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UP PRESIDENT EDGARDO J. ANGARA FELLOWSHIP
EDCOM2 The Second Congressional Commission on Education

ON HIGHER EDUCATION ROADMAP, INDUSTRY, AND AGRICULTURE

Cultivating Innovation in the Philippines

by Addressing Policy Gaps and Creating Pathways for Collaborative Progress between Academe and Industry

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UP CIDS | MONOGRAPH SERIES

is published by the

University of the Philippines
Center for Integrative and Development Studies
Lower Ground Floor, Ang Bahay ng Alumni
Magsaysay Avenue, University of the Philippines
Diliman, Quezon City 1101

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Website: cids.up.edu.ph

ISSN 2719-0722 (Print)
ISSN 2719-0730 (Online)

Cover image credit
Cover design by Jose Ibarra Cunanan and Jessie Feniquito, UP CIDS Publications Unit

UP PRESIDENT
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FELLOWSHIP

The **UP President Edgardo J. Angara (UPPEJA) Fellowship** is a grant for pioneering policy research. It aims to promote high-level policy discussions and research on a wide range of topics that address national development goals and imperatives, such as science and technology, economic development, environment and climate change, good governance, and communications.

The Fellowship was established by the University of the Philippines Board of Regents on September 29, 2008 in honor of the late Senator Edgardo J. Angara, who served as UP President from 1981 to 1987 and concurrent UP Diliman Chancellor from 1982 to 1983.

Angara, also a former Senate President, is known for his contributions to Philippine education, serving as the Chairperson of the First Congressional Commission on Education in 1990, which was credited with a number of pioneering reforms in the education sector, including its “trifocalization” and the Free Higher Education Act.

In addition to his notable contributions as a legislator, Angara’s leadership also gave rise to the **UP Center for Integrative and Development Studies (CIDS)**, which he initiated during his presidency.

Officially established on June 13, 1985, and originally called the University Center for Strategic and Development Studies (UCSDS), CIDS serves as a think tank that leverages the multidisciplinary expertise of UP to address the nation's most pressing challenges. The core objectives of CIDS encompass the development, organization, and management of research on national significance, the promotion of research and study among various university units and individual scholars, the securing of funding from both public and private sources, and the publication and wide dissemination of research outputs and recommendations.

For 2024, the Higher Education Research and Policy Reform Program (HERPRP) served as the UP PEJA Fellowship Awards secretariat in partnership with the Second Congressional Commission on Education (EDCOM II).

From the Executive Director of UP CIDS

It has been a long time in the making, but I am pleased to see the UP PEJA Fellowship finally coming to fruition. After all the forums, meetings, presentations, and threads of communication between and among the PEJA Fellows, UP CIDS' Higher Education Research and Policy Reform Program (HERPRP), and the Second Congressional Committee on Education (EDCOM 2), we now have a series of papers that tackle the various facets of Philippine higher education. The series includes the study you're reading.

For much of its history, the UP PEJA Fellowship has been housed in and implemented through the Center for Integrative and Development Studies (CIDS), the University of the Philippines' policy research unit. Over the years, the Fellowship has funded and published the studies of policy scholars, many of them luminaries in their respective fields.

In 2023, after a few years' hiatus, not least because of the COVID-19 pandemic, the UP PEJA Fellowship resumed and began looking for a new set of Fellows. This time, however, UP CIDS, through its Higher Education Research program, embarked on a historic partnership with the Second Congressional Committee on Education (EDCOM 2).

Linking directly with the government in administering the UP PEJA Fellowship was a first for UP CIDS. And that this was a partnership with a national-level policy-making body made it even more special.

As I have always maintained, this type of linkage is exactly what UP CIDS, as a policy research unit, must do: embedding research within a framework of stakeholder engagement.

Guided by the policy objectives of EDCOM 2, the PEJA papers not only tackle the complex issues in education, but also show stakeholders – the state, civil society, and the teachers themselves – how we can tackle them. For all our efforts in improving education in the Philippines, what else can and should we do?

Many thanks to the PEJA fellows for their valuable contribution, and to the UP CIDS Higher Education Research Program for shepherding this important undertaking. With collaboration, great things do happen.

Rosalie A. Hall, PhD
Executive Director
UP Center for Integrative and Development Studies

From the Convenor of UP CIDS-HERPRP

We at the Higher Education Research and Policy Reform Program serve as a convening body that builds partnerships and networks that pursue a shared research agenda and build an evidence basis for policy. Our activities include fellowships for scholars who publish with us and consultancies for junior researchers who wish to begin a career in higher education studies. We maintain databases, conduct events, and publish various manuscripts on higher education.

For 2024, our full attention was devoted to the UP PEJA Fellowship Program, serving as a secretariat for the researchers who studied higher education as it intersected with government and finance, industry and agriculture, regulation and tuition and technical and vocational education, training and lifelong learning, the UP PEJA Program awards grants for pioneering work on a wide range of topics that address national development concerns. This was the very first time that the program focused on a singular topic. This demonstrates the commitment of the University of the Philippines to higher education.

With the support of the UP Foundation, we have assembled what we have been calling the *Avengers* of Philippine education. They are preeminent scholars whose findings and recommendations directly address key policy concerns. Their papers at once draw from empirical data as well as their professional expertise for which they have been identified as a UP PEJA fellow.

Fernando dlC. Paragas, PhD
Convenor
Higher Education Research and Policy Program
UP Center for Integrative and Development Studies

Letter from the Executive Director of EDCOM II

The **Second Congressional Commission on Education (EDCOM II)** is collaborating with scholars across various institutions to provide valuable insights for the development of evidence-based policies that address the unique challenges and opportunities in the Philippine education landscape.

Our commitment to excellence, integrity, and ethical conduct in advancing research and disseminating knowledge, which we share with our research partners, is defined by the following principles:

The Commission is dedicated to upholding the highest standards of academic rigor in the evaluation, review, and dissemination of research publications. Our pledge is to ensure the integrity and quality of the knowledge we contribute to the scholarly community.

The Commission is committed to fostering transparency and data integrity in all aspects of research. This includes transparent communication, disclosure of methodologies and data sources, and providing clear guidelines to authors, reviewers, and the broader academic community.

The Commission promotes ethical research conduct, emphasizing the responsible and respectful treatment of research participants.

The Commission places a strong emphasis on accessibility. We are committed to facilitating the translation of research findings into accessible formats in order to engage the broader public, taking into account ethical and legal considerations. Our goal is to promote public understanding and awareness of scientific advancements.

In adherence to these principles, the members of the Second Congressional Commission on Education (EDCOM II) pledge to be stewards of good scholarly research for a better, more inclusive educational system for the Filipino people.

Karol Mark R. Yee, PhD
EDCOM II Executive Director

Declaration of Funding

This research was conducted in collaboration with the Second Congressional Commission (EDCOM II).

The funding source played no role in the design of the study, data interpretation, or decision to publish the findings as the author(s) maintained complete autonomy in the research process, ensuring objectivity and impartiality in the presentation of results.

Declaration of Interest

None

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Cultivating Innovation in the Philippines

by Addressing Policy Gaps and Creating Pathways for Collaborative Progress between Academe and Industry

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Executive Summary

Academe-industry collaboration spans a broad range of activities and target outcomes (Junaini et al. 2008). While many of these activities and target outcomes are supported by existing and upcoming policies, much of the focus has been on improving the country's ability to innovate. This innovation is marked by an increase in the country's global competitiveness, and the introduction of new products and services that match industry needs with the technical capabilities of the academe.

In general, there has been a growing policy support for innovation, which has resulted in heightened innovation output as measured by technology transfer industry agreements with the academe. However, the status of such metrics are hardly commensurate to the level of overall research and development

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(R&D) activity. R&D in the country mostly follows the technology-push approach, as opposed to the demand-pull approach where activities are driven by explicit challenges from industry, with collaboration starting at the stage of conceptualization. Moreover, many industry sectors that are supported by specific policies to boost their productivity have yet to achieve their goals; this situation is exacerbated by a lack of corresponding academe-industry collaborations that address the challenges highlighted in these policies.

