

# A Criteria Catalog of Innovation Facilities at Higher Education Institutes: An Observational Approach

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## Abstract

The present paper deals with designing a criteria catalog for the definition and characterization of academic innovation facilities established within premises of higher education institutes. The in-depth content analysis of available scientific literature on the topic and web description of existing innovation facilities from their official websites is carried out following a purposive observational approach. As a result, a criteria catalog of 12 aspects including 6 functional and 6 structural aspects along with their possible field configurations is devised and proposed herein. The proposed catalog should assist in defining a particular innovation facility in more standardized manner and thereby serve as a guideline for planning and establishing new academic innovation facilities. The catalog should also enable to cross-compare and distinguish multiple innovation facilities across different geographies in order to reveal their relative strengths and weaknesses.

**Keywords:** Academic entrepreneurship; Innovation facilities; Incubation centers; Higher education institutes; Criteria catalog; Innovation teaching and ecosystem.

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## 1. Introduction

In recent years, Higher Education Institutes (HEIs) such as universities are in transition. Previously HEIs were characterized by two functionalities; i.e. education and research. Lately, however, another functionality being considered integral to HEIs is the academic entrepreneurship

and innovation (Jahangir et al., 2014). Academic entrepreneurship refers to the facilitation and fostering of entrepreneurial activities of students and faculty by the HEIs within the academic context as an attempt to address the changes in the global arena that calls for the integration of industry, government, and academia in national innovation systems (Etzkowitz & Leydesdorff, 2000). This orientation of universities towards becoming entrepreneurial organizations and engaging in a Triple Helix (university-industry-government) environment, is being nurtured by the external influences in the form of explicit policies from government aiming at increasing universities' responsibilities in ensuring the proper communication and commercialization of research outcomes and also the internal development within universities intending to facilitate their academics and students to utilize academic learning in practical ways with the support of academic experts (Clauss et al., 2018). It is believed that in order to prepare the students to face modern challenges with success and better compete in labor market, HEIs need to offer relevant and updated curricula with strong focus on critical thinking, creativity, flexibility, and entrepreneurship and vocational training (Aguilar-Santelises et al., 2015). This vocational orientation of academic activities prompts the HEIs to adopt a strategy for teaching-learning process that ensures the students' access to knowledge and skills for lifelong learning that include the core generic skills, skills for personal development, and specific skills for their integration in work environment (Roger-Monzó et al., 2015). Furthermore, HEIs have to ensure that the students are able to recognize and apply the acquired skills in professional field adequately and in an efficient manner (Canzer, 1997). The basic premise underlying the academic entrepreneurship and innovation is that the HEIs conduct wide range of research activities and some of research results have high potential of commercialization. Academic entrepreneurship and innovation enable the utilization of such potential research results and flourishing of new ideas produced by the faculty and students of HEIs leading towards their commercialization in the market as a contribution in the socio-economic development of the communities (Salamzadeh et al., 2011). By doing so, HEIs promote new startups, introduce new ways of commercialization, and prepare graduating students for recognizing and adopting self-employment opportunities (Tunio, 2020) by enabling and encouraging the close collaboration between academic coordinators and those in the associations and professional bodies (Roger-Monzó et al., 2015). Thus, the HEIs are believed to act as a catalyst for entrepreneurial activities and also as revenue-generating agents (Wood, 2011).

In order to implement academic entrepreneurship within academic environment, HEIs have adopted various approaches including the offering entrepreneurship teaching and training programs,

organizing entrepreneurial events such as idea competitions and entrepreneurship fairs, introducing the academia-industry linkages programs, and the like (Garo et al., 2015; Ndou et al., 2018). Increasingly, to promote such activities in a proper and structured manner, HEIs have started investing in organizational structures internal to the institutes (Garo et al., 2015). One prominent approach of doing so is the establishment of dedicated Innovation Facilities (IFs) within organizational boundaries. These facilities are variously termed as entrepreneurship centers, incubation centers, innovation centers, innovation laboratories, research centers, innovation units, and technology incubation centers; having a uniform objective of developing and strengthening the academic entrepreneurship ecosystem at local and national levels. These facilities are mostly not traditional or discipline-oriented departments; rather possess an interdisciplinary and transdisciplinary research scope (Dolan et al., 2019). In addition to being potential sources of research commercialization and thereby bringing economic and development benefits to the societies, such facilities are also believed to be an excellent source of revenue generation for the HEIs through donations, external project funding and grants, technology commercialization, and open academic events (Finkle et al., 2006). Realizing the importance of such entrepreneurship and innovation facilities in transforming traditional universities and HEIs into the entrepreneurial ones and their potential in alleviating the economic situation of the nations, increasingly, the government and other national innovation policy makers have also taken various initiatives of introducing, funding and supporting the establishment of such facilities (Tunio, 2020) in developed as well as in developing countries (Marques et al., 2019). These facilities at the HEIs are increasingly considered as an indispensable component of the Triple Helix initiatives and for guaranteeing the competitiveness and growth in global based economy. They are believed to promote different forms of interactions between different actors to foster economic growth, and social change and development (Marques et al., 2021).

