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Engineering Technology Application and Commercialization through University-Based Business Incubator

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***Abstract*--Central Luzon's expansion affects the Philippines' economy. Industrial estates and economic zones, port facilities, effective water, power, and telecommunications infrastructure, road networks that promote cooperation between Subic, Clark, and the seven provinces' economic and tourism hubs, and a strategic location that makes transportation from the North to Manila easy. The flat terrain produces much of the Philippines' rice. Manila north. Mountains divide Zambales and Aurora from the flat interior. Central Luzon is the Philippines' industrial center and Asia Pacific's transshipment hub.**

Cabanatuan's downtown business sector was also explored. Nueva Ecija's Cabanatuan is a major Central Luzon city. Successful city enterprises build houses, businesses, and tourist attractions. Agricultural equipment, feed, fertilizer, and food manufacturers thrive in cities. Furniture and clothing companies too. Cabanatuan's universities may have software and animation labs. State institutions Since it's in northern Nueva Ecija, Central Luzon State University prioritizes agriculture. The second Cabanatuan state university is Nueva Ecija University of Science and Technology. It's a business hub. Novo Ecijanos benefit from university technologies.

Even though agriculture is Central Luzon's main industry, industrial estates and economic zones strive to industrialize it. The crew thinks agricultural equipment and machinery might help the local economy. This research examines university engineering technology transfer for commercialization.

***Index Terms*: Technology Business Incubators, Technology Transfer, Engineering Technology**

INTRODUCTION

Policymakers are increasingly acknowledging the significant geographical characteristics of entrepreneurship and innovation. The development of technology business incubation (TBI) as a ground-breaking strategy for fostering local and regional ecosystems for creative entrepreneurship over the course of the previous 50 years is noteworthy.

Technology incubators, accelerators, and scientific parks are only a few examples of efficient incubation structures that have helped to build sustainable regional ecosystems by concentrating creative entrepreneurship and grabbing policymakers' attention (Mian, 2012). Given the connection between creative entrepreneurship, competitiveness, and economic well-being, policymakers worldwide are searching for methods to increase regional economic development (Colombo and Delmastro, 2006). The establishment of a locally innovative business environment is now commonly recognized as being aided by incubation platforms. Incubation platforms are seen as key job-creating engines and resources to launch and revitalize sectors and areas as a reaction to the current economic issues facing the world (Aaboen 2009).

Non-profit organizations called business incubators help innovative start-up companies grow quickly and succeed. They provide a range of company tools and services, including as physical space, financial assistance, technology assistance, and networking opportunities. In general, collaborations between universities, businesses, and all tiers of government result in the development of technology business incubators (Etzkowitz, 2003).

Incubators help link science, technology, education, experience, entrepreneurial talent, and funding (Smilor and Gill 1986, Mian 2016). They are a component of a local ecosystem that also consists of research labs, academic institutions, industrial clusters, banks, and investors. Because of this, incubators are seen to be systems that are special in supplying essential links in the entrepreneurial value chain at the local and national levels (Phan, Siegel, and Wright, 2005). They are hybrid organizations that work with local businesses, colleges, and government agencies to promote the diffusion of technology into the local economy (Etzkowitz and Klofsten 2005).

Link and Siegel emphasize their regional importance in promoting technology-based economic development and enhancing the area's reputation, which are thought to serve as conduits for stimulating the emergence of entrepreneurship in a region (2007). A regionally integrated technology incubation mechanism has the potential to be the main means of nurturing and expanding such businesses, as entrepreneurial universities are increasingly seen as engines of knowledge-based regional economic growth through technology transfer and commercialization of research findings (Smith and Zhang 2012). Therefore, a contextual analysis of theseincubation models as components of their regional ecosystems is required to shed light on the Incubators and regional actors should communicate and interact dynamically, and their importance to regional economic development should be evaluated.

