

## I5 Framework: Institutions-Industries-Interactions Innovations-Incubators for Strengthening Start-up Ecosystem in Higher Education Institutions

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**Abstract**—In Higher Education Institutions (HEI), we understand the need for academia and industry interaction. However, there is a requirement for continuous improvement. Moving from the outdated exchange of funding for research to forming long-term tactical partnerships with incubators and innovation activities in academic institutions is essential. This study aims to explore and design an I5 framework to strengthen the entrepreneurial ecosystem in higher education institutions. This work boosts the existing literature and awareness of the higher education strategy in India. Furthermore, it harnesses the innovation and incubation culture in the institutions by interacting closely with the industries through the proposed I5 framework. The authors mainly proposed a conceptual framework to address the need for Institutions to get involved proactively with enable and empower stakeholders from the idea stage to the product stage and further to create their own venture.

**Keywords**—intellectual property rights (IPR), innovations, spin-off companies, incubation, university-academia, firm, transfer of technology, university-industry relations.

### 1 Introduction

Due to population expansion, India's higher education system is a vital sector. The sustainable growth of higher education is planned by both the federal government and state governments. As indicated in Figure 1 (The future of Indian Higher Education [2]), the expectations can only be met if the educated workforce is advanced towards a world economy with an interdisciplinary approach. The universities are divided into schools with disciplinary themes, where they emphasize the value of connections across academic disciplines and international collaboration. This research work focus on creating an ecosystem with a conceptualized framework to address the need for Institutions to get involved proactively with enable and empower stakeholders from the idea stage to the product stage and further to create their own venture [6, 18].

### 1.1 Understanding the existing indian system of higher education

Many distinct universities and colleges in India make up its vast and intricate higher education system. There are 49964 institutions, divided into 903 universities, 10011 freestanding institutes, and 39050 colleges, according to the annual All India audit of higher education [8]. There are 36.6 million students enrolled in higher education globally, with a gross enrollment ratio (GER) of 25.8%. The undergraduate program (29.06 million) has a large student body, with a dispersed enrollment in each faculty of study as follows: arts & humanities (36.4%), science (17.1%), engineering & commerce (14.1%), and then a similar percentage in each of these fields. Higher secondary schools have a GER of 62.5%, and over 13.5 million pupils are enrolled each year. With a 7% acknowledged increase over the previous ten years, the nation is anticipated to fulfill higher education GER by 2020 by a factor of 30%. However, some highly competent high school students struggle to enroll in higher education [7]. In the upcoming years, the number of students enrolled in tertiary education will increase by five times, and institutional capacity will increase by three times [8]. The goal during such multifold expansion is to reduce the current problems and reframe them as possibilities.

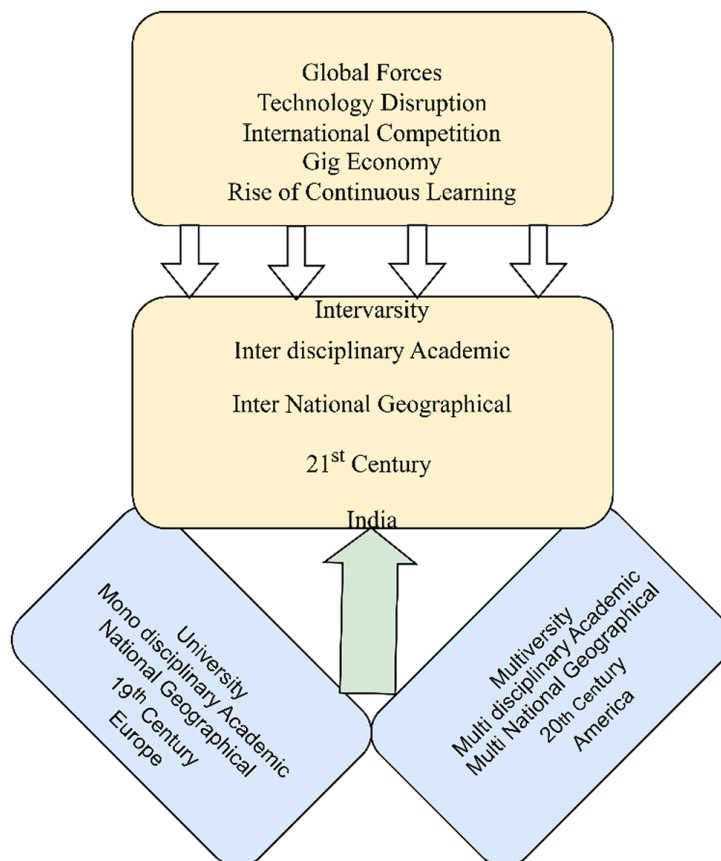


Fig. 1. The predicted peak of indian higher education in the 21st century [2]