With the increasing number of such IFs being established at universities and other HEIs, research investigating their structural and functional embodiments has also grown proportionally. However, the extant literature has remained fragmented because that the different authors have investigated the phenomenon from different perspectives. The present studies can be seen focusing on four different directions of the phenomenon. The first set of studies (e.g. Dolan et al., 2019) have focused on the exploration of the role and effectiveness of such facilities in achieving the entrepreneurial objectives of HEIs in particular and regional and national communities in general.

These studies look at the external evaluation and offer much importance in determining the functional value of such facilities. These studies, however, do not look at their internal design and further development. The second set of studies (e.g. Finkle et al., 2006; Finkle et al., 2013; Salamzadeh et al., 2011; Yıldırım & Aşkun, 2012) have focused on their financial and strategic dimensions and have explored the benefits and challenges that the HEIs encounter while establishing such facilities. The third strand of studies (e.g. Jahangir et al., 2014; Karimi et al., 2010) have focused more on policy aspects and institutional embodiments and factors that affect the establishment and success of such facilities in particular regions. These two group of studies mainly focus on structural embodiments of these facilities in terms of their external and physical factors and do not elaborate their internal and functional factors that may also influence their working and effectiveness in achieve their targeted goals. The last set of studies (e.g. Finkle et al., 2006; Ndou et al., 2018) have elaborated the stakeholders of these facilities and determined their relevant activities while participating in these academic IFs. These studies also focus on external factors of participants and do not cater the internal attributes and activities of the facilities that also play an important role. Increasingly, to the best of our knowledge, no any study has yet dealt with the phenomenon holistically and captured a complete picture of the paradigm. Consequently, research investigating innovation facilities hosted at HEIs has remained fragmented and thereby a conclusive description of their structural and functional attributes is still missing in scientific literature. In other words, it is still ambiguous that “what an innovation facility located at HEI may comprise of, how it can be structured, and what it may offer in terms of its structural and functional propositions?”

In order to address above mentioned research gap in scientific literature and offer a comprehensive description of the paradigm, the current paper aims to elaborate structural and functional manifestations of IFs located at HEIs aggregately from the available literature on the topic and the web description of existing IFs at HEIs worldwide. The main research question guiding this study is: “How an innovation facility established within HEI can be defined and characterized in its structural and functional terms?” More specifically, the study intends to discover a conclusive description of such IFs and determine: a) “What an innovation facility at HEI might structurally comprise of?” b) “What objectives an innovation facility at HEI might target to achieve?” c) “What entrepreneurial activities an innovation facility at HEI might undertake?” and d) “What functionalities and services an innovation facility at HEI might offer to its stakeholders?”

As a result, the paper offers a comprehensive conceptual framework of innovation facilities at HEIs embodying their several structural and functional key attributes together with their proper possible field configurations. The criteria catalog of IFs envisaged herein should offer several implications. Firstly, as the literature review discussed above indicated the lack of all conclusive description of such innovation facilities, the proposed catalog will fill the research gap and advance the understanding of structural and functional attribution of IFs hosted at HEIs. On the other hand, this would practically assist the HEI administrators and other policy makers in planning, initiating, and exercising the establishment of such new facilities in a standardized manner. Secondly, it will offer a criteria catalog that will help the administrators and HEIs to define a particular innovation facility in more standardized manner. Similarly, this would facilitate the cross-comparing of multiple facilities and thereby enable to uncover relative strengths and shortcomings of different IFs hosted at different HEIs. Thirdly, it will establish the reference grounds for measuring the comprehensiveness and effectiveness of particular innovation facility at HEIs and thereby reveal individual challenges that these facilities encounter while undertaking and promoting the entrepreneurial activities within academic environment.

The remainder of the paper is structured as follows. Section 2 describes the methodological approach of the study. Section 3 explains the proposed criteria catalog for the IFs established within the premises of the HEIs. Section 4 concludes the paper with an outlook to future research agenda.

## 2. Research Approach

This is a conceptual paper wherein understanding of the topic and relevant data is derived from two sources: the available scientific literature on the topic, and the description of existing academic innovation facilities from their official websites. The overall research approach is given in Figure 1.