In this paper, we present an innovation case study that brings together both extrinsic and curricular factors (i.e., intrinsic within the academe). In the first half, we review government policies as extrinsic motivators and supporting factors for academe-industry collaboration. We map out general supporting policies, enumerate demand-creating policies for specific industries, and identify interventions and improvements for more productive policy crafting and implementation. In the second half, we analyze the capacity of the academe and industry to carry out collaborative innovation. We highlight the collaboration potential of Higher Education Institutions (HEIs) and industry, the current environment for collaboration, specific enabling policies, challenges encountered by the stakeholders, design pegs from other countries, and recommendations for manpower support to bolster innovation and academe-industry collaboration.

On the demand-creation side, we forward the following recommendations:

- Align collaboration roadmaps with demand-creating policies
- Set quantitative targets over a fixed time horizon
- Ensure progressive management of R&D and technology transfer by an experienced executive team
- Provide longer grants for strategic programs (at least five years) for continuity and impact
- Craft business prospectus with comparative investment analysis
- Provide technical and management training for industry

On the curricular side, we recommend the following:

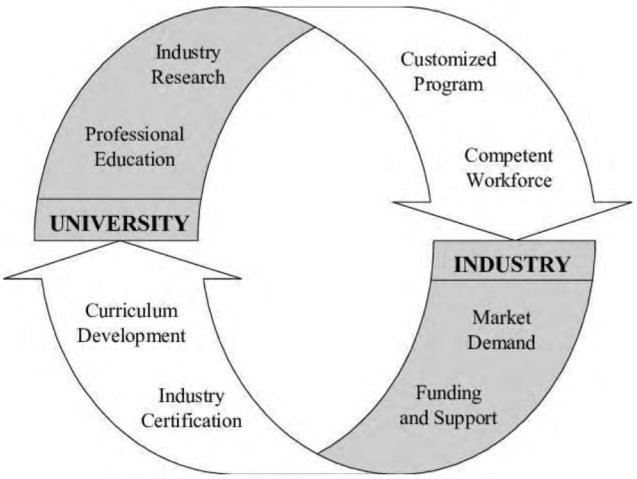
- Include industry contact and market validation in Technopreneurship ("Tech101") course implementations mandated by the Commission on Higher Education (CHED)

- Provide mechanisms for students to interact with industry and learn about industry challenges
- Seed discussions with sectors covered by demand-creating policies
- Create partnerships with the Department of Trade and Industry (DTI) and other agencies
- Provide a course series that act as a pathway for progress in product and customer development
- Create mechanisms for interdisciplinary collaboration in courses
- Provide funding incentives for students and faculty advisers to continue the ventures.

Overview

Academe-industry collaboration spans a broad range of activities and target outcomes (Junaini et al. 2008) (see Figure 1). While each of these activities and target outcomes are supported by existing and upcoming policies, much of the focus has been on improving the country's ability to innovate. This innovation is marked by an increase in the country's global competitiveness, and the introduction of new products and services that match industry needs with the technical capabilities of the academe.

FIGURE 1. ACADEMIA-INDUSTRY SMART SYNERGY MODEL (JUNAINI, ET AL., 2008)



There are two different approaches to innovation supported by two different policy types. According to Nemet (2009) as cited by Nuñez-Jimenez, Knoeri, Hoppmann, and Hoffmann (2019), "technology-push policies seek to enhance the supply of technologies by providing incentives that reduce the costs of their development, e.g., through direct subsidies for research and development" (p.2). Meanwhile, policies supporting demand-pull or market-pull innovation "foster technological change in technologies by stimulating their demand, e.g., through regulation, financial incentives, or information campaigns" (Peters et al., 2012 as cited by Nuñez-Jimenez, et al., 2019, p.2)

Most of the research and development (R&D) activities in the academe are technology-push in origin. Out of the hundreds of ongoing and recently concluded technology-push R&D projects in the University of the Philippines (UP) alone , only 62 are covered by technology transfer industry agreements, such as technology licensing. These figures highlight the challenges of the technology-push approach to innovation, and the need to balance innovation efforts to increase the percentage of demand-pull activities. Through a case study, we highlight an example of the latter, illustrating both the program's external and internal motivators, and specific mechanisms that support the demand-pull approach.

From Class Project to Industry Partnerships: An Innovation Case Study

To illustrate the policies that can drive academe-industry collaboration, we discuss the Hearing for Life (HeLe) project for newborn hearing screening that started as a class project by four students from the Technopreneurship class in the UP Diliman College of Engineering. The Technopreneurship class was instituted as a required course for scholars of the Engineering Research and Development for Technology (ERDT) program—a consortium of eight universities with graduate engineering programs supported by the Department of Science and Technology Science Education Institute (DOST-SEI). Through this course in the 2nd semester of A.Y. 2013-2014, Roxanne de Leon, Ronald Angelo Reyes, Maria Anna San Luis and Norman Roy de Guia, proposed the HearO project to address the problem of newborn hearing screening highlighted by Dr. Amado San Luis of the St. Luke's Medical Center.

As part of their required senior project in the Electrical and Electronics Engineering Institute, two students, de Leon and Reyes, prototyped a device that can measure the brain response of a newborn infant to check for hearing problems. In the course of developing their prototype, they met with Dr. Charlotte Chiong from UP Manila College of Medicine and the Philippine National Ear Institute, who was the chief advocate for Republic Act No. 9709, or the Newborn Hearing Screening Act. This encounter led to a

collaborative R&D program between the two UP campuses, and with the University of California under the Philippine California Advanced Research Institutes (PCARI) program of the Commission on Higher Education (CHED). After the first phase of prototyping and initial clinical evaluations, the team gained support from the DOST Philippine Council for Health Research and Development (PCHRD), and developed a partnership with EsiTech, an electronics company. With the on-going support from DOST-PCHRD and the partnership with EsiTech, the team was able to conduct subsequent product refinements and clinical evaluations. Through continuous and collaborative R&D, the goal is to scale up the technology in support of RA 9709.

From the HeLe project history, we note two key factors that led to project initiation and progress: first was the presence of engineering courses that encouraged customer and market contact (such as the ERDT Technopreneurship course), and supported prototyping of innovative products. Second, there were demand-creating policies (RA 9709) that promoted the utilization of these innovative products.

Given the track record of technology-push innovation, and the possibilities for other modes of innovation highlighted in the HeLe project, we now turn our focus to demand-pull innovation. In particular, following the above two factors in the HeLe project, we analyze how demand-pull innovation can be supported by university curricula and demand-creating policies.

Why: Motivation for innovation

In this section, we review government policies as extrinsic motivators and supporting factors for academe-industry collaboration. We first map out general supporting policies, enumerate demand-creating policies for specific industries, and then identify interventions and improvements for more productive policy crafting and implementation.

General innovation support policies

We start with national policy frameworks that are not specific to any industry or technology. Some of these policies support both technology-push as well as demand-pull innovation.

- **Republic Act No. 7459: An Act Providing Incentives to Filipino Inventors (not Investors)**

  An Act Providing Incentives to Filipino Inventors and Expanding the Functions of the Technology Application and Promotion Institute, Appropriating Funds Therefor.

- **Republic Act No. 11534: Corporate Recovery and Tax Incentives for Enterprises Act or "CREATE."**

  An Act Reforming the Corporate Income Tax and Incentives System, Amending for the Purpose Sections 20, 22, 25, 27, 28, 29, 34, 40, 57, 109, 116, 204 and 290 of the National Internal Revenue Code of 1997, as Amended, and Creating therein New Title XIII, and for Other Purposes.

  Among the revisions, enterprises can avail incentives such as, so long as they meet the necessary conditions: income tax holiday, special corporate income tax rate, and enhanced deductions. In the enhanced deductions, enterprises can avail of 100 percent additional deduction on R&D expenses incurred. Moreover, the registered projects or activities are prioritized according to the Strategic Investment Priority Plan (SIPP), which covers the Philippine Development Plan. The prioritization takes into account several factors, which include but are not limited to: use of modern, advanced, or new technology; market competitiveness promotion; and the ability of the project or activity to address gaps in the supply or value chain.