There are 60.48% and 47% of colleges and universities in the rural region. But the enrollment ratio between rural and urban populations differs significantly. Due to familial conditions and a lack of assistance, dropout rates are particularly high in rural areas. Due to a lack of qualified teachers, inadequate facilities, and insufficient money, the majority of rural institutions likewise struggled to provide high-quality higher education. In addition, there is a significant gender gap as well as one between rural and urban communities. According to the 2018 human development index report, the nation is improving in terms of education. However, women's empowerment is heavily concentrated because of the gender development index's slow progress. Additionally, public spending on socioeconomic development, notably in education, has to be increased. The reservation policies increase community involvement but call for further focus to promote equitable growth.

### **1.2 Gig economy demands towards development of skills in higher education**

The need for technical courses has risen in recent decades due to the information technology boom. The supply-demand gap and the low employability of qualified students, however, are reversing the trend and leaving open positions in technical education. No field is self-contained, hence the gig economy business demands a mix of domain expertise in science, technology, social science, analytics, and finance (New Vision for Education [24]), as depicted in Figure 2. Interdisciplinary courses with flexible choice-based options are offered by prominent universities all around the world.

### **1.3 Institution research works and industry collaborations for community development**

With a knowledge-based workforce, the nation aspires to dominate the global economy, yet a meager 0.5% enrollment in research would not be adequate [1]. This significantly influences many things, such as inventions, high-quality instruction, and socioeconomic progress. India's poor performance in higher education is seen as the result of its exclusion from the top international rankings [8]. The partnership between academics and industry is relatively small, and maintaining a future-focused curriculum is challenging. However, as seen in Figure 3, the connection between academia and industry research has unique advantages in guaranteeing high-quality instruction, producing industry-ready professionals, and providing research discoveries to support community growth [12].