Initially, related academic literature (in English language) was searched with relevant keywords such as ‘Entrepreneurship/Innovation/Incubation at/and HEIs/universities’, ‘entrepreneurial university’, ‘academic entrepreneurship and innovation’, ‘student entrepreneurship’, and ‘academic startup/business incubation’ using Google Scholar search engine. Subsequently, the title and abstract of searched articles were reviewed to identify relevant articles and successively full text of selected articles was retrieved. Following this, the list of URL of innovation facilities located at HEIs was

generated by searching the web with Google search engine with same keywords as used for literature search. All search hits were manually evaluated to filter out irrelevant hits and duplicate entries. Furthermore, the retrieved URLs were analyzed to identify cross-links to other such IFs. After that, the URLs were examined one by one and all relevant information was retrieved for further analysis.

Following this, the relevant literature and web description retrieved herein was analyzed following a thematic data analysis approach (Bryman, 2012) through the stages of familiarization, coding, theme generation, theme revision, themes definition, and write-up as in Ullah and Ullah (2021). As a result, the list of several structural and functional dimensions/constructs of the IFs at HEIs along with their possible field configurations (possible values) was retrieved. Finally, a criteria catalog of IFs at HEIs is constructed based on identified dimensions/constructs.

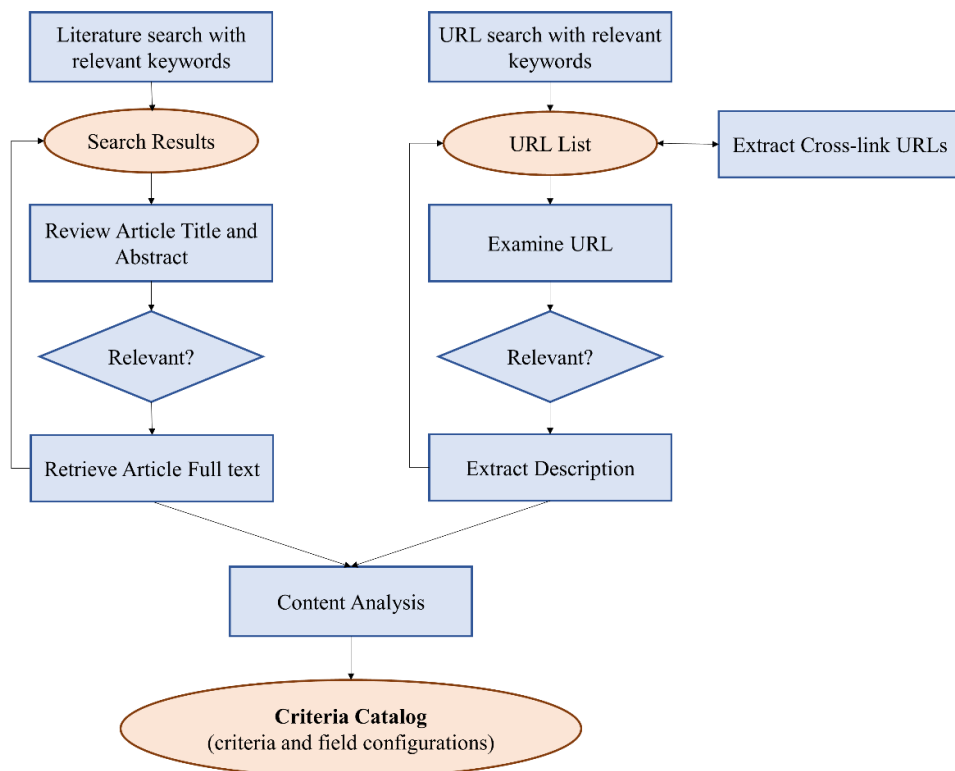


Figure 1- Research approach of the study

### 3. Criteria Catalog of Innovation Facilities at HEIs

The content analysis of existing literature and web description of existing IFs located within HEIs undertaken in this study has revealed that there are 12 essential attributes that collectively frame the definition and characterization of IFs at HEIs. The identified attributes can be distinguished between primary/functional criteria (6 attributes) and secondary/structural criteria (6 attributes). Figure 2 presents the identified attributes along with their possible field configurations. It is important to note here that whilst the field values for identified criteria are not disjoint, therefore, with respect to a particular criterion, a specific facility may qualify for more than one possible field value.

#### 3.1. Primary / Functional Criteria

The six identified functional criteria for defining and distinguishing IFs include strategic focus, service portfolio, business incubation process coverage, methodological maturity, technology integration, and success indicators.