- **Republic Act No. 10055: Philippine Technology Transfer Act of 2009.**

  An Act Providing the Framework and Support System for the Ownership, Management, Use, and Commercialization of Intellectual Property Generated from Research and Development Funded by Government and for Other Purposes.

  As stipulated in Section 3, this Act "aims to promote and facilitate the transfer, dissemination, and effective use, management, and commercialization of intellectual property, technology and knowledge resulting from R&D funded by the government for the benefit of the national economy and taxpayers."

- **Republic Act No. 11293: Philippine Innovation Act.**

  An Act Adopting Innovation as Vital Component of the Country's Development Policies to Drive Inclusive Development, Promote the Growth and National Competitiveness of Micro, Small and Medium Enterprises, Appropriating Funds Therefor, and for Other Purposes

  Section 26 of the law includes a general demand-creating clause, which states that: "Requirements for innovative goods and services shall be identified, together with the clear output specifications, as well as functional or performance criteria. The guidelines shall also allow project-based competition to encourage participants to develop innovative solutions."

- **Republic Act No. 11981: Tatak Pinoy (Proudly Filipino) Act.**

  An Act Mandating The Formulation, Financing, Implementation, Monitoring, and Evaluation of a Comprehensive and Multi-Year Tatak Pinoy (Proudly Filipino) Strategy, Establishing a Tatak Pinoy Council, Appropriating Funds Therefor, and for Other Purposes.

  The law shall provide market-driven and future market demand support; allow the State to prioritize procurement of locally manufactured products, goods, and services; and ensure better technology transfer among firms, academe, and government institutions.

Sectoral demand creating policies and implementation challenges

On top of the general innovation incentives above, the following policies are designed to create demand for specific products, services, or industries.

- **Republic Act No. 9709: Universal Newborn Hearing Screening and Intervention Act of 2009.**

  An Act Establishing a Universal Newborn Hearing Screening Program for the Prevention, Early Diagnosis and Intervention of Hearing Loss.

- **Executive Order No. 879 (2010), and Senate Bill No. 2513 (proposed "Kawayan Act").**

  Creating the Philippine Bamboo Industry Development Council (PBIDC) to Promote the Bamboo Industry Development Project and Directing the Use of Bamboo for at least Twenty Five (25%) Percent of the Desk and Other Furniture Requirements of Public Elementary and Secondary Schools and Prioritizing the Use of Bamboo in Furniture, Fixtures and other Construction Requirements of Government Facilities and Allocating Funds Therefore and Other Purposes.

- **Republic Act No. 9242: Philippine Tropical Fabrics Law.**

  An Act Prescribing the Use of the Philippine Tropical Fabrics for Uniforms of Public Officials and Employees and for Other Purposes.

- **Republic Act No. 11650: Instituting a Policy of Inclusion and Services for Learners with Disabilities in Support of Inclusive Education Act.**

  An Act Instituting a Policy of Inclusion and Services for Learners with Disabilities in Support of Inclusive Education, Establishing Inclusive Learning Resource Centers of Learners with Disabilities in all School Districts, Municipalities and Cities, Providing for Standards, Appropriating Funds Therefor, and for Other Purposes

As articulated in Section 7, one function of an Inclusive Learning Resource Center of Learners with Disabilities (ILRC) is providing auxiliary aids and services such as quality reading and writing materials, especially Braille for learners with visual impairments, and acquiring and adapting of equipment or devices which will enhance learning process of the learners.

- **Republic Act No. 11697: Electric Vehicle Industry Act.**

  An Act Providing for the Development of the Electric Vehicle Industry

  The act mandates that for key public and private sectors, at least five percent of their fleet, whether owned or leased, shall be electric vehicles (EVs).

- **Republic Act No. 11898: Extended Producer Responsibility Act of 2022.**

  An Act Institutionalizing the Extended Producer Responsibility on Plastic Packaging Waste, Amending for this Purpose Republic Act No. 9003, otherwise Known as the "Ecological Solid Waste Management Act of 2000"

  The act sets targets for the recovery of the plastic product footprint of producers from 2023–2028.

- **Republic Act No. 11037: Masustansyang Pagkain para sa Batang Pilipino Act.**

  An Act Institutionalizing a National Feeding Program for Undernourished Children in Public Day Care, Kindergarten and Elementary Schools to Combat Hunger and Undernutrition among Filipino Children and Appropriating Funds Therefor

  The law mandates that a national feeding program be implemented to support the nutrition of young learners in our public schools, such as fortified meals and milk, along with the conduct of health and nutrition information programs.

- **Republic Act No. 11148: Kalusugan at Nutrisyon ng Mag-Nanay Act.**

  An Act Scaling Up the National and Local Health and Nutrition Programs through a Strengthened Integrated Strategy for Maternal, Neonatal, Child Health and Nutrition in the First One Thousand (1,000) Days of Life, Appropriating Funds Therefor and for Other Purposes

  The act aims to reduce maternal and child mortality, and stunting through proper prenatal and early childhood nutrition.

A common problem in implementing these policies is the limited supply of key products, equipment, or other resources needed to deliver on the mandate. In a senate press release, the Department of Education (DepEd) Undersecretary Alain Pascua highlighted

the insufficient supply of bamboo desks and chairs (Senate of the Philippines 2016). In the same press release, Senator Cynthia Villar also lamented that:

> *The ones making these are complaining that you are not helping them. Sinasabi n'yo daw hindi sila competitive, akala ko this is to help the industry and to make bamboo a more sustainable source of wood. Kung may EO, dapat special treatment sila. (You are saying that they are not competitive; I thought this is to help the industry and to make bamboo a more sustainable source of wood. If there is an EO, they should receive special treatment).*

Similar issues were brought up by Baguio-based weavers with regard to RA 9242 during a focus group discussion with UP and the Department of Trade and Industry (DTI); they shared that implementation is not widespread, and that even the limited buyers tend to prefer bulk producers. Moreover, their production is also hampered by low production of cotton, and the limited supply of natural dye. While these demand-creating policies are intended to boost local production in multiple parts of the supply chain, innovation and other interventions are still needed to fulfill these goals.

Bamboo industry policy case study

In order to draw specific recommendations for policy interventions, we take a closer look at the policy outputs and outcomes from one of the sectors covered in the previous section.

A key output of the Philippine Bamboo Industry Development Council (established through Executive Order No. 879) is the Philippine Bamboo Industry Development Roadmap (2021). In addition to an industry analysis, it also establishes a general R&D agenda to address gaps and challenges in this sector. The agenda focuses on farming, post-harvest interventions, processing equipment, product design, rayon production, waste utilization, and policy development.The document also highlights over 40 million pesos worth of projects on bamboo funded by the DOST Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD).

A common limitation of these industry development roadmaps is the dependence on proposal-driven participation by research and development institutes (RDIs). Moreover, technology transfer outcomes were not included in the list of DOST-funded projects. For these reasons, progressive consortium R&D planning and proposal generation may produce better outcomes.

Following EO879, the emphasis on the bamboo industry was further intensified when then Secretary of the Department of Agriculture William Dar included bamboo as one

of the priority crops under the High Value Crops Development Program (HVCDP) (DA Press Office 2020). Through this pronouncement, HVCDP in DA Regional Field Office No. 5 released a technoguide to develop and promote the bamboo industry in Bicol. While the guide provides production techniques and few economic uses of bamboo, it lacks the financial analysis and business prospectus that will enable bamboo farmers and other key stakeholders to make business decisions and to craft strategic roadmaps advising following steps (DA Bicol 2021). In addition, a related paper by Rivera (2006) summarizes the economics and market potential of bamboo for engineered products. While both documents provide a macroeconomic and technical analysis of the industry, at most only a net present value (NPV) analysis is provided in aid of business decision making. Greater business participation could be encouraged if financing requirements, payback period, cash flow analysis, comparison to other cropping alternatives, and similar details were provided as part of an actionable business prospectus for farmers, investors, and finance institutions. In summary, policies and R&D roadmaps can be further strengthened with the addition of financial analyses to encourage industry decision makers to adopt the proposed initiatives.