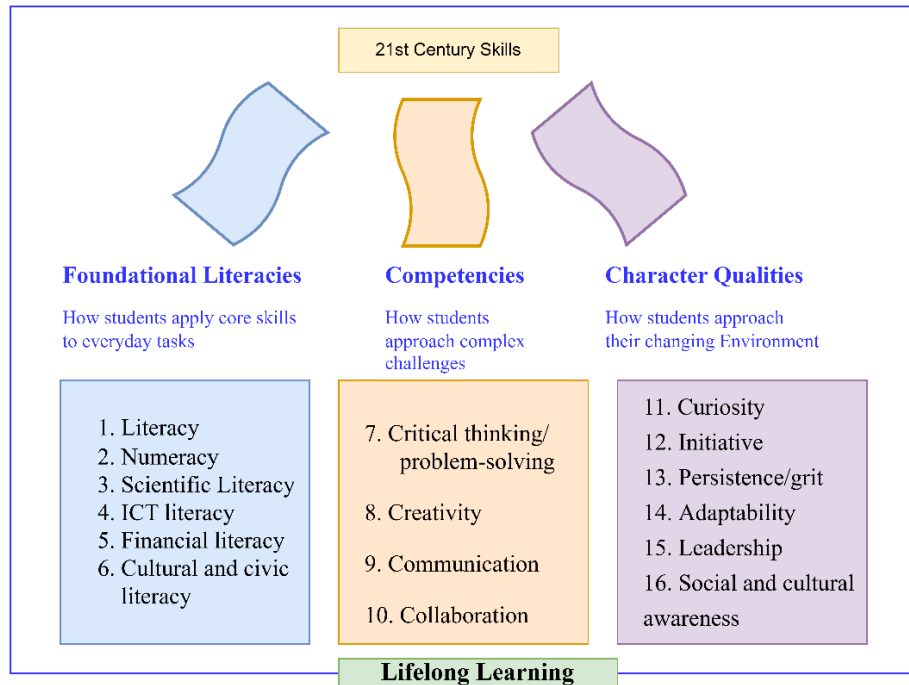
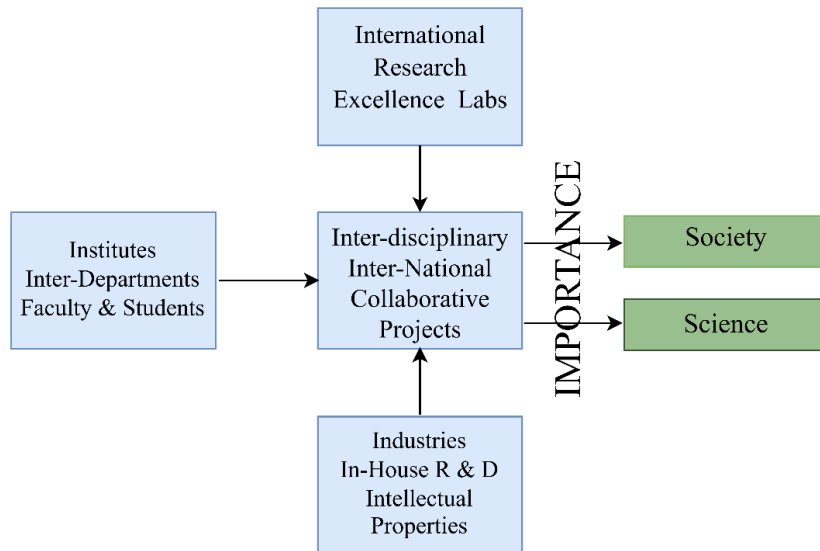


Fig. 2. Twenty-First-century economy skill [24]

#### 1.4 Exploring foreign collaborations and student mobility programs and aligning with native system

According to [8], there are much more Indian students leaving the country (553440) than international students studying in India (46,144) from nearby third-world nations. Most departures are for postgraduate programs, which raises serious concerns about brain emigration and income loss. Higher education quality, admissions policy changes, and administrative procedures all require significant attention if we are to draw in international nationals. Only top-ranked colleges are granted authorization to establish new foreign institutions and branch campuses [2]. Additionally, it is debatable whether private institutions should be allowed when foreign for-profit organizations are not. Some reputable international schools work with Indian partners to provide semester-abroad programs since the potential development has not gone unrecognized [8].



**Fig. 3.** The significance of the collaboration between industry, institute, and international research [5]

The recent new initiatives in Indian HEI's are welcomed but to be geared at accelerated rate in implementation. Higher education system is changing rapidly worldwide to meet the global industry needs. Human capital is only the way to compete with global standards and needs. The presence of vast challenges insists to carefully choose the proven strategies that lead to real and lasting results for success pathway. The study of rapid change in global requirements, issues and opportunities of higher education in India would help us to take necessary steps to face modern, competitive economy [12]. With strong foundations from government, public, private and international (GPPI) supports, The five pillars supporting youth empowerment—education, excellence, employment, entrepreneurship, and export—will be built upon solid foundations from government, public, private, and international (GPPI) assistance, as depicted in Figure 4.

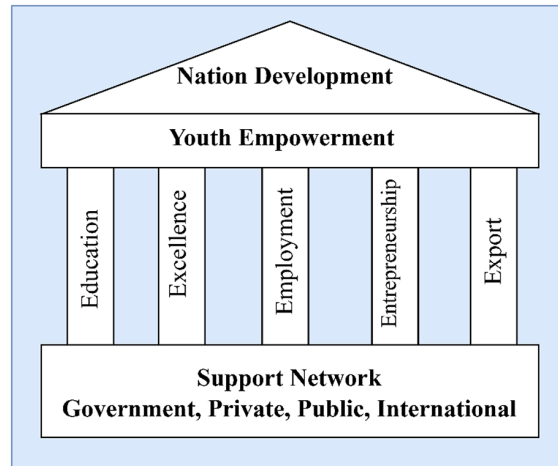


Fig. 4. Youth empowerment through the 5Es and the GPPI network: nation building [12]

Academia and industry are two vital foundations of our economy. A strong collaboration between the two will speak well for our economy’s growth through promoting innovation, expanding the education system, and creating a prepared workforce for the future. It’s time to establish a supportive environment where business and academia can collaborate [9]. Large corporations are beginning to see the significance and are increasing the number of research-based projects. The Prime Minister’s Fellowship Program for Doctorate Research and many other government initiatives like Start-up India would also help bridge this gap and encourage it across industries and sectors.

