Science, Technology, Research and Innovation for Development (STRIDE)

Philippines Innovation Ecosystem Assessment

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List of Acronyms and Abbreviations

ASEAN	Association of Southeast Asian Nations
BPO	business process outsourcing
CHED	Commission on Higher Education
DOST	Department of Science and Technology
DTI	Department of Trade and Industry
ERDT	Engineering Research and Development for Technology
ESO	entrepreneur support organization
GEMS	Green Enviro Management Systems, Inc.
GERD	gross expenditure on research and development
GDP	gross domestic product
GPPB	Government Procurement Policy Board
IPOPHIL	Intellectual Property Office of the Philippines
ITSO	Innovation and Technology Support Office
ISI	Institute for Scientific Information
HEI	higher education institution
JICA	Japan International Cooperation Agency
MUST	Mindanao University of Science and Technology
NCR	National Capital Region
OECD	Organisation for Economic Co-operation and Development
PCIEERD	Philippine Council for Industry, Energy, and Emerging Technology Research and Development
PBEd	Philippine Business for Education
P-GUIRR	Philippine Government–University–Industry Research Roundtable
PHP	Philippine peso
R&D	research and development
STAC	Science and Technology Advisory Committee
STEAM	science, technology, engineering, agriculture and mathematics
STEM	science, technology, engineering, and mathematics
STRIDE	USAID/Philippines Science, Technology, Research and Innovation for Development Program
SUC	state universities and colleges
TESDA	Technical Education and Skill Development Authority
USAID	United States Agency for International Development
UP	University of the Philippines

I. Introduction

The USAID/Philippines Science, Technology, Research and Innovation for Development (STRIDE) Program is implemented by RTI International with partners Rutgers University, Florida State University, Philippine Business for Education (PBEd), and the University of Michigan-William Davidson Institute. The mission of USAID's STRIDE is to spur inclusive economic growth by boosting the capacity of Philippine universities to conduct science and technology research aligned with the growth requirements of the private sector, building up the innovation ecosystem for the benefit of the country.

STRIDE has conducted this assessment of the Philippine Innovation Ecosystem to identify critical strengths and weaknesses as identified by Philippine stakeholders, and interpreted by STRIDE. It is intended to be an opportunity for a representative cross-section of Philippine stakeholders from government, university, and industry to provide perspective and direction to STRIDE in its efforts to improve the research and innovation environment. The assessment is not intended to be an authoritative statement on the innovation ecosystem, nor to reflect the opinions of STRIDE or USAID, nor to substitute for data-driven assessments. It is, to our knowledge, the first known attempt to understand how specific challenges originate and ripple through different areas of the ecosystem.

In particular, the assessment was prepared to inform the activities of the Philippine Government University Industry Research Roundtable (P-GUIRR), a new consultative body supported by STRIDE, which is intended to provide a neutral forum for stakeholders in the science, technology, and innovation to discuss critical challenges and collectively devise locally-appropriate solutions. The assessment is being released on the occasion of its first meeting in November of 2014.

Section II provides an overview of the innovation ecosystem assessment model, the resulting scorecard, and the process STRIDE used to conduct the assessment. ***Section III*** summarizes stakeholders' views on each factor in detail, resulting in a completed overall scorecard for the Philippine innovation ecosystem. ***Section IV*** presents four key cross-cutting chains of impacts that have far-reaching impacts and suggests ways that STRIDE stakeholders, including the P-GUIRR, can address the underlying causes to achieve durable improvements in innovation performance.

II. Assessing interactions between university research and the economy

What Is an Innovation Ecosystem?