It is worth zooming out to the bigger furniture sector as described in the Philippine Furniture Industry Roadmap (2012-2030) from the Chamber of Furniture Industries of the Philippines (CFIP) (Valenzuela 2016). It is interesting to note that the roadmap does not mention EO 879 at all—focusing mainly on the homestyle sub-sector instead. This lack of visibility was also apparent during interviews with university respondents, resulting in a lost opportunity to align university R&D roadmaps to support these policies.

The roadmap highlights the limited supply of sustainable raw materials, and the "lack of management education/manufacturing programs for middle managers and skilled workers" (Philippine Furniture Industry, Valenzuela 2016, p.23). Both are challenges which can be addressed by the academe, along with the provision of training assistance for design students, professional designers and manufacturers, and the development of advanced and cost-effective technologies, machineries/equipment and production processes.

While the Philippine Bamboo Roadmap devotes a whole chapter on strategies and timelines (see Chapter 7 of the Philippine Bamboo Roadmap) which provides detailed qualitative objectives, it does not enumerate quantitative targets for these objectives. Similarly, the Philippine Furniture Industry Roadmap only makes a general growth forecast for the industry without setting quantitative targets for key performance indicators (KPIs) that will support such growth.

In contrast, the 2018 to 2023 Clam and Bamboo Value Chain Development Plan for the Nghe An and Thanh Hoa provinces of Vietnam (a country in the top three of global bamboo

exporters) provides quantitative targets for several KPI's as shown below (Oxfam Vietnam n.d.):

- "35,000 SSPs adopt appropriate production techniques and practice sustainable standards.
- 95% of targeted SSPs have increased annual income from clam and bamboo.
- 150 SSP groups are better organized and strengthened capacity to negotiate for their position and equitable benefit sharing in the value chains.
- 60 MSME processors, including seven lead firms, enhance added value and improve their investment and sourcing policies.
- 80% of targeted SSPs and MSMEs have increased access to national and international markets.
- 5 Public-Private Alliances are established in five provinces and function effectively."

We can also take cues from other successful organizational models, notably the Cooperative Research Center (CRC) model in Australia, which is estimated to have contributed $32.5 billion in present and economic impact over the life of the program. From 2012 to 2020, it created 22,007 full-time equivalent jobs, and increased Australia's Gross Domestic Product (GDP) by $5.61 for every dollar invested in the program by the government.

The program brings together industry participants and research organizations, most of which are in the academe, "to solve critical issues, develop new technologies, products and services and compete on the world stage" (CRC TiME n.d.). CRCs are formed for different industry sectors, and typically commercialize their technology outputs through licensing or spin-off companies. A private company is formed for each CRC that is run by a management team with industry experience and guided by a board. The board includes industry representatives as well as independent directors (ACIL Allen 2021). A CRC can run up to ten years, which provides better continuity for innovation initiatives compared to the one- or two-year durations of DOST, CHED, and DA grants. The most common sequence for university R&D in the Philippines is a one- to two-year grant for the prototype development, followed by another one- to two-year grant for industry engagement, including field pilots and scaleup. Unfortunately, there is often an additional one- to two-year gap between these two grants, which makes it difficult to retain the research team on top of delaying the technology transfer to the industry. Longer grant durations would minimize these issues. Accountability concerns can be addressed with diligent monitoring

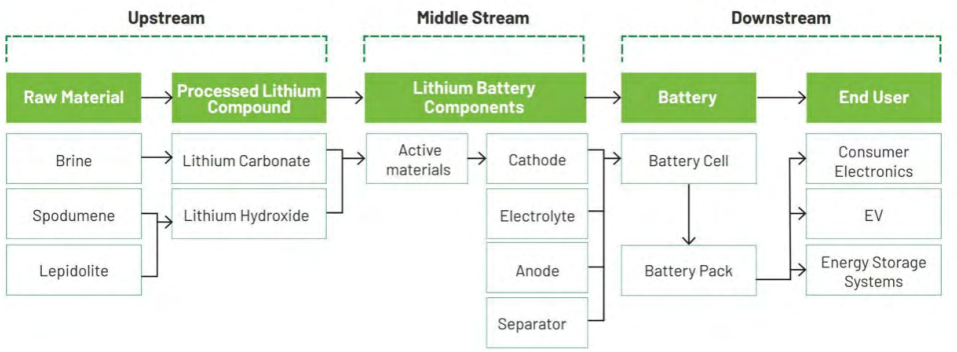
and advising of the project outcomes, with unproductive teams and projects subject to pre-termination or deferment (in case the project needs to be retooled).

Innovating the supply chain

While general innovation support policies provide the impetus for local products, they do not directly address some of the issues that also plague sectoral demand-creating policies, particularly gaps in the supply chain. While R&D can certainly address these gaps in general, the traditional proposal-driven approach may still fail to address a number of challenges, as R&D proponents are typically only concerned with their particular areas of expertise.

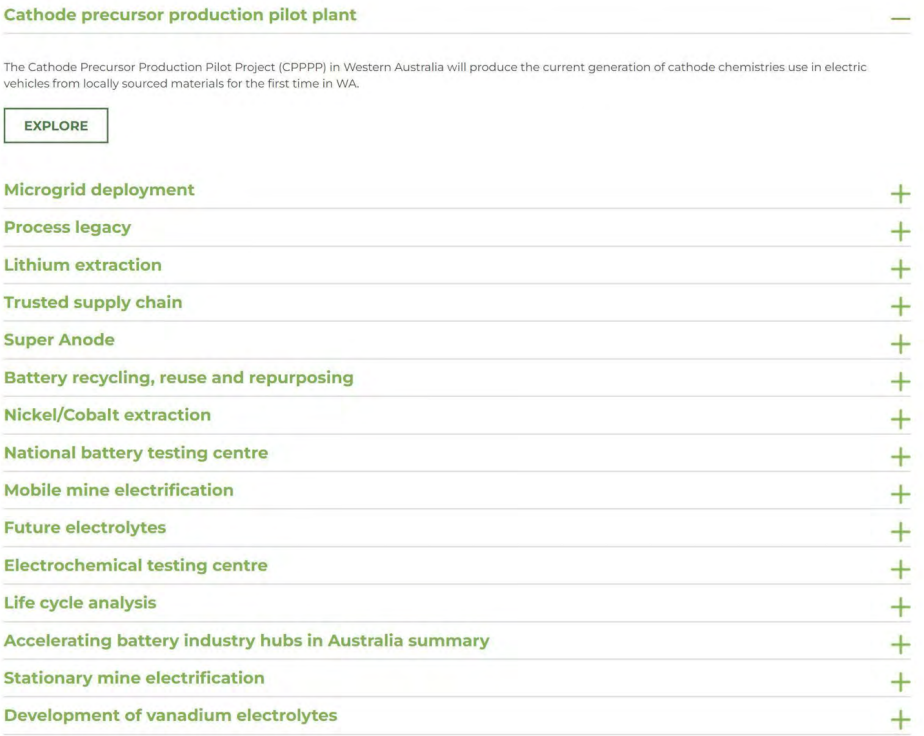
One example that addresses supply chain gaps is the practice of the Australian Future Batteries Industry CRC. The organization developed a supply chain for battery minerals and products, and identified suppliers or key players in the various sectors as shown below. This enlightens the local market and players to pinpoint limitations while leveraging on its capabilities.

FIGURE 2. LITHIUM SUPPLY CHAIN (FUTURE BATTERY INDUSTRIES CRC 2022).



To support the chain, the CRC has research programs with different universities that focus on various areas, as summarized in the table below. This supply chain view also allows for better utilization of limited resources (e.g., manpower, capital, equipment, etc.) by prioritizing basic gaps in the supply chain, and avoiding overallocation in parts that are no longer problematic.

FIGURE 3. RESEARCH PROJECTS (FUTURE BATTERY INDUSTRIES N.D.)



Who and How: Innovation Manpower

In this section, we analyze the capacity of the academe and industry to carry out collaborative innovation. This part highlights the collaboration potential of Higher Education Institutions (HEIs) and industry, the current environment for collaboration, specific enabling policies, challenges encountered by the stakeholders, design pegs from other countries, and recommendations for manpower support to bolster innovation and academe-industry collaboration.