The German pharmaceutical company Bayer established links with colleges in the late 19th century [23]. Likewise, the US National Research Council brought together industry experts and academic researchers to support the war effort during World War I [2]. Such alliances, meanwhile, weren’t widespread. Today, developing more and more partnerships is essential to any economy due to the increasing impact of knowledge on economic improvement.

Due to globalization and the pressure of international competition, boundaries between countries, institutions, and disciplines are dissolving due to globalization and the pressure of international competition, creating an uneven knowledge production system that is becoming increasingly global [25]. A nation’s ability to mobilize and use knowledge-intensive resources is becoming an increasingly significant component in determining that nation’s success. Regions that want to compete more successfully in a global economy must develop soft structures that encourage knowledge production and permit businesses to increase a region’s potential for innovation [6]. Policymakers in industrialized nations began to establish rules and regulations controlling the use of intellectual property to facilitate the contribution of a national university system to industrial innovation (Mowery, 2010). This regional development strategy necessitates a trustworthy environment, claims Cairney [6]. In the current knowledge-based economy, universities look for new and cutting-edge research to benefit society and humanity. A sustained and successful research output requires funding and partnerships.

Collaboration also creates more job prospects for recent graduates and gives students and universities a chance to find solutions to real-world issues. One of the main motives for colleges working with businesses is fundraising since business money is more accessible than state funding. Fundamentally, a university must see businesses as collaborators in its goal to do research and educate students, not just as a potential source of more funding. It requires developing a strategic collaboration between business and academics based on shared needs and work flexibility. On the other hand, businesses must contend with fierce competition and swiftly adjust to a changing climate due to rapid technological improvements. They have realized for some time now that effective innovation cannot be done just through internal R&D. (R&D). Companies may access a virtually endless pool of skills and abilities by collaborating with colleges. With access to highly trained students, professors, facilities, and cutting-edge technology, universities may be seen as crucial partners for local businesses. Partnerships may assist commercial enterprises to improve their standing and image [26]. Universities must have the flexibility and capacity to take a more significant part in global knowledge creation if they define their place in the national economy. Universities used to be places where only a chosen few went to learn. It had been transferred to isolated populations and kept. Universities have the potential to be significant growth drivers by training individuals with excellent research skills and by commercializing and putting new information to use to improve wealth and quality of life [27]. Therefore, an integrated innovation system of research institutes, universities, and companies/industries is required.

According to data from the World Economic Forum, knowledge and technological innovation will be primary drivers of an area's economic growth if its average per-capita income is over 9000 US dollars. Small- and medium-sized firms (SMEs) comprise about 98% of all businesses in Taiwan and are crucial to the country's sustained economic growth. Nevertheless, few of these SMEs have formed research and development (R&D) departments due to a lack of funding. Universities in Taiwan now hold more than 70% of the country's R & D resources and have evolved into cutting-edge research and development centers. Original and ground-breaking concepts, inventions, and breakthroughs are routinely transferred from universities into commercial applications through university-industry partnerships, which support the development of an entrepreneurial economy.

## **2 Focus on academic innovation and incubation**

There are many intelligent, imaginative people in colleges and institutions. The difficulty lies in channeling this inventiveness and vitality to foster an innovative culture. College and university administrators must support this creative culture on their campuses. Leaders should maintain the following areas to encourage creativity:

- a) Recognizing and rewarding innovation, even when it is unsuccessful.
- b) Raising awareness of design for innovation techniques and educating teachers and staff on them.
- c) Supporting cross-disciplinary teams to find solutions to issues.
- d) Clearly stating the issues that need to be solved.