There aren't enough TBIs in the nation to support startups, small and medium-sized enterprises, and academic researchers. (PASUC, 2019). However, during the last ten years, a number of Technology Business Incubators (TBIs) have emerged in the Philippines. The Department of Science and Technology provides the majority of the funding for these TBIs at universities (DOST). 14 TBIs are funded by the DOST-Philippine Council for Industry, Energy, and Emerging Technology (PCIEERD), while 16 TBIs are supported by the DOST-Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development. This research aims to explain how these university technology business incubators function at a few state universities in Luzon, especially those that are government-funded. Additionally, this research will ascertain if TBIs are completely functional and serving their original purpose. In order to answer TBIs' issues and optimize their use to get better advantages via the creation of a strategic development plan, this research would be pertinent. It may also act as a model for other schools and state institutions who want to create their own business incubators (Armas, 2022).

The Philippines' Central Luzon area is expanding and has a large economic impact on the country. The area is home to a number of industrial estates and economic zones, as well as port facilities, effective water, power, and telecommunications infrastructure, road networks that foster cooperation between Subic, Clark, and the seven provinces' economic and tourism hubs, and a strategic location that facilitates the transportation of people, goods, and services from the North to Manila. Although there are some mountainous and foothill sections, the region is mostly flat and produces the majority of the rice marketed in the Philippines. It is located to the north of Metro Manila. Mountains divide the rather flat heartland from the coastal provinces of Zambales and Aurora. As the industrial heart of the Philippines and the Asia Pacific, a hub for international transshipment, and a showcase for a strong and vibrant agricultural sector, Central Luzon is the perfect place for investments and leisure.

Additionally, it was suggested that the business be located in the province's economic hub of Cabanatuan, downtown. A provincial or regional branch would be ideal in Cabanatuan, one of Central Luzon's main urban hubs and located in Nueva Ecija. Projects for housing, commercial buildings, and tourist destinations are a few examples of successful companies in the city. Manufacturing agribusinesses for agricultural equipment, feed, fertilizer, and food processing are also excellent candidates for urban locations. The same is true for companies that produce consumer products like clothing and furniture. Due to the many higher education institutions present, Cabanatuan may potentially host centers and other technology-related activities like software development and animation.

Two State institutions are located in Since it is located in the northern section of Nueva Ecija, where farming is the main source of income for the local people, Central Luzon State University, which is first in the province, concentrates on the agricultural sector. The Nueva Ecija University of Science and Technology is the second State University and is located in the province's capital city of Cabanatuan. It is the hub of commerce and commercialization and has access to all potential business opportunities. The University is committed to creating technologies that enhance the quality of life for Novo Ecijanos.

Central Luzon strives to be an industrialized area with centers of industrial estates and economic zones, even if farming or agriculture is the region's main industry and the main player in business. The team also sees the potential for creating tools and machinery that would facilitate farming and generate other goods that would boost the local economy.

One of the two (2) state universities situated in the province of Nueva Ecija is the Nueva Ecija University of Science and Technology. There are thirteen campuses altogether, including six satellite universities and seven extension campuses. These are thoughtfully dispersed throughout many municipalities. At NEUST, there are ten colleges, with the College of Engineering serving as the focal point. The university was able to develop many research and innovation centers because to its excellent partnerships with other governmental organizations. One of them is the Metal Innovation Center, which is situated on the Sumacab Campus and will serve as the TBI's operational hub. The DOST-MIRDC, DOST Region III, CHED, and NEUST have all contributed funding to the project. Modern equipment and facilities that are meant for both academic and research and development objectives are shown in the project. The Innovation and Technology Office (ITSO), which acts as the university's intellectual property office, is a further noteworthy undertaking. Additionally, the Intellectual Property of the Philippines and NEUST-ITSO partnered to create the organization.

Additionally, the institution maintains a Shared Service Facility for Product Packaging and Labeling, which offers support for product packaging and design development for startups and MSMEs in the province. These are the initiatives that are anticipated to complement the NEUST TBI and vice versa.