**i. Strategic focus:** The first and most important criterion for defining a particular IF is its strategic focus. The content analysis carried out in this study shows that the IFs are aimed at achieving three strategic objectives; i.e. entrepreneurship education and research, industry linkage and networking activities, and business incubation and research commercialization. While some of IFs offer all-inclusive services ranging from entrepreneurship education and learning to the incubation and commercialization activities; the others focus only on the entrepreneurship learning and knowledge creation (Maas & Jones, 2015). It can be concluded that the most prioritized strategic focus which is integral to all AECs is the entrepreneurship education and research with the vision to encourage students' inclinations and intentions to act in an enterprising and/or entrepreneurial manner (Maas & Jones, 2017). It is believed that entrepreneurship process and capabilities can be taught to students by professional before, during, and after the commencement of entrepreneurial activities (Matlay, 2008). In this regard, the IFs are focused on designing a suitable entrepreneurship curriculum and executing and practicing the designed modules and programs (Maas & Jones, 2017). Herein, most IFs leverage combination of theoretical and practical approaches for describing the entrepreneurial challenges and business plans together with understanding of case and field studies.

Whilst, traditionally entrepreneurial education has been limited to business schools; recently it is considered as relevant for other disciplines too and viewed as an effective way to engage larger part of students (Wright et al., 2009) from the engineering, life sciences, and computer science and technology disciplines who are more inclined to produce innovations (Secundo & Passiante, 2007). In this way, IFs play twofold role of promoting entrepreneurship programs and activities, and also engaging in joint/multidisciplinary programs with other faculties and departments. In regard of entrepreneurial education, the IFs engage in different activities that could be defined as either 'educating about entrepreneurship' including the programs aimed at creativity stimulation, self-dependence and personal development, and initiative orientation and entrepreneurial mindset; as 'education for entrepreneurship' including the programs aimed at identification of business opportunities, and venture creation and being startup/entrepreneur, or as 'educating through entrepreneurship' including the programs aimed at providing abilities and skills for business survival and progress (Kirby, 2004).

The second strategic focus of IFs at HEIs could be recognized as industry linkage and networking activities. This focus is supported with the vision of the university to participate in Triple Helix alliances and to open up the pathways to its research activities and their output for the industry and government agencies. By doing so, the facilities broadens its boundaries from in-house development to the open innovation ecosystem whereby academia (faculty and students) are put in contact with industry through different networking events and activities. As a result, entrepreneurs at university gain insights on market attributes and opportunities whereas industry gain knowledge on new research and developments produced from university. One particular activity in this regard are the networking events that allow the students to present their ideas before interested funding agencies from government and industry and thereby acquire finance for the further development and configuration of their entrepreneurial ideas. The funding partners, often regarded as Angels, finance the entrepreneurial activities of students for developing a proof of concept of selective innovative ideas and successively adopt them to their business. The networking events organized by IFs also serve as an open platform for the academia and industry to share their knowledge, competencies, experiences, and skills with each other in order to configure new innovation projects individually as well as in collaboration with each other. IFs, also organize various internal and external idea pitching and competition events that allow the students to present their ideas, solicit feedback from teachers, experts, and peers, and refine and transform them into more viable ones with higher reliability and



effectiveness. The interactions enable the expansion of networks beyond academic fields and thus the clarification of the benefits and difficulties bound up with the commercialization of research output (Fritsch & Krabel, 2012; Perkmann et al., 2013).

The third and most advanced strategic focus of IFs at HEIs is the business incubation and commercialization to get the research and the innovative products and services produced therein actually implemented in the market. In this regard, IFs in addition to organizing the networking and knowledge sharing events, also facilitate the students throughout the incubation process of their entrepreneurial ideas by providing the expert advice, tangible resources, financing opportunities, and network mediating services. In doing so, these facilitate the shared co-working spaces along with usual amenities and field specific office accessories for the students and faculty to transform their research results and innovative ideas into useful products, and also offer the financing either from internal funds on the profit sharing basis or by acquiring external funding through transfer and commercialization process with external funding agencies. Thus, the IFs supporting business incubation and commercialization process encompasses several stages including the discovery, evaluation, dissemination, and registering of research results, and then their marketing and supply to the industry through licensing and formal commercialization (Lopes et al., 2018; Siegel et al., 2004). The later may take place through oral communication of intangible research results, physical transfer of tangible products, or through an intellectual property licensing program (Parker & Zilberman, 1993).

**ii. Service Portfolio:** The second characterizing attribute of an IF is its service portfolio. As the innovation process is a multifaceted activity; supporting it in a successful and effective way requires an array of diverse services (Memon & Meyer, 2020). In this regard, all the services offered by existing IFs can be delineated in three types of services: human facilitation, resources provision, and financial support. Human facilitation in the form of teachers and experts is the most integral component of IFs. The facilitators are supposed to offer consultation, mediation, and guidance to the students throughout the innovation process with their methodological and technical expertise and skills. This enables to achieve the objectives of the facility, bring in the group/team dynamics and process management, and get most out of the innovative ideas of students and other participants. The second array of services offered by IFs is the resource provision. The existing IFs are offering a wide array of resources ranging from the availability of a creativity stimulating environment to the usual