Collaboration potential: HEI Profiles

In the Philippines, the Commission on Higher Education (CHED) is the governing body of higher education institutions (HEIs) and state universities and colleges (SUCs); they assess and recommend policies, programs, and plans to ensure that higher education in the country is at par with the global standards.

CHED has been promoting the establishment of academe-industry linkages across HEIs and SUCs. The formation of linkages is also subsumed in one of the four criteria for institutions to be recognized as Centers of Excellence (COEs) and Centers of Development (CODs). According to CHED, a COE "refers to a department within a higher education institution, which continuously demonstrates excellent performance in the areas of instruction, research publication, extension and linkages, and institutional qualifications" (CHED n.d.a). Meanwhile, a COD "refers to a department within a higher education institution, which demonstrates the potential to become a Center of Excellence (COE) in the future" (CHED n.d.a).

As stipulated in the CHED Memorandum Order No. 55, series of 2006, the extension and linkages criterion (which includes academe-industry collaboration) comprises 20 percent of the total score, while 45 percent goes to instructional quality, 30 percent to research publication, and 5 percent is based on institutional qualifications. To fulfill the extension and linkages criterion, applicants would need to submit evidence such as memorandums of agreement (MOA) with industry partners that are focused on research, internships, or other collaborations.

Currently, there are 199 COEs and 233 CODs in various regions across different disciplines namely, Agriculture Education, Business and Management Education, Criminal Justice Education, Engineering, Health Professions Education, Humanities, Information Technology, Library and Information Science, Science and Mathematics, Social Science and Communication, and Teacher Education. Table 1 shows the number of COEs and CODs per program and region.

TABLE 1. NUMBER OF COE/CODS PER REGION AND PER PROGRAM (CHED N.D.B)

REGION	COE	%	COD	%	PROGRAM GROUP	COE	%	COD	%
Region 1	5	2.5	14	6.0	Agriculture Education	21	10.6	20	8.6
Region 2	5	2.5	9	3.9	Business and Management Education	24	12.1	20	8.6
Region 3	10	5.0	13	5.6	Criminal Justice Education	7	3.5	3	1.3
Region 4A	18	9.0	19	8.2	Engineering	31	15.6	56	24.0
Region 4B	2	1.0	0		Health Professions Education	13	6.5	13	5.6
Region 5	3	1.5	10	4.3	Humanities	6	3.0	9	3.9
Region 6	4	2.0	13	5.6	Information Technology	18	9.0	35	15.0

REGION	COE	%	COD	%
Region 7	17	8.5	24	10.3
Region 8	2	1.0	6	2.6
Region 9	2	1.0	6	2.6
Region 10	16	8.0	33	14.2
Region 11	5	2.5	16	6.9
Region 12	1	0.5	3	1.3
NCR	100	50.3	49	21.0
CAR	8	4.0	14	6.0
CARAGA	1	0.5	4	1.7
Total	**199**	**100**	**233**	**100**

PROGRAM GROUP	COE	%	COD	%
Library and Information Science	1	0.5	1	0.4
Science and Mathematics	28	14.1	26	11.2
Social Sciences and Communication	14	7.0	12	5.2
Teacher Education	36	18.1	38	16.3
Total	**199**	**100**	**233**	**100**

As shown in Table 1, the National Capital Region (NCR) has the highest number of both COEs and CODs, comprising 50.3 percent and 21.0 percent, of recognized centers respectively. In COEs, Region 4A (9.0 percent) and Region 7 (8.5 percent) follow NCR. With regard to CODs, Region 10 (14.2 percent) and Region 7 (10.3 percent) have the next highest number. In terms of program group, teacher education (18.1 percent), engineering (15.6 percent), and science and mathematics (14.1 percent) have the highest number of COEs. In CODs, engineering (24.0 percent) has the highest number followed by teacher education (16.3 percent) and information technology (15.0 percent).

The above information highlights the potential of RDIs across the country to support research, development, and innovation through various degree programs. However, it also emphasizes the need to reach out and capacitate other regions and degree programs. The COEs and CODs are highly concentrated in NCR and Regions 4A, 7, and 10, while others have less than five or even no centers. Collaboration across RDIs and across regions would help to address this issue, which could also reduce gaps in the supply chain.

Experiences

Given the potential of the RDIs, it is pertinent to assess the collaboration experiences, processes, best practices, and challenges of the academe and industry. Through interviews and surveys with representatives from the academe and the industry, we give an overview of the current situation on the ground.

In terms of academe-industry collaboration, the interviewed HEIs shared that they most commonly interact with the industry through internship and curricular development.

To improve industry feedback, one HEI has an industry advisory board for curriculum development that provides topic suggestions, gives feedback on the duration of student internship engagement with the industry, and offers co-delivered microcredentials with the university. The same HEI also conducts reverse pitching sessions with the industry to encourage more demand-creating innovations. In terms of Tech101, the specific HEI conducts a challenge laboratory similar to that of the University of California, Berkeley, where they onboard an industry per semester.

Another HEI taps the capstone projects of graduate programs to increase academe-industry collaboration, allowing students to propose projects they can use in the institutions they are affiliated with. The HEI also plans to allow graduate students to participate in a professional internship program during the mid-year break to expand industry immersion beyond their affiliation. Furthermore, the HEI has an institutional coordinator for undergraduate internships to establish partnerships and agreements with host training establishments (HTEs). After the internship has ended, the HEI asks for an evaluation from the HTEs. However, for the HEI, the Tech101 delivery is lacking since it mostly focuses on business, and not on innovation and product development.

Additionally, another HEI embeds social involvement in the curriculum; students are asked to immerse themselves in communities, while faculty members receive additional credit as incentive to involve communities in the course design.

Alongside the institutions' experiences with academe-industry collaborations, the following are some of the challenges cited by the interviewed HEIs:

- Lack of funding to support immersion activities with industry partners
- Focused academic approach on entrepreneurial courses
- Difficult inculcating an entrepreneurial mindset in students
- Only practices technology extension and not commercialization
- Hesitation of the industry to share challenges with the academe
- Collaboration gaps between colleges in an HEI due to timeline differences

To provide more information on the experiences and challenges, we also conducted a survey with the University of the Philippines and its industry partners regarding academe-industry collaboration.

On the academe side, the survey showed that out of the 111 respondents, most had collaborations mainly with their co-faculty (88.3 percent), government agencies (67.6

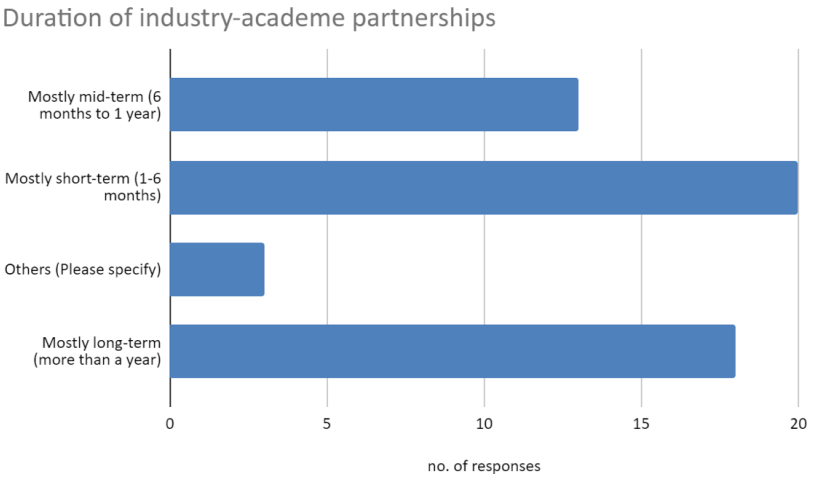
percent), and the industry (51.4 percent). In addition, more than half (65.8 percent) had a strong willingness to engage in collaborative activities.

Following the initial survey, respondents were asked follow-up questions to determine their motivations for engaging in industry-academe collaboration, and the activities they conduct. From the university perspective, they usually collaborate with the industry on training and workshop design/delivery, and research activities. Their main motivation was to solve technical problems and reduce risk, gain access to facilities and resources, establish long-term partnerships, develop products, and enhance reputation or branding.