Research Objectives

The main objective of the study is to conduct a feasibility study on the establishment of a Technology Business Incubator facility at Nueva Ecija University of Science and Technology. Specifically, the study aims to:

1. Describe the framework or environment of the TBI
2. Describe the strategies for the implementation
3. Determine the manpower requirements of the TBI
4. Propose a sustainability plan for the TBI

METHODS

In this study, the descriptive approach of research was used. Descriptive study aims to accurately and comprehensively define a population, condition, or phenomenon. It can answer the questions what, where, when, and how, but not why. A descriptive study plan may use a variety of research methods to investigate one or more variables. In observational research, unlike experimental research, the researcher does not affect or alter the variables; they are instead observed and quantified.

RESULTS AND DISCUSSION

A. Design a Framework for the Operation of the TBI

The DOST-NEUST i-MeTAL collaborates closely with the university's other research and innovation institutes. These facilities are also anticipated to provide prospective companies and incubatees for the TBI. The following are a few of NEUST's centers for research and innovation:

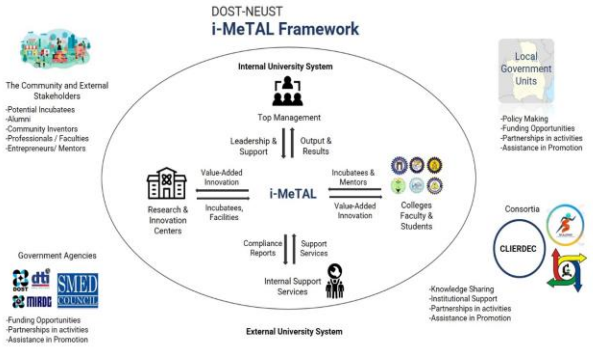

Figure 1- Framework of NEUST TBI

a. The DOST-NEUST i-MeTAL will collaborate closely with the university's other research and innovation institutes. These facilities are also anticipated to provide prospective companies and incubatees for the TBI. The following are a few of NEUST's centers for research and innovation:

b. The DOST-MIRDC and Region 3 financed Metal Innovation Center initiative. NEUST contributed significantly to the project's cost. The center provides cutting-edge facilities, cutting-edge machinery, and cutting-edge equipment for the study and development of metal technologies. MIC is anticipated to work closely with DOST-NEUST i-MeTAL given that the TBI specializes on metal startups and technology.

c. The main duty of the NEUST Innovation and Technology Support Office (An IPOPhl Accredited ITSO) is to support professors and students with intellectual property services. Since the ITSO manager is also a project member of the DOST-NEUST i-MeTAL, the office is anticipated to help the TBI with its demands for IP services.

d. shared service center for labeling and product packaging. The SSF at NEUST serves as a hub for packaging and label design and development. Additionally, it provides assistance with branding and the creation of other marketing materials. The incubators are anticipated to get assistance from the center in improving their packaging and labeling so they can compete better during the commercialization phase.

College and Campuses

As a university focused on science and technology, NEUST has confidence in the College of Engineering, which provides engineering courses with a Technopreneurship curriculum. A BS in Information Technology is available through the university's College of Information and Communications Technology. Additionally, it features a College of Management and Business Technology that grants BS degrees in Entrepreneurship and Business Administration. It is intended that the staff and students from these universities would conduct research and develop concepts that might lead to the creation of technology-based enterprises.

Government-Industry-Academe Linkages

One of the goals of the incubator is to boost self-assurance and mobilize support networks from the neighborhood, which includes important participants like other academic and research institutions, governmental organizations, and big and medium-sized businesses. NEUST now maintains connections with various governmental organizations, SUCs, NGOs, and private businesses. Students may participate in faculty immersion programs, research and development projects, community involvement projects, seminars and trainings, and recruitment initiatives via partnerships with these businesses. A presentation on orientation is helpful for introducing the idea of incubation to prospective sponsors. This procedure should provide objective information on the traits and goals, the issues and opportunities, as well as the duties and commitments of the major participants as mentioned above.

It is important to identify the locators in the area and invite them to the aforementioned orientation event. A focus group discussion examining the local startup ecosystem using startup mapping should include at least 50 people (CEO, founders, local community leaders, builders, and advocates in the startup community). The final product will be a directory of local entrepreneurs, advocates, programs, events, and resources. The aim is to identify areas of assistance that need improvement and explore feasible solutions with the neighborhood. The TBI wants to build and maintain additional partnerships with various government and corporate sectors (at least 25 percent of all the registered businesses in the region).