- e) Recognizing consumer attitudes (students).
- f) Allotting time for unscheduled activities.
- g) Too many rules are relaxed.
- h) Exercise open-minded listening
- i) Supporting the creation of prototypes.

These methods are both straightforward and intricate. This requires new ways of thinking for certain managers, yet it also requires them to let go, which may be challenging.

Transforming faculty from providing outstanding students to a model that drives innovation, helping businesses transform while creating innovative new companies. We need to develop resources at the university that can deliver POC (proof of concept) research that leads to innovations. We propose a set of simple and transparent principles that will help participants navigate the complex environment of academia-business relations [11] and transfer of academic IPs, as shown in Figure 5. In this way, we can strengthen Institution Industry Interactions through Academic Innovations and Incubators.

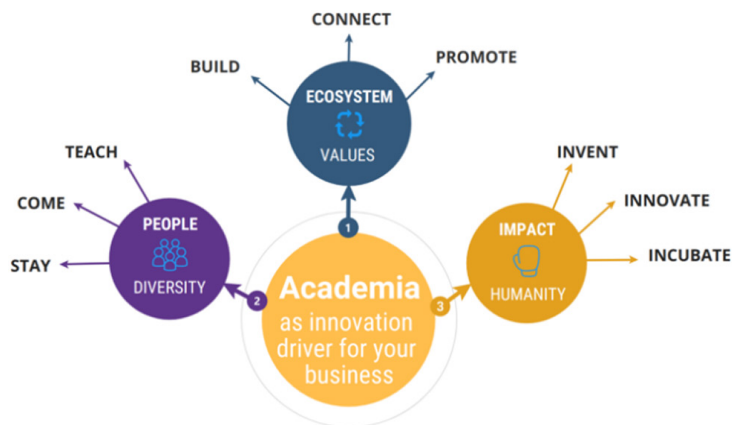


Fig. 5. Academia as an innovation driver [10]

- **Ecosystem bootstrap and maintenance (build):** building an innovation ecosystem includes awareness sessions for students, faculty development programs, events like competitions, quizzes, etc.
- **Connecting to the right business partners (connect):** the essential element is connecting with the right stakeholders for effective and mutual growth.
- **Promotion of research and transfer capabilities (promote):** all higher education institutions have to work on core research areas and encourage by suitable incentives, awards, and rewards
- **Values:** the ecosystem consists of stakeholders with ethics and moral values towards achieving common goals.
- **Capacity building (PEOPLE):** Human resources being the critical element, training and empowering people should be the primary activity.



- **Educating students and staff towards delivery for companies and commercialization (TEACH):** Empowering students can be done through teaching by faculty.
- **Attracting talents and senior experts (COME):** young minds with new and experienced seniors contribute immensely to the ecosystem; hence, we always need to welcome them and stay connected to build the system.
- **Retention and systematic development of research capacities (STAY):** Staying connected with the R&D team and talent retention is crucial.
- **Diversity:** Diversified involvement brings in various thoughts.

Impact on business and society IMPACT, supporting fundamental research leading to applications INVENT and cultivating scalable research outcomes and startup (INCUBATE), making academia and companies innovate together to scale.