amenities to the field specific technical tools. The dedicated physical environment offered by IFs is supposed to bring a dislocation effect and promote the out-of-the-box thinking of the participants and thereby enhance the novelty of the ideas (Lewis & Moultrie, 2005; Memon et al., 2018). Besides the dynamic and vibrant physical space, IFs offer a set of necessary tools to be dynamically configure dependent on the requirements of different innovation projects. This includes the usual work spaces along with office amenities, and the state-of-the-art technology of not only one kind but often the competing technologies for the generation, discussion, assessment, and implementation of the ideas. The combination of methodological skills available from human facilitators and cross cutting technology assists the students in assessing the potential of their ideas, predicting any future obstacles, and thus reducing the risk factor involved in the commercialization of ideas. Also, by offering access to all required resources, IFs address and alleviate the dearth of necessary resources and therefore guarantee more fruition of potential ideas in the market. The third service category offered by IFs is the financial support. In this regard, as already discussed, IFs arrange programs and events to interconnect the students with potential investors from industry and government agencies (often regarded as Angels) who provide seed money for the actual implementation and actualization of proposed ideas and then are willing to commercialize them together. The second way which the IFs financially aid the students is with the prize money through various idea competitions. In such events, students present their ideas and compete with each other to win cash prizes as well as free services or resource facilities provided by IFs. Another way the IFs offer finance to students is through loans or partnership in the selected innovation project. In this regard, IFs either generate their own funding sources or acquire grants from government and other funding agencies and invest that money in potential ideas.

**iii. Process Support:** The third functional aspect that the IFs can be characterized are the extent and scope of innovation process supported by their offered services. As discussed above, IFs are offering an array of varying services; certain services target to facilitate certain aspects of entrepreneurship and innovation process and therefore bring different functional benefits (Memon & Meyer, 2020). In this regard, while few IFs offer all-inclusive support throughout the innovation process from idea generation and evaluation to the idea implementation and commercialization. Whereas, many IFs only support a part of innovation process and thus their service portfolio can be delineated as pre incubation, incubation, and post incubation. In the context of pre-incubation services, the IFs facilitate front-end of innovation and entrepreneurship process through consultation,

moderation, and idea generation and evaluation stages. During this process, IFs offer expert advice, brainstorming sessions, and group as well as individual consultation meetings, idea generation and hatching techniques, tools, and methods, and networking events for feedback acquisition and idea refinement. As a result, such IFs leave students with a well-developed idea with strong potential of fruitful implementation whereby the rest of the process is solely relied on students. Whereas, in the context of incubation services, the IFs also support the development of proof of concept, actual implementation, and market-launch or industry handover of the resultant product/service. In this regard, IFs facilitate all required operational resources methodological skills and expert advice, tangible resources (office space, raw material, and technological tools, etc.) and finance. Herein, the students and IF moderators (teachers and administrators) collectively develop the actual innovation prototype, present to potential partners, and get it actually implemented in the market. Once, the product/service is implemented in the market as a startup business by the students or in collaboration with an established business, the IFs are no more part of it and students manage it further and carry on their business on their own. In the end, some IFs support innovation process even beyond the commercialization. In doing so, IFs remain in long-term contact with students (mostly while investing in said business on partnership basis) and also engage in the evaluation of offered innovation in the market, soliciting user feedback, and supporting continuous improvement of product or service based on user feedback and changes in market.

**iv. Methodological Maturity:** The fourth functional aspect characterizing the IFs at HEIs is the maturity level of their methodological approaches that they apply in intermediating innovation process. As innovation process is not a defined process and thus every project has its own requirements and procedures, there is no any single methodology used by all IFs in assisting their students through the innovation process. Furthermore, the intermediation process for the successful innovation development is dependent on several factors such as target market and customer community, involved stakeholders, nature of innovation, time frames for development and commercialization, etc. Therefore, in terms of methodological approaches levied by IFs in different projects, they can be either defined as IFs with fixed methodology, varying methodologies, or no defined methodology. The IFs working with a single fixed and very well defined methodological approach are very rare; yet examples exist who adopt same methodological approach in all projects. They usually have their own theoretical or practical methods developed as a result of their own research which they find most handy and effective in undertaking activities that they are engaged in.

The structure and undertaking of such an approach is very standardized and always disclosed to all involved parties and to the public. The other IFs can be defined as IFs with varying methodological approaches. This group of IFs can be regarded as most advanced ones with respect to this particular criteria because they have availability and command over several possible methodological approaches. They have understanding of several existing methodologies that can be applied to a particular situation for accomplishing a particular task and always adopt the most suitable one for a particular project depending on its nature and requirements, and suitability with and preference of the students and other stakeholders who have to work with it. Yet another group of IFs exist who have no defined methodology. These IFs are very much in inception stage and have not devised or decided any particular methodological approach. They always adopt varying approaches on ad hoc and trial basis and often apply more than one to the same task simultaneously.