For the industry, there were 236 respondents, however, only 89 were able to complete more than 70 percent of the survey. Out of the 89 respondents, only 60 were from the private sector, for-profit-organizations (FPOs), non-government organizations (NGOs), and others. The remaining respondents were affiliated with government agencies, and thus were not included in the analysis. As such, the total number of valid industry respondents was 60.

Ninety percent or 54 of the 60 respondents had previous collaborations with universities, which focused mostly on training and workshop design/delivery, internships, and research (joint R&D, basic research, sponsored research, field study/analysis, policy analysis/ development, and the like.)

FIGURE 4. DURATION OF INDUSTRY-ACADEME PARTNERSHIPS

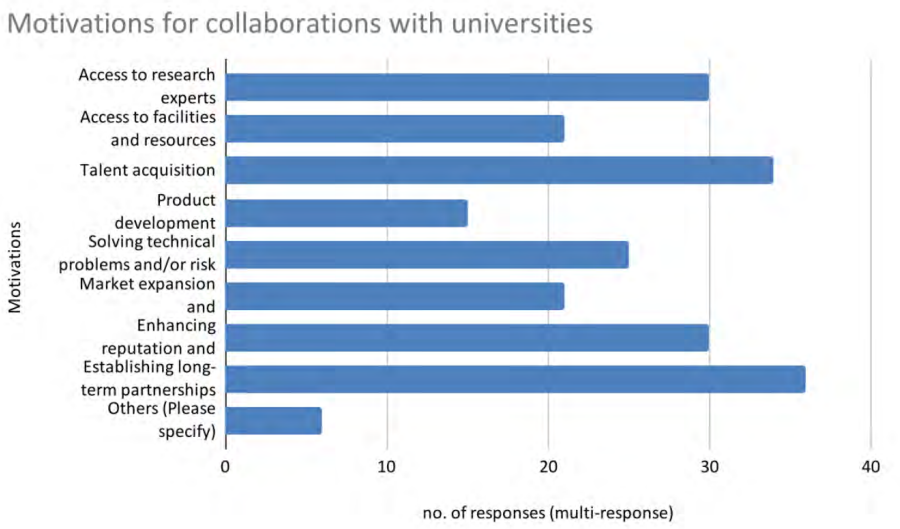


37 percent said that most of their collaborations were short-term (lasting only one to six months) and project-based. The industry's main contact points in engaging with the

university were their own networks, professors and staff they personally know since they are alumni of the same HEIs, recommendations of other collaborators, professional working sites (e.g.,LinkedIn), and the university website.

The five main motivations for engaging in collaborations with the academe was to establish long-term partnerships, acquire talent, gain access to research experts, enhance reputation and branding, and solve technical problems and/or reduce risk. Other motivations include access to facilities and resources, and market expansion and commercialization.

FIGURE 5. MOTIVATIONS OF THE INDUSTRY FOR COLLABORATIONS WITH UNIVERSITIES

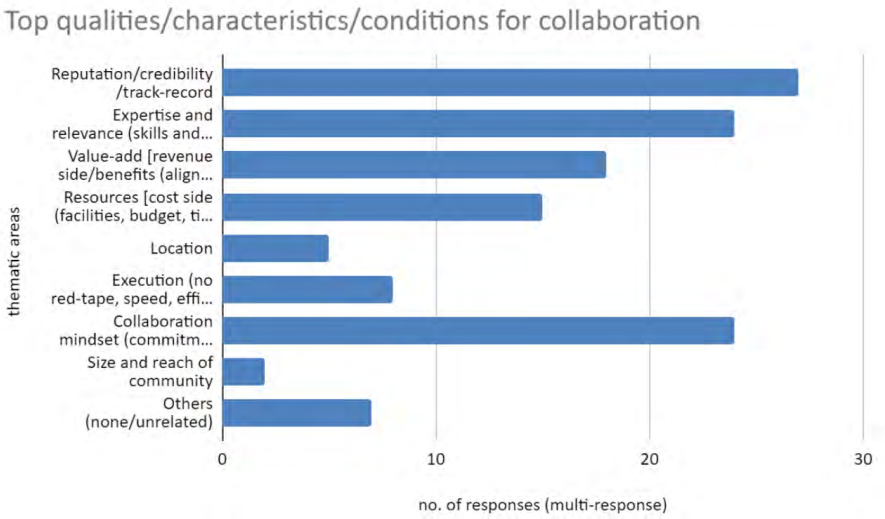


Out of the 60 respondents, only six had no prior collaboration with the university; this was due to a lack of connections with the university, unreasonable procurement processes, budget and time, and bureaucratic and incompetent administrators. However, some of the respondents had reasons that were related to their functions as an individual and not necessarily the nature of their institution(e.g., forming linkages were outside of their work scope and responsibilities). For those who had no prior collaboration with universities, they would be motivated to form partnerships based on collaboration outputs, personal initiatives (e.g., a desire to share experiences and a willingness to give back to their alma mater), talent acquisition, and opportunities for career development.

The top characteristics, qualities, and conditions for the industry to collaborate with universities were also asked and identified. Private companies, NGOs, FPOs, and other organizations gave much emphasis on the reputation, track-record and credibility of

the universities. This includes academic excellence, history of successful collaborations, branding, rankings, and experience. The industry also put value on the collaboration mindset of the universities, as exemplified by their commitment, openness and willingness for collaboration, and partnerships, relationships, and collaborative culture. Moreover, the industry also considers the expertise of the universities, which includes the institution's research capabilities, course offerings, and experience.

FIGURE 6. TOP QUALITIES, CHARACTERISTICS, OR CONDITIONS OF ACADEME FOR INDUSTRY COLLABORATION



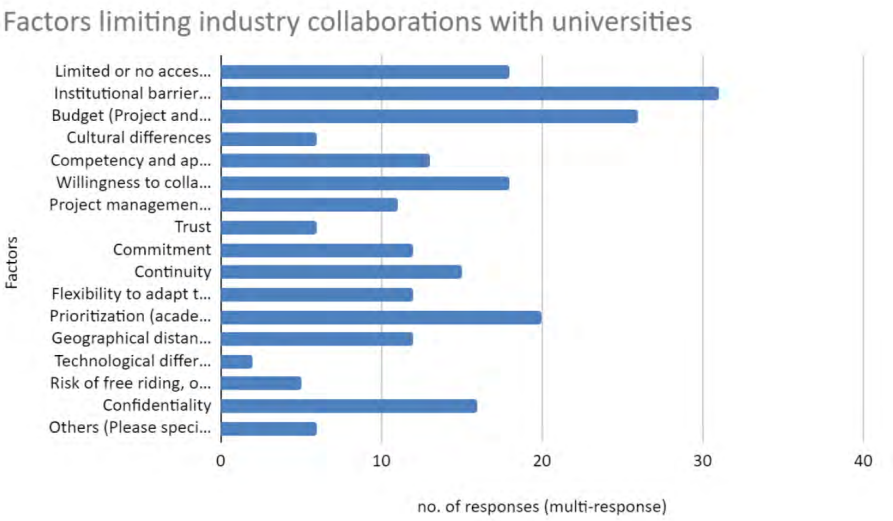
While the industry and universities engage in similar activities, their motivations somewhat differ. The university gives more weight to solving problems and developing products, while the industry focuses on building partnerships and accessing research experts and potential employees. This finding is consistent with extant literature that claim institutions have different roles in collaboration; universities are geared more towards knowledge production, industries focus on wealth creation, while the government aims to provide normative control (Cai and Amaral 2022).

Challenges

In the University of the Philippines, institutional barriers proved to be the main factor limiting their collaborations with industry. This includes slow decision-making, long contract reviews, tax cuts in the honorarium, and faculty load among others. Budget concerns (e.g., project and transaction costs) and continuity of the projects were the next factors that hinder them from engaging with industry partners.

For the industry respondents, the four main factors that limit or hinder collaborations with the academe were institutional barriers, followed by budget concerns, prioritization (e.g., academic objectives, industry priorities, etc.), and limited or no access to university resources/experts. Institutional barriers include administrative procedures and bureaucracy, and outdated procurement systems. One of the respondents also identified the "poor system of ensuring performance standards'' as a limiting factor.