According to the U.S. National Science Foundation, *innovation ecosystem* refers to the "economic…dynamics of the complex relationships…between actors or entities whose functional goal is to enable technology development and innovation."[1] Growth of the innovation

[1] Jackson, D. (2011). What is an innovation ecosystem? Arlington, VA: National Science Foundation. Internet Retrieval: http://bit.ly/1yTOPcq.

ecosystem requires two distinct but interdependent systems—the knowledge economy (driven by fundamental research) and the commercial economy (driven by the marketplace). In order for an innovation ecosystem to grow and be self-sustaining, two conditions must hold. First, a percentage of the profits of the commercial sector must be channeled to *investments in (fundamental) research*, either through direct expenditures or via taxes that provide government funds to this research. Secondly, these investments must ultimately lead to *innovation-induced growth in the economy:* additional profits in the commercial economy that are, in financial terms, meaningfully larger than the original investments. In a virtuous circle of innovation, part of these increased profits are re-invested in research, either directly or through taxation, promoting healthy growth of the innovation ecosystem.

> ***A healthy innovation ecosystem channels some of the profits from the private sector into research and innovation, resulting in innovative commercial products that grow the economy. When this succeeds, it creates a "virtuous circle" of more research and innovation and more innovation-driven profits in the economy.***

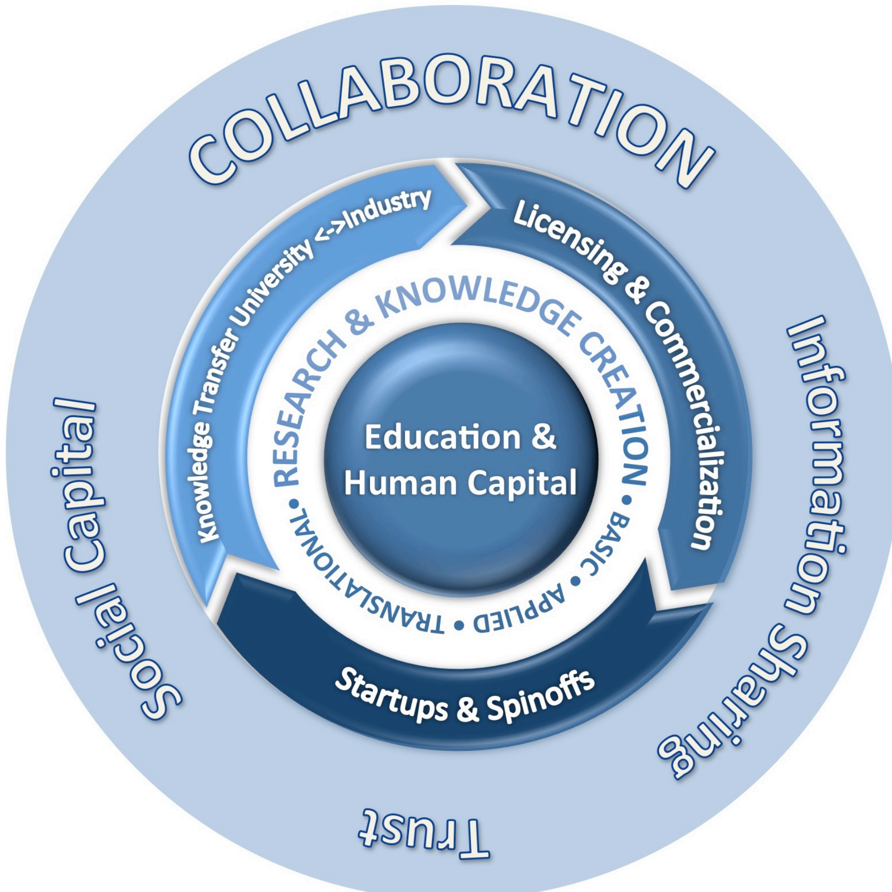
Every country has a different mix of institutions (mechanisms, organizations, actors, and governance arrangements) to facilitate the journey from fundamental research to commercial profitability. Because most (more than 90 percent of) technologies or innovations fail to complete this journey, the quality of these institutions is critically important. Furthermore, in developing and middle-income countries that are new to the innovation process, very little can be assumed about which institutions are in place, how well they work, and whether they are contributing to the health and growth of the innovation ecosystem. Assessing the innovation ecosystem requires a coherent model that is adaptable to widely varied national conditions.