**v. Technology Integration:** The fifth functional aspect characterizing the IFs at HEIs is the maturity level of their technology adoption and integration in achieving their goals. In this regard, the level of technology integration can be considered as low if the IF only works with basic usual technological tools and applications for digital content presentation, processing, and storage, and teaching/learning tools. Beyond this, technology integration can be recognized as medium if the IF, in addition, also leverages the technology for idea generation and evaluation, developing and simulating prototypes, and evaluating market and business plan. At the advanced level, technology integration can be regarded as high if the IF works with very specific, sophisticated, and field specific technological tools. It is important to note here that this characterization with reference to technology integration is very relative and can be identified differently in conjunction with stated goals of IF, actual activities undertaken therein, and the possible availability of relevant technological tools for various tasks. Within the present highly technology-induced era wherein more and more attention is being given to developing technological and technology enabled innovations; leveraging technology to ease the innovation development, and to ensure the effectiveness and applicability of new product or service is very much crucial. Therefore, technological maturity of IFs directly relates to and predicts the chances of successful outcome of the innovations being developed therein. Also, availability of technological tools enables to produce more viable ideas and aids in testing and developing the proof of concept of abstract ideas which are very difficult to actualize otherwise.

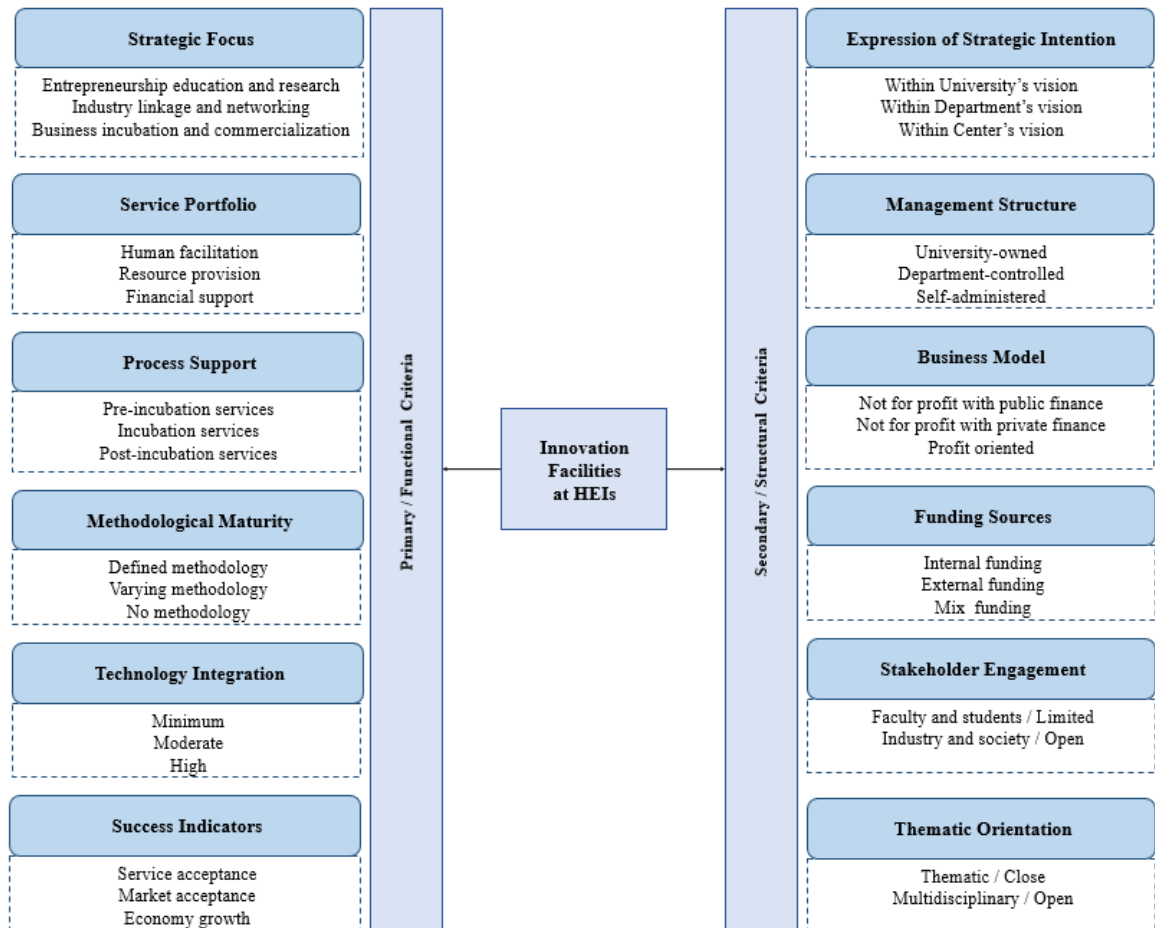


Figure 2 - Criteria catalog of Innovation Facilities at HEIs

**vi. Success Indicators:** The sixth functional aspect characterizing IFs at HEIs are the factors that IFs perceive as their success indicators. According to this criteria, IFs can be organized in three groups. The first ones are those IFs who mainly focus on providing entrepreneurial education and mentorship. These IFs consider the acceptance and attitude of their students towards the offered services as their success indicators. They assess their effectiveness in terms of students' learning and efficacy. If students are found satisfied with the knowledge and mentoring received therein, the IFs believe they are working well and achieving their defined target. The second group, in addition to students' satisfaction with their offered services, also perceive that if their mentored innovative products/services are actually implemented in the market successfully. They follow the ideas up to the launch in the market, collect market feedback, and also engage in the refinement/improvement

process iteratively until the product/service is fully accepted by the customers. These IFs measure their success in terms of the number and performance of successful innovations actually introduced in the market. The third group of IFs in this regard measures the success in broader aspect. They do not only strive to introduce the innovations in the market, but also assess how the developed innovations are generating revenue and what socio-economic growth they are bringing to the owner, region, and the nation at a larger level.

### 3.2. Secondary / Structural Criteria

The six identified structural criteria for defining and distinguishing IFs at HEIs include expression of strategic intention, management structure, business model, funding sources, thematic focus, and stakeholder engagement.