FIGURE 7. FACTORS LIMITING INDUSTRY COLLABORATIONS WITH UNIVERSITIES



Curriculum mapping

Universities are not just educational institutions for knowledge production, but they are also R&D and entrepreneurship learning centers, vital in innovation creation and the triple-helix model (Asmara 2023). However, researchers and faculty members have limited resources to innovate beyond their capacity regardless of interest. Considering that student training is the primary role of the academe, there is a need to tap the student population and identify how the university can assist in promoting student innovation.

In Hall's (2021) study of the challenges encountered by students in "inside innovation" or innovating within the university, he found that students have difficulty understanding the bureaucratic processes, and identifying who to approach for collaborative opportunities. Hall also determined that students appreciated market assessments, business plans, and entrepreneurship training, and found them to be useful university support services. Hall

then recommends that universities implement technology entrepreneurship, partnered services, system add-ons, and immersions to encourage innovation.

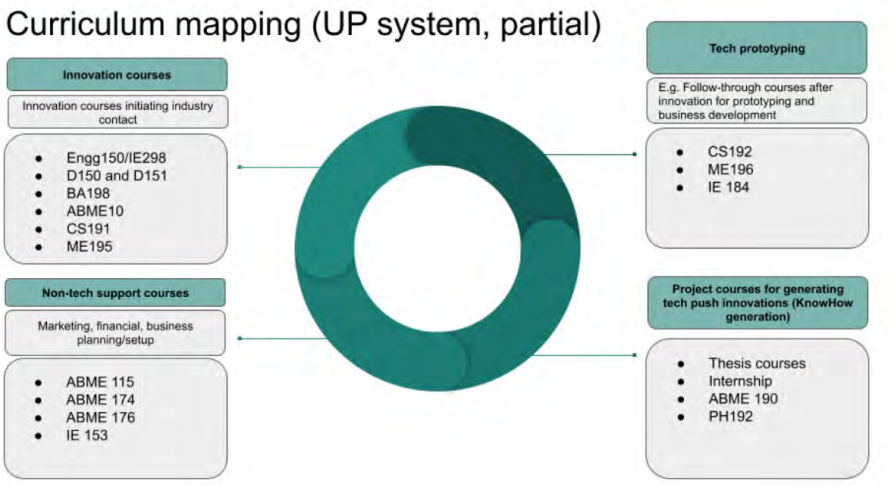
To support innovation and integrate entrepreneurship in the Science, Technology, Engineering, Agriculture, and Mathematics (STEAM) disciplines in the country, CHED mandated the addition of a General Education course, "Technopreneurship 101," in all engineering programs. The addition was made possible in 2016, through CHED Memorandum Order No. 57, "Implementing Guidelines for the Engineering Faculty Training on Technopreneurship 101."

Some of the key topic areas covered by the course are opportunity recognition and needs analysis, customer and market validation, pretotyping and prototyping solutions, and business fundamentals. These topics require collaborations with the industry that would allow for problem-solution alignment, and the validation of the design and cost of pretotype and prototype solutions.

However, other degree programs also offer courses with similar objectives. To give a full picture of the opportunities for innovation and points of student interaction with industry, this study conducted a curriculum mapping of the University of the Philippines System, while noting that the top universities in the country with a similarly diverse set of programs (including engineering courses) have a similar innovation curriculum map.

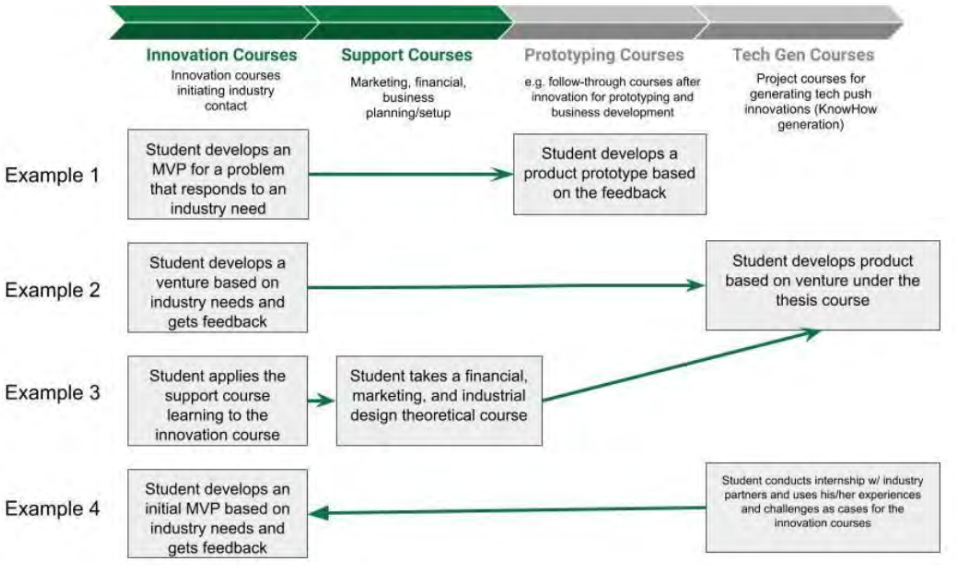
In the curriculum map, we categorized the courses into four types: innovation courses that have industry collaboration or contact, innovation follow-through courses, technology-push innovation courses, and support courses. The innovation courses include the CHED mandated Tech101 for engineering programs, as well as social innovation, product development, and entrepreneurship courses across other programs. The follow-through courses are the second part of the product development courses, focusing more on prototyping and business development while still integrating industry collaboration. The technology-push courses focus on research and skills development; these include the thesis and internship subjects, and entrepreneurship-focused courses. Lastly, support courses provide the theoretical background for product development, industrial design, marketing, finance, and business planning, which bolster the innovation and business development activities.

FIGURE 8. PARTIAL CURRICULUM MAPPING OF THE UP SYSTEM



Through this mapping, the study was able to lay down the innovation courses that the university can tap for academe-industry collaboration, as well as the other courses that can continue the ventures and support collaborations once the class ends. As an example, students who take innovation courses in the earlier part of the curriculum can conceptualize projects that can be developed further in their thesis subjects, which typically occur in the last part of the program. The figure below shows an example of a pipeline of curricular courses to support innovation continuity.

FIGURE 9. CURRICULUM FLOW FOR COURSE TYPES ON INNOVATION



After categorizing the courses under innovation, the study provided more information on the courses' reach, phase in the customer development process, final output, potential next steps after the course, and problems encountered. Based on the initial data, most innovation courses are program-specific and ladderized, meaning students can only take the course after completing other required courses.

However, only a limited number of courses were included in the mapping. For future studies, inclusion of courses from all colleges will paint a fuller picture of the available courses in different specializations. In addition, inclusion of course timelines would be essential to streamline the pipeline, and map out collaborations between courses.

Curriculum collaboration

There are two challenges in implementing the collaborative and integrative curricular ecosystem above. The first is providing opportunities for students from different programs to directly interact with each other in the same class. The second is creating pathways for innovation opportunities and project outputs to flow from one class to another. Both of these challenges are present in the traditional siloed implementation of entrepreneurship and innovation courses; each degree program offers their courses exclusively to their students, thus limiting the possibility of interaction between different courses, or different departments and colleges.

The first step to addressing both challenges is to simply map the relevant courses in a university, and then facilitate networking among the faculty teaching these courses.This will open up informal mechanisms for innovation, such as sharing of project documentation from students of other courses and programs. Potential intellectual property (IP) issues in such arrangements can be addressed by 1) having clear IP policies that recognize and incentivize contributors to the IP, and 2) working with the university's IP or technology transfer office to track the different co-inventors and co-authors of the IP as the project progresses.

Addressing the challenge of direct student collaboration during the semester would require finding one or more common schedules for students of different programs to attend. This is generally easier for a single college, or for courses offered as a general elective across the university. The disadvantage of general electives is that fewer students might take them, as compared to required core courses. One alternative is to allow students from other colleges to take a core innovation-related course in their own college, and get it credited as a general elective.

