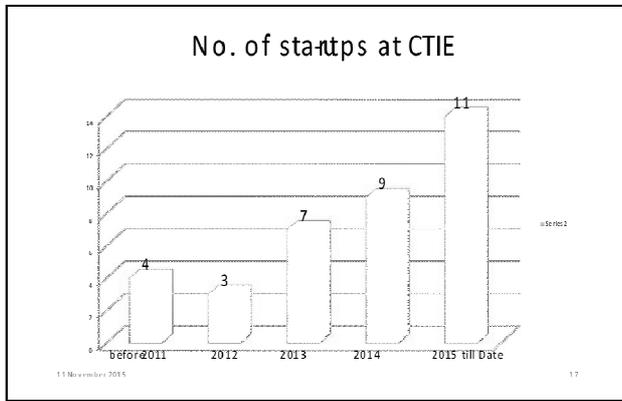


Fig No. 3. CTIE yearly start-ups since 2011.

There is increased awareness of the potential benefits and opportunities from Technology Commercialization. The new start-up culture is enhancing the effectiveness of entrepreneurship education given on campus as students could relate classroom learning with activities happening outside of the classrooms. All these successes point to the fact that, entrepreneurship skills can be learnt and acquired through well designed entrepreneurship program. Integrating Entrepreneurship education not only results in tech start-ups, but also promotes entrepreneurial culture and attitudes in established organizations. With their creative product and technology ideas, engineers can be excellent sources of high growth potential entrepreneurial ventures. By creating an environment that fosters entrepreneurship, this resource of engineering entrepreneurial creativity can be tapped to build investable start-ups that have a positive impact on the local / national economy.

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