**i. Expression of strategic intention:** The first and foremost structural aspect of an IF is the Expression of strategic intention (Yıldırım & Aşkun, 2012) meaning the entrepreneurial strategy, mission and objectives that the facility is established to pursue and achieve through its dedicated innovation support activities. It has been observed that IFs are established to target entrepreneurial intentions specified at three different levels. First, the entrepreneurial objectives and motivations are encompassed within university's strategy, mission, and vision and objective/policy statement. Such HEIs target entrepreneurial achievement at larger level and are often regarded as new form of universities; the entrepreneurial universities. These IFs established to achieve university's objectives are usually university owned and mostly working in multidisciplinary fields wherein faculty and students of different academic departments are involved. At the middle level, IFs are established to streamline the achievement of mission, vision, policy and objectives of individual academic units within HEIs such as business-related departments or centers. This is the more traditional and more common form of IFs being established worldwide. These department owned IFs are mostly working on single thematic projects in alignment of thematic orientation of the owning department. At the lower and more independent level, the IFs are established with their own agenda and entrepreneurial objectives to achieve. Such IFs work independently and are often focused on multidisciplinary entrepreneurial activities.

**ii. Management structure:** The second distinguishing structural aspect of IFs is the Management structure / positioning of the facility within HEI. In this aspect, the facility can be either

owned by the university and working independent of any academic unit/department, or the facility could be embedded within an academic unit and be controlled by same administration who is responsible for taking care of the owning department. The management structure of IFs aligns with the level and type of entrepreneurial intention and objectives that the facility is established to achieve, and the overall corporate strategy of the HEI (Maas & Jones, 2015). It is observed that within department owned facilities the entrepreneurship goals of the students and faculty are pursued, while in university owned facilities the interdisciplinary projects involving people from various faculties including humanities, life sciences, engineering, and business are undertaken. On the contrary, there also exist examples of IFs which are established within HEI premises but are controlled with independent administration. Such self-administered facilities are either established with external funding/grant acquired within the context of some externally funded research/development project or are established to achieve a designated specific task and thus have a shallower, but an interdisciplinary and multidisciplinary, focus and entrepreneurial objectives.

**iii. Business model:** The third aspect that can distinguish existing IFs is their business model. It has been revealed from the content analysis that IFs are either working on a not-for profit model with public/private finance. These facilities are offering their services as part of public services for their students, faculty or society and are more focused on developing entrepreneurial skills and enabling participants in undertaking their entrepreneurial projects. The students, as part of their educational stay at HEIs, are trained and guided to transform their startup ideas into well-framed and established businesses. Typical services of such centers include credit based entrepreneurial education, idea and business plan competitions, and student internships and training programs. Whereas, the IFs might be established with profit-oriented business model whereby they, besides facilitating entrepreneurial activities of students and faculty, also sale their services to external people form industry and society in order to earn revenue that can be used to run the facility or engage in other entrepreneurial development work. Such facilities work more as business units and are not only engaged in training and teaching soft skills but also on more specialized services for the business community and often support business incubation or innovation development throughout the process. Examples of external offerings of such IFs include executive education programs, practical startup mentoring and incubation services, industry startup competitions, and paid seminar/workshops on various entrepreneurship related topics such as business planning, strategic planning and management, and fund acquisitions and utilizations.