Another alternative is to review the rubrics of two courses that are offered during the same semester (e.g., one from engineering and one from business), identify common criteria for choosing a project, facilitate networking to allow students from both courses to form groups, and then have the members work on the respective deliverables for their classes. Common presentation schedules can be arranged for both classes as a culminating activity. As an example of a collaborative activity, mechanical engineering students can develop the machinery for a project, while electronics engineering students can take charge of developing the instrumentation for the system. Another example could be having the engineering students prototype a software application, while the business students perform market research and financial analysis.

To address the second challenge of providing project continuity from one semester to another, mechanisms that not only encourage sharing of project documentation, but also grant access to external/customer contacts must be established. This role can be carried out by the research office, the technology transfer office, the innovation hub, or the technology business incubator of the university. Incentives or seed funding support for worthwhile projects can also ensure project progression.

ASEAN Benchmarking

In Indonesia, one of the driving commitments for innovation is their focus on increasing the number of entrepreneurs by five percent–taking advantage of the demographics as mentioned by the Coordinating Minister for Economic Affairs Airlangga Hartarto (Saputra and Ruhman 2023). Similarly, they have demand-creating policies that enable universities to collaborate with specific industries. One example is the presidential regulation supporting the implementation of carbon capture and storage (CCS), allowing CCS businesses to allot 30 percent of their storage for imported CO2 (Reuters 2024). This incentivized both a university and industry to align their priorities and collaborate on the opportunities provided by the regulation.

We also conducted interviews with Indonesian universities and a best practice of one university is the creation of subsidiary or university-owned companies that serve as teaching industries for students, while simultaneously furthering collaboration with industries. In terms of curriculum, one best practice of another Indonesian university is the establishment of a compulsory subject on entrepreneurship in all degree programs.

Conclusion & Policy Recommendations

Demand-creating policies

While demand-creating policies provide an opportunity to support the growth of key sectors in our economy, supply chain issues and limited academe-industry collaborations prevent these policies from achieving their objectives. Increased collaboration would provide innovative and cost effective solutions, workforce training, and market and business intelligence. Policy implementation would benefit from the following practices that were identified in benchmarking with other countries such as Vietnam and Australia:

- **Alignment of research roadmaps with demand-creation policies.** Implementing agencies or councils created by the policies can conduct activities such as collaborative research planning or proposal writeshops to support the overall industry roadmap. Conversely, industry and university consortia might also include crafting of demand-creating policies as a key output to support their industry.

- **Quantitative targets over a fixed time horizon.** Industries in other countries are constantly working to improve their own competitiveness, so it is important that the roadmap is implemented in a timely manner. Setting quantitative targets also helps the organization evaluate and prioritize interventions, especially when resources are limited.

- **Progressive management of R&D (open innovation) and tech transfer (i.e., licensing to OEMs) by an experienced executive team.** The impact of an R&D collaboration is measured in technology utilization by the industry. An executive team with experience in developing and deploying products and services will facilitate the path to impact.

- **Longer grants (at least five years) for continuity and impact.** The longer period would make it easier to develop game-changing solutions, retain the research team, and speed up the technology transfer to the industry.

- **Business prospectus with comparative investment analysis.** Ultimately, innovations are adopted by the industry not only on its technical merits but also for its financial viability. New technologies need to be benchmarked with competing options to facilitate decision-making.

- **Technical and management training for industry.** Universities are ideal for this necessary role as they can complete the technology transfer package.

One method to integrate these recommendations in public policy is to identify the target outcomes for each demand-creating policy, then work backwards. Let's illustrate this approach using RA 11037, or the Masustansyang Pagkain para sa Batang Pilipino Act. Key stakeholders and customers are institutions that run feeding programs for children, which would include DepEd, local government units (LGUs), and the Department of Social Welfare and Development (DSWD) in the public sector, as well as related NGOs in the private sector.

For DepEd in particular, we must first identify which education outcomes are affected by nutrition, such as intake of calories, vitamins and minerals. We must then develop a roadmap for providing cost-effective sources for these nutrition inputs that would also appeal to students on a sensory level (taste, texture, smell, and appearance), while constructing mechanisms to track child nutrition and its impact on education outcomes. Third, we must identify gaps and interventions in the supply chain (e.g., farming, post-harvest, food processing, and logistics/distribution). Interventions should be ranked according to impact and difficulty in order to better allocate scarce resources and quickly deploy solutions. Finally, with the ranking of interventions in place, quantitative and achievable time-bound targets for community nutrition (e.g., percentage of students with calorie, iron, and iodine deficiency), can be set with confidence and appropriate budgets allocated to scale the priority interventions.

Curricular ecosystem development

There is great potential for contributions by students in industry collaboration, considering their required project, thesis, and dissertation courses in many academic programs. Not only can they assist in R&D, they can also serve as the initial contact with the industry, and can expand the reach of the collaboration. Hence, we can maximize the participation of students in innovation and collaboration through the following:

- **Ensure that Technopreneurship 101 implementations include industry contact and market validation.** Students should tap and address industry needs in developing their ventures, and get feedback for further development. Reviewing demand-creating policies can be a starting point for understanding industry needs.

- **Provide mechanisms for students to interact with industry and collect industry challenges.** One of the challenges in the innovation courses is finding industry partners for students to collaborate with. Hence, it is important for the academe to seed the discussions with the sectors covered by demand-creating policies, and share the challenges with the innovation courses. The academe should also form partnerships with DTI and other agencies to connect with Micro, Small and Medium Enterprises (MSMEs), NGOs, and other industries in the courses.

- **Provide a course series or interaction mechanism between courses to create a pathway for progress in product and customer development.** To maximize student outputs, a course series should be developed to give the students a background on where and how they can escalate their ventures, for both technology development and customer development. This will give them the opportunity and motivation to create outputs that they can use and continue beyond a single course.

- **Create mechanisms for interdisciplinary collaboration in courses.** Collaboration is one of the important skills for students to thrive in the 21st century. However, most innovation courses are program-specific, limiting student interaction with other colleges, thereby limiting their outputs. One of the challenges is the lack of either technical or business background of the students due to homogeneous settings. Through curriculum mapping, the academe can plot where, how, and what the students can collaborate on to produce more holistic outputs. This will also decrease the possibility of redundant projects among the students.

- **Provide funding incentives for students and faculty advisers to continue the ventures.** Another roadblock for students is the lack of funding to continue their outputs beyond the class, compounded by the need to find a job after graduation to support their families. Hence, students should be given access to funding to further develop their outputs beyond their degree program. The academe can also provide support by taking on the students' outputs through their faculty advisers.

Areas for Further Research

While we were able to provide an in-depth analysis of a key institution and industry sector, as well as an initial sensing of other institutions and industries through interviews and surveys, it is still important to confirm how well these insights hold up with the general population, and expand the regional benchmarking of best practices. We outline the next steps below:

- Conduct ASEAN sector case studies (preferably with available impact assessment, e.g., CRC Australia)
- Profile university involvement in industry roadmap implementations (e.g., Vietnam bamboo)
- Perform local stakeholder validation
- Implement sector profiling of other existing demand-creation policies (e.g., Philippine Tropical Fabrics)

- Conduct an in-depth analysis of the courses in other categories, and curriculum mapping with other universities

Acknowledgement

We are grateful for the support of the University Partnership with industries and Communities to Hone Innovation and Participation (UP CHIP) program team led by Asst. Prof. Remund Jordan B. Labios and Asst. Prof. Renen Szilardo C. De Guzman from the University of the Philippines Los Baños and UP Emerging Interdisciplinary Research in data gathering. In addition, we thank the HeLe project team led by Dr. Charlotte M. Chiong of UP Manila. We also thank the Department of Trade and Industry, Asian Development Bank, and the PRISTINE Working Group for connecting with state and international universities. We thank the UP constituent universities, Batangas State University, Mariano Marcos State University, University of Science and Technology of Southern Philippines, Adamson University, Ateneo de Manila University, and Technological Institute of the Philippines for their insights and support in the study.

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This policy paper is funded from the UP President Edgardo J. Angara Fellowship Award for 2024, and is released under the Monograph Series published by the University of the Philippines Center for Integrative and Development Studies.

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