### 3 I5 Framework: Institutions-industries-interactions-innovations-incubators

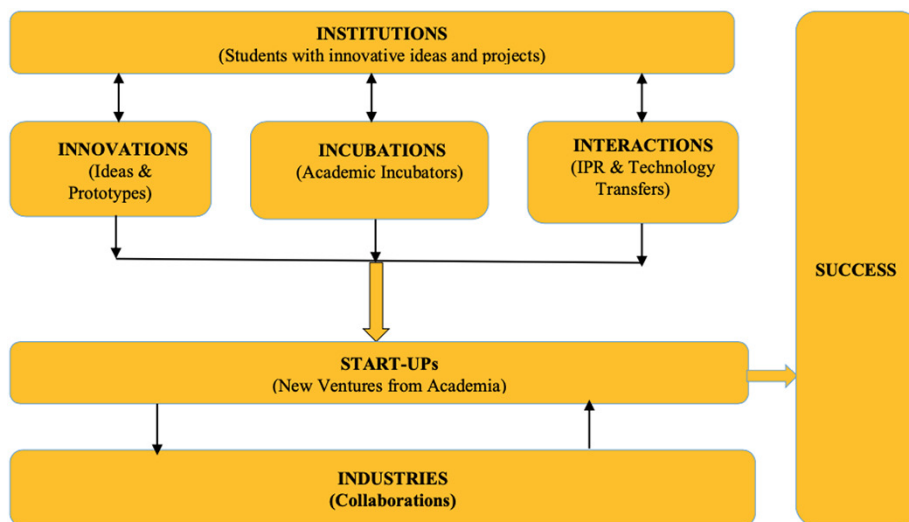


Fig. 6. Proposed I5 Framework

The I5 framework is strategically designed by connecting with all a university's stakeholders to build an entrepreneurial ecosystem and economy through Industries, as shown in Figure 6. The primary stakeholders of any university include students, and all students are subjected to academic projects. Innovative projects are to be selected based on their novelty, feasibility, and social relevancy. These creative projects are to be encouraged to get incubated at an incubator. Incubators support [4] innovative ideas to convert to startup facilities are depicted in Figure 7. Let us consider a case study of REVA NEST, a Technology Business Incubator. REVA NEST is an innovative platform that enables startups to grow from idea to go-to-market, by providing them with

world-class incubation facilities, with experienced industry professionals as mentors, fund support and subsidized costs. Established at the REVA University campus aims to build the entrepreneurial ecosystem by empowering and nurturing student start-ups and incubating innovative technology-based start-ups. The University faculty members and industry mentors associated with REVA NEST advise incubated companies on Technology Product Development, Patenting, Commercialization, Marketing, Business Set up and Operations, and Human Resource Sourcing and Development. REVA NEST has access to universities full equipped state of art Centre of Excellence in the sector of Electronics and Communication, Design & Manufacturing, Construction and Biotechnology. It offers a Creative and Innovative program for aspiring entrepreneurs in the thrust areas of the Internet of Things (IoT), Electronic System Design and Manufacturing (ESDM), Robotics & Intelligent Systems, Clean Energy, Art and Design.

### 3.1 Ecosystem enablers: Institution and industry partnerships through incubation facilities

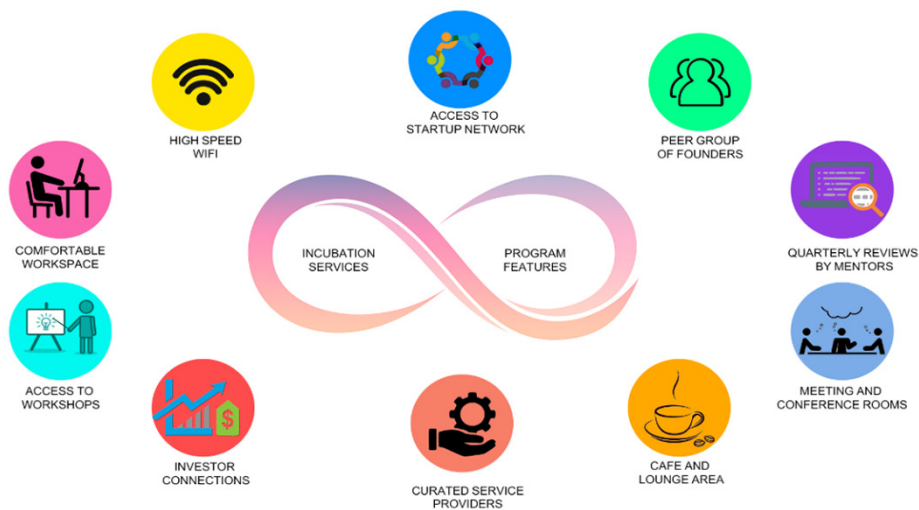


Fig. 7. Various facilities provided by incubation (Source REVANEST [22])

By supporting and encouraging student startups and incubating cutting-edge technology-based startups, we at REVA NEST, a technology business incubator founded on the REVA University campus, hope to strengthen the entrepreneurial ecosystem. Additionally, REVA NEST’s industry mentors and university academic members guide incubator firms on technology product development, patenting, commercialization, marketing, business setup and operations, and sourcing and developing human resources, as shown in Figure 8.