Alumni and Other Stakeholders

1. Alumni will participate in the TBI program as long as they are interested in taking advantage of the incubation program and facilities. An Alumni Technopreneur may form a startup with students, faculty, fellow alumni, and the outside start-up community in order to work on their ideas with the aid of technology, mentoring, access to funding, and start-up resources.
2. Successful alumni entrepreneurs are a source of funding for TBI, end-to-end consultation for different incubation program modules (see letter c), and implementation help. They could also be an early-stage investor, an angel investor, or a vital component of any industry alliance that results in corporate sponsorships for TBI incubatees. Alumni will participate in the TBI program as long as they are interested in taking advantage of the incubation program and facilities. An Alumni Technopreneur may form a startup with students, faculty, fellow using technology, coaching, financing, and start-up resources, alumni and the outside startup community may collaborate on their ideas.
3. A source of money for TBI, end-to-end advice for various incubation program modules (see letter c), and implementation assistance are successful alumni businesses. They could also be a crucial member of any industry collaboration that leads to corporate sponsorships for TBI incubatees, an early-stage investor, an angel investor, or another kind of investor.

B. Determine The Strategies For The Operation Of A Technology Business Incubator

TABLE 1
STRATEGIES FOR THE IMPLEMENTATION OF TBI

Strategies	Specific Activities
Establish a Technology Business Incubator facility with adequate facilities and an environment conducive to innovation	1. Create a TBI Committee (Board of Directors) and call the organization's first meeting. Any further measures are the responsibility of the Board. 2. Establish a steering group to help with the first stages of the implementation process and operations. The Board and management may get help from an experienced advisory committee in assessing prospective enterprises for admission into the incubator, exit problems, and cutting-edge technology obstacles. Employ, select, train, and fairly compensate a capable TBI management team that can and is responsible for provide real assistance to help the companies/incubatees thrive. 3. Operating methods, such as selection criteria, rents, service fees, and member agreements, must be finalized by the Committee. 4. finish the legal steps necessary to create the TBI (e.g. Ensure board approval for the working space to be used by the incubator in Integrated Science and Technology Center Building) 5. Conduct research missions and benchmarking exercises to other prosperous TBIs domestically and abroad. 6. Create the Incubator Space/Area Design and Write the Engineering Specifications 7. Obtain quotes for the remodeling and construction work, then negotiate contracts. 8. Complete the building, buy the office supplies, and set them up. 9. You could achieve agreement among important participants by doing startup mapping around the area. 10. To create a memorandum of understanding and agreement, contact numerous parties (e.g. Food Innovation Center, Food testing lab and other University Laboratories support the operations of the TBI, existing regional technology support center be utilize by the incubator, Partnerships and sponsorships for TBI related activities, etc).
Develop and create set of programs that will nurture technopreneurship skills among students, faculty members and researchers in and outside the university	1. Conduct pre-incubation/entrepreneurial workshop 2. School caravan introducing the program of the TBI and call for entry (Road shows to various senior high school and college endorsed by DepEd, CHED and DOST Regional Office (Ideation Workshops) 3. Startup workshops and boot camps for students and teachers 1 or 2-day workshops that will cover importance of youth in technopreneurship and in nation building, design thinking/ideation, business model canvas, simplified validation board and pitching. 4. Conduct Startup Weekend annually Startup Competition 5. Establish and maintain a website that will showcase all activities of the TBI (awareness caravan, startup competition, partnerships, etc.)
3. Help create /	6. Establish selection procedure