**iv. Funding sources:** The next structural aspect that the IFs can be differentiated is their funding source. The IFs can be seen operating on internal finance provided by the HEI itself as part of its broader vision towards entrepreneurial activities. Such IFs operate under direct control of the HEI or business-related academic unit and are mostly offering their services for the students as part of their standard curriculum and teaching and training modules. On the other hand, IFs are also being operated with external finance wherein they engage in several fund raising activities and seek finance from grants, donations, and funded projects. These are the facilities which are not established by the HEIs to comprehend their overall entrepreneurial intentions, rather they are established as part of external project or as an advance step of the HEI in achieving a particular milestone without any proper budget from internal finance sources. Besides, there exist IFs which are running with share of both internal and external finance. These facilities are initially setup with internal finance from HEI and continue receiving some fixed or variable amount from internal sources, but also engage in external fund raising programs in order to support usual activities and further development and enhancement of service portfolio. According to Finkle et al. (2013), the internal fund raising activities that the IFs engage in might include idea/business plan competitions, internships/students clubs, technology parks/incubators, technology transfer and venture capital fund, and distance learning programs. While the external activities that IFs engage in to raise funds might include seminar/workshops, grants, executive education programs, entrepreneur competitions and venture capital fund, and incubators and practical entrepreneur/startup programs.

**v. Stakeholder engagement:** Another defining attribute of IFs is the stakeholder engagement. While students and faculty are basic stakeholders who are facilitated by all IFs in working on their entrepreneurial ideas and cultivating and effectively implementing them in the market. In this regard, the department owned IFs seem to be open to students of respective department only; whereas the university controlled IFs tend to be open to students and faculty of all departments and thus are mostly multidisciplinary in their thematic orientation. On the other hand, some IFs are also triggering collaborative linkages with other stakeholders that includes the industry partners, other HEIs, and also the wider user communities and regional startups from civil society. This allows such IFs to extend the impact of their activities, encompass wide array of ideas and evaluations, and thereby develop most effective product/service systems. These IFs, besides usual internal and external entrepreneurial activities, are also holding various networking events such as conferences, open idea competitions, idea or business plan fairs and exhibitions, etc.



**vi. Thematic scope:** The last structural attribute defining a particular IF is its thematic scope which refers to the domains/areas wherein it supports the entrepreneurial activities and business incubation. The IFs established within academic units seem to have specific focus related to the department that they are part of. For example, the IF established within business department concentrate towards entrepreneurship process in a general way, whereas an IF established within IT department supports the hatching and fruition of technology oriented ideas. As opposed to these department owned IFs, the IFs operating under the management of university and not any particular academic unit are more open in their scope and therefore support entrepreneurial ideas in multiple domains often described as multidisciplinary/interdisciplinary innovations.

#### 4. Conclusion

The current paper deals with the concept of innovation facilities which are increasingly being established within premises of higher education institutions in order to adopt the triple helix of industry-academia-government linkages for ensuring the proper utilization of research results of HEIs into the market. Research indicates that the existing IFs at HEIs are varying in their structure and functioning and thereby literature on the topic has explored them from different perspectives. In this regard, the objective of this paper is to offer a comprehensive criteria catalog of IFs at HEIs for understanding the paradigm in a holistic manner and enabling the comparison and differentiation of various facilities with each other.

The current paper based on the purposeful observation and review of available scientific literature on the topic and the web description of existing IFs at HEIs worldwide proposes a criteria catalog of 12 attributes (cf. Figure 2). In terms of functional manifestations, IFs can be differentiated in terms of their strategic orientation and objectives that they aim to focus, array of services they offer, stages of innovation process they support through their offered services, maturity of their methodological approaches, extent of their technology leverage, and the factors that they consider as indicators of their success. Whereas, in terms of structural manifestations, IFs can be differentiated with respect to the expression of their strategic intention that they strive to achieve, management structure, business model, funding sources, types of stakeholders who are engaged therein, and the thematic focus of innovation that they support to develop.

The proposed criteria of IFs envisaged herein offers several implications. Firstly, it will aid in understanding the overall structure and functioning of IFs hosted at HEIs and thereby help in conceptualizing and establishing new facilities at HEIs in a standardized manner. Secondly, it will help to define and assess the comprehensive and effectiveness of a particular IF and also cross-compare multiple IFs for discovering their relative strengths and shortcomings. The current paper has proposed a criteria catalog which opens research directions for further pursuit. One, empirical research on existing IFs at HEIs within and across different regions and economies might be undertaken to cross compare and thereby identify their similarities and differences. This would enable to reveal their relative strengths and shortcomings as well. Two, extended qualitative and quantitative studies may be undertaken to further explore and verify the completeness and generalizability of the proposed criteria catalog of IFs at HEIs.

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