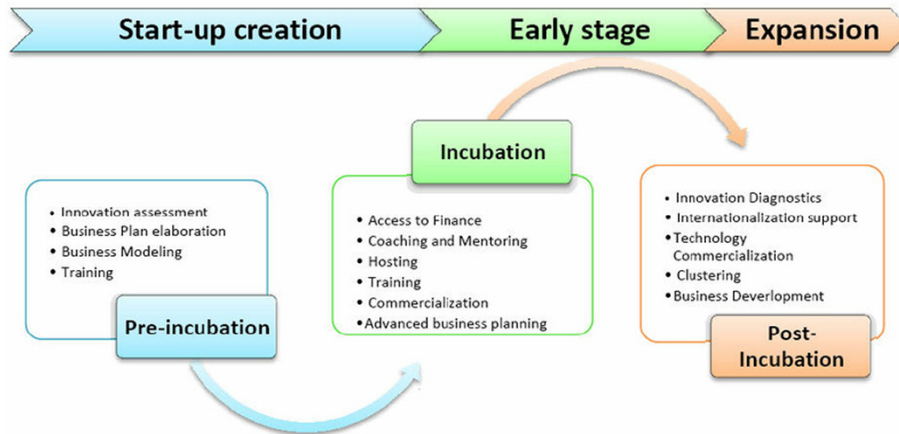


Fig. 8. The three-stage process for business incubation [5]

The Ministry of Science and Technology of India’s Central and State Governments has recognized REVA NEST TBI. As a result, universities with state-of-the-art Centers of Excellence in electronics and communication, design and manufacturing, construction, and biotechnology are accessible to REVA NEST. Additionally, it provides prospective entrepreneurs with a Creative and Innovative curriculum in the focus areas of the Internet of Things (IoT), Electronic System Design and Manufacturing (ESDM), Robotics & Intelligent Systems, Clean Energy, Art, and Design.

### 3.2 Innovation management

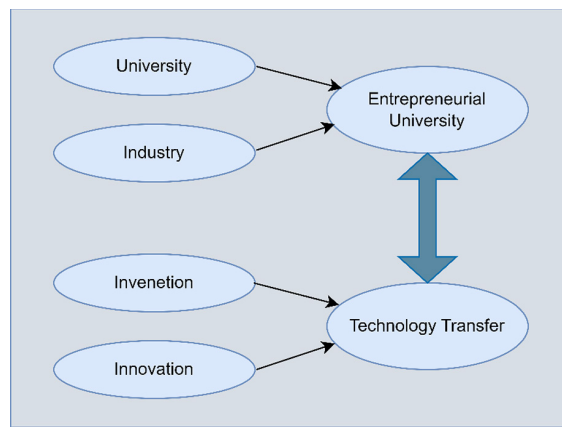
There are a lot of intelligent, creative people in colleges and institutions. The difficulty is channeling such intellect and creative drive [3] to create an innovative culture. If higher education institutions succeed, their administrators must promote a culture of creativity on their campuses. To foster creativity, leaders should support the following behaviors:

- a) Rewarding innovation, even if it fails;
- b) Training faculty and staff in Design for Innovation techniques;
- c) Fostering cross-departmental teams to solve problems;
- d) Clearly defining problems that must be addressed;
- e) Understanding your customers (students);
- f) Providing time for unstructured time;
- g) Not imposing too many rules;
- h) Listening with an open mind;
- i) Encouraging prototypes; and,
- j) Using data and observation.

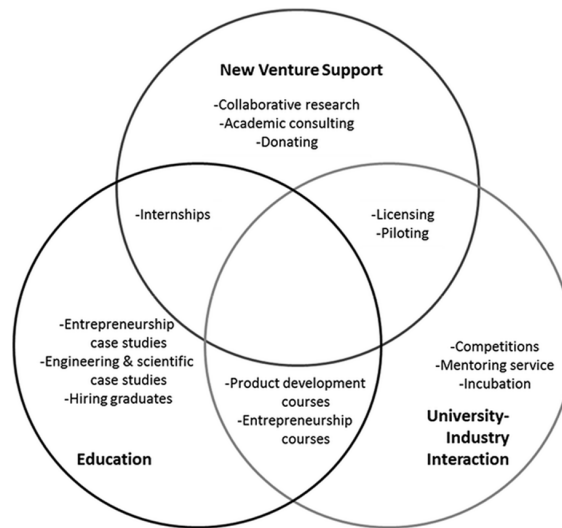
These methods are both straightforward and intricate at the same time. Some managers must change their ways of thinking, while others must let go, which can be challenging.