establish startups with successful business models	7. Initiate selection process for companies/tenants/incubatee that have the potential to grow and to create jobs (e.g. for those who will (a) win in the startup competition and startup weekend (b) be awarded as "best thesis" 8. Provide software of value-adding counselling and services as well as the hardware of affordable workspace and shared facilities. 9. Establish a customize delivery of services that will address the development needs of each company/incubate (see theoretical framework c.). 10. Design flexible exit policies which require the business/incubatee 'graduates' when the scale of operations, staff and sales have expanded to a point where the space and service requirements go beyond the incubator's capacity – usually after two to three year.
To establish network and harmonize connections between the academe (students, faculty members, alumni and researchers), government agencies and industries.	1. Secure consensus among key stakeholders by conducting orientation seminar to familiarize with the incubation concept 2. Secure MOA with Nueva Ecija SMED Council to become one of the mentor/adviser of the TBI and their members as potential startup client 3. Secure MOA from industry partner (Industry matching activity for TBI operations and curriculum development) 4. Secure MOA to government especially on the utilization of their S&T center. 5. Schedule regular industry consultation (for curriculum development and TBI operations planning)
Manage the TBI as a businesslike enterprise, which progressively recovers significant proportions of its operating costs	1. Prepare feasibility analyses, and the business sustainability plan to assess and decide whether the incubator is going to be effective and sustainable. 2. Continuously evaluate and improve services as the incubator progresses and its needs change. 3. Establish a well-prepared inter-country collaborations and strategic alliances to reduce development costs and time. 4. Institutionalizing the operation of the incubator facility.

C. Determine The Human Resource Requirements For TBI

TABLE 2
HUMAN RESOURCE REQUIREMENTS FOR THE TBI

Position	Percent Time Devoted to the Project	Responsibilities
Project Leader (TBI Manager)	3 hours/day (Weekdays) 8 hours/day (Saturdays)	1. Oversee the overall operation of the TBI. 2. Prepare and submit the project plan. 3. Manage project deliverables according to the approved project proposal. 4. Lead and manage the project team. 5. Determine the strategies to be used on the project implementation. 6. Establish a project schedule and determine each phase. 7. Assign tasks to project team members. 8. Provide regular updates to the University and DOST. Take corrective action as necessary.
Project Development Officer III (Assistant TBI Manager)	8 Hours/Day 5 Days/Week	1. Plan, organize, and manage S.M.A.R.T. programs and activities aimed at growing and expanding the startup ecosystem, both locally and regionally, in accordance with the work plan developed by the Project Leader/Center Manager. 2. Ensure that TBI projects and activities are completed on schedule and efficiently by overseeing the TBI's day-to-day operations. 3. Plan and manage financial resources necessary for the successful completion of projects and activities. 4. Organize and facilitate meeting among team and the management; 5. Develop and implement monitoring and evaluation systems that will ensure tracking of project results. 6. Provide regular and timely updates and reports on project progress to the team and management by assisting in the production of the following: a. periodic updates on the project's accomplishments/progress; and b. financial reports packaged as a project output (monthly for team members, quarterly and yearly for management). Stay updated on new approaches, tools and best practices on incubation management
Project Assistant III (Startup and Community Engagement	8 Hours/Day 5 Days/Week	1. Assist the Program Development Lead in implementing initiatives aimed at growing and expanding the startup ecosystem on a local and regional level, including

Program Officer)		hackathons, networking events, demo days, pitching contests, seminars, and acceleration programs. 2. Coordination of pre- and post-incubation activities with trainers and speakers 3. Oversee daily interactions with entrepreneurs and new businesses. 4. Utilize an online project management application to organize and monitor team activities. 5. Maintain current knowledge of emerging methods, technologies, and best practices for startup growth and development. 6. Create and execute monitoring and evaluation methods that will guarantee the entrepreneurs' and start-up businesses' milestones and development are closely monitored.
Project Assistant III (Marketing and Promotion Officer)	8 Hours/ Day 5 Days/Week	1. Ensure that online and offline content is consistent with the tone, persona, and overall BEE Hub brand 2. Develop a short- and long-term content strategy, including a content calendar and effective marketing initiatives that result in stakeholder action Create and manage campaign marketing budgets;
Project Assistant III (Administrative Assistant)	8 Hours/ Day 5 Days/Week	3. Maintain the TBI facilities and support its day-to-day operations; 4. Monitor office supplies, goods, and other general things used in daily operations and handles purchase when necessary; 5. Maintain a file system for both hard and soft versions of essential papers. 6. Document preparation and mobilization for the conduct of events and programs, including request letters, activity proposals, space and equipment reservations, and cash advances. 7. Request for purchase of food and catering, office supplies, and other necessary goods 8. Travel papers such as a Travel Order, an Authority to Travel, and an Authority to Hire a Vehicle, among others. 9. Documentation of post-activity activities, including narrative reports, meeting minutes, and liquidation papers such as receipts and BIR forms. 10. Track, monitor, and maintain records of budget utilization; 11. Coordinate and maintain records for staff, such as monthly accomplishment reports; 12. Write content for the TBI newsletter; 13. Serves as liaison with NEUST finance/accounting in preparing financial and progress reports for submission to funding agency.

D. Proposed Sustainability Plan For The TBI

Table 3
Proposed Sustainability Plan For The TBI

Plan	Strategies	Responsible Person
1. Creation of University Innovation policy and allocation of annual fund from the university Research Budget	1. Propose a policy to the Administrative Council and Board of Regents that a significant part of the University Research Fund will be allocated to the operation of the TBI 2. Creation of University Innovation Council 3. Submit a proposal to the university for internal funding	TBI Manager Research Director Budget Officer
2. Manage the TBI as a business enterprise with the capability of earning	1. Design a business model for the TBI 2. Prepare a business plan 3. Determine other potential sources of income for the TBI 4. Collect fees from activities and services for private clienteles	TBI Manager TBI Project Member
3. Submit proposal to different government funding agencies or NGOs	1. Identify call for proposals from different agencies 2. Study the funding requirements 3. Submit proposal for funding	TBI Manager TBI Team
4. Find local and international partners for the TBI	1. Identify potential partners in local and international organizations 2. Conduct joint activities with partners 3. Determine future projects with partner-organizations	TBI Team
5. Construction of TBI Building	1. Inclusion of the project to the Land Utilization and Development Plan 2. Coordination with University Infrastructure Development Office for the budgetary requirements	TBI Manager IDO
6. TBI Personnel Transition Plan	1. Creation of TBI Personnel development plan 2. Endorsement to the university for the transition from TBI personnel to regular teaching positions	TBI Manager TBI personnel
7. Capacity Building for TBI Personnel	1. Benchmark with other TBIs on the sustainability practices 2. Conduct capacity-building trainings on TBI operation sustainability	TBI Team TBI Personnel

CONCLUSION

The NUET is one of two state universities in Nueva Ecija. Six are satellite campuses and seven are extension campuses. These are in various cities. NEUST includes 10 colleges with Engineering as the flagship. The university created research and innovation centers with the help of other government entities. Metal Innovation Center, where the TBI will function, is one of them. Project supported by DOST-MIRDC, DOST Region III, CHED, and NEUST.

The project has modern facilities and equipment for academic and R&D use. Innovation and Technology Office (ITSO) functions as the university's IP office. The NEUST-ITSO was founded using Intellectual Property of the Philippines. The institution maintains a Shared Service Facility for Product Packaging and Labelling that helps startups and MSMEs in the province with packaging and design. These initiatives will complement NEUST TBI and vice versa.

Policy makers are realizing that entrepreneurship and innovation have regional implications. In the last 50 years, technology business incubation (TBI) has emerged as a creative way to boost local and regional entrepreneurial settings. There are several instances of effective incubation mechanisms, such as technological incubators, accelerators, and scientific parks, that have helped to building sustainable regional eco-systems with a concentration of creative entrepreneurial activity (Mian et al. 2012). The link between creative entrepreneurship, competitiveness, and economic prosperity has policymakers seeking for ways to boost regional economic development globally (Corona et al. 2006).

In the Philippines, TBIs were founded a decade ago. The Department of Science and Technology funds most university-based TBIs (DOST). DOST funds 14 TBIs. 6 are financed by DOST- Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) (PCAARD).

The government has too few TBIs to assist SMEs, startups, and university research. (PASUC) This research examines university technology company incubators in four areas: marketing, organization and management, technical, and finance. The research may provide a standard for other colleges planning TBIs. A business strategy and plan for tech incubators will be established.

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