### 3.3 Interactions (intellectual property rights [2] and technology/knowledge transfer)

The ability to innovate in technology requires in-depth expertise. Therefore, the university's role is crucial to ensuring that the idea is fully developed and prepared for production when it reaches the industry. Although it can be viewed as a straightforward exchange, a technique transfer, or even a change of ownership, technology transfer (TT), which is a component of the technological diffusion that Schumpeter included in the innovation trilogy (invention, innovation, and diffusion), is referred to as a process, which is an important definition to guide some concepts as shown in Figure 9.



(a)



(b)

Fig. 9. (a) Technology development, transfer, and (b) University start-up interactions ([13, 14, 17])

#### 4 Case study: Electric vehicle startup – Evon Pvt. Ltd

REVA NEST-TBI opted for the I-5 framework and found it very useful and effective. TBI was applied and validated through one of the applicants of TBI. The case study is about the Electric vehicle- EV startup, where we all agree that EV is expected to be the future of the automobile industry. The start-up named EVon is presented here. Student Innovation from academic project converted into a service-based electric vehicle company. The founder and team participated in an ideation contest conducted by HEI. They got selected for the pre-incubation and incubation progress at the Incubator of the university situated within the campus. They were supported with nine-month seed funds, mentoring, and business development training.

Further, they were assisted and guided with B-plan and registration process. EVon is an application to redefine technological solutions for tracking and analyzing electric charging stations. Founders want to connect the application with home chargers for charging individual EVs. The unique idea is to provide users who own an EV home charger to lend their chargers to users willing to use the chargers. EVon services include: i) home charger: ii) providing EV owners to establish an EV charging station with zero investment. Further planning to increase charging stations across the cities. The second service is tracking all EV chargers. The third service is to recommend a nearby charging station. Easy Installation and payment are the fourth services of the application. The solution provided by the startup EVon is expected to boost the EV automobile market. In this way, we can see the success of the EVon, where the I5 framework was considered indirectly—*Institution* backed up their idea, *Industries* partnered with them, several *Interaction* with different stakeholders, their *Innovative* ideas were executed at an *Incubation* center. In this way, if the HEIs can focus on I5 framework, we can see the massive success of HEIs and startups. By efficiently assigning the necessary virtual resources [15, 16, 19, 20, 21], the current work can be extended to Cloud Computing apps by allowing massive data processing and numerous users to access it.

#### 5 Conclusions

The study was aimed at the I5 framework for Higher Education Institutions [7]. HEIs can benefit in many ways from this interaction with the industry. The review explained how an academic project could be converted into a startup and systematically scaled to Industry. Initially, creating awareness of innovation and entrepreneurship is the critical activity in HEIs. Teachers need to get empowered through faculty development programs and workshops to build the workforce by training students to make the ecosystem. Faculty Innovation ambassadors are responsible for harnessing innovative works and projects and mentoring them through incubation. The incubation process holds aspiring entrepreneurs from the idea stage to the startup stage. Mentors have to ensure that idea is well protected by filing intellectual copyrights. Timely reviews and feedback during the incubation phase are crucial for the growth of startups. With a matured product with IP, one can venture into the startup and explore to seek acceleration support and technology transfer to niche industries. The I5 framework for HEI shall ensure a robust start-up ecosystem on the campus. Adopting the I5 architecture would guarantee that the Indian economy would grow in the international

market and that our country would quickly become a developed one. The five pillars of youth empowerment—education, excellence, employment, entrepreneurship, and export—shall be built upon with a firm foundation from Government, Public, Private, and International (GPPI) assistance, resulting in necessary nation-building in the following decades. Future research is planned to evaluate the framework with multiple case studies and stakeholders.

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