The RTI/STRIDE Innovation Ecosystem Model

This assessment uses a model of the innovation ecosystem developed by STRIDE implementer RTI International in its worldwide work helping governments, businesses, and universities harness innovation for economic growth. This model, illustrated in ***Exhibit 1***, encompasses five dynamic processes and one contextual factor. The five processes are (1) education and human capital development; (2) research and knowledge creation; (3) direct collaboration between universities and industry, particularly but not exclusively through industrial extension and direct service provision; (4) intellectual property: protection, licensing, and commercialization of technology; (5) startup and spinoff companies based on technology and innovation. These processes occur in the context of (6) the environment for collaboration, including information sharing, trust, and social capital, which is represented by the outer circle.

The model puts the process of education and human capital development at the center, because the innovation enterprise depends most fundamentally *on educating people*, particularly in the science, technology, engineering, agriculture, and mathematics (STEAM) fields.

Exhibit 1. RTI/STRIDE Innovation Ecosystem Conceptual Model



Upon this foundation, the research and knowledge creation—basic, applied, and translational—that comprise the core activities of the knowledge economy can develop. While the ecosystem model is most focused on university-based research, the presence of *meaningful* research programs in government and private sector labs is also an important indicator of ecosystem strength.

Three (non-exclusive) pathways by which innovation can move from the knowledge economy into commercial application comprise the third concentric circle depicted in the model. All three of these pathways are built on the foundation of research and resultant knowledge creation.

Knowledge transfer between universities and industry is usually achieved by way of direct service agreements in which universities provide specific scientific or technical expertise to perform discrete analytical or other tasks on behalf of commercial clients. Often conducted under the auspices of "industrial extension," these are highly practical but relatively un-glamorous activities from the university perspective, largely because they do not normally yield new publication-worthy discoveries or patentable intellectual property. *Yet they are extremely important for universities to demonstrate their technical competencies to industry, building the foundation of trust that enables other types of productive collaborations with industry.*

Technology-based spinoffs and startup companies are a second pathway from research to the commercial marketplace. Typically, small growth-oriented firms are formed to commercialize the results of university (or other) research, frequently include the researcher as a member of the founding executive team or as chief scientist (though usually not as Chief Executive Officer due to the need for experienced entrepreneurs to perform key executive roles), may or may not be initially funded by venture capitalists or angel investors, and may maintain close ties to the institution in which foundational research was conducted. In addition to solid underlying technologies from research, this pathway typically requires marshaling significant entrepreneurial, managerial, and financial resources, particularly with new and un-tested technologies.

The third pathway is the **commercialization of research through licensing of properly protected intellectual property**—principally from universities but also from government labs and small private research firms, and most typically by medium or large companies seeking to harness new research to offer more innovative and profitable products and services. Licensing and commercialization rests on relatively sophisticated general legal infrastructure that protects intellectual property rights, as well as specific capabilities, both in licensor universities and in licensee firms.

Finally, we consider the **context for collaboration**, in which all of these activities occur. Since the beginning of contemporary innovation studies, researchers have found that innovation ecosystems thrive on a high-trust, collaborative, win-win culture like that found in Silicon Valley and Northern Italy, where shared commercial ambitions and meritocratic and cooperative norms of conduct combine to create "social capital." Depicted as the outer ring of the model, the general environment of collaboration influences the overall (level of friction) in the system.

Factors Considered and the Innovation Ecosystem Scorecard

In constructing this assessment, and in considering the development of innovation ecosystems in middle-income countries worldwide, we noted that in many cases, slow growth resulted from excessive "supply-side" focus, particularly in the training of science and engineering PhDs in situations with insufficient government funding and private investment in research. Similarly, public investment in applied research and technology development sometimes occurs without regard for whether the national business community has the capabilities and motivation to put innovations to use in the commercial sector. Entrepreneurs may have ideas and technology but markets for their products may not exist domestically, and access to global markets may not be assured. While "collaboration" tends to be self-reinforcing, all of the other factors and processes in the model can be understood in terms of distinct *supply* and *demand* conditions, and each is supported by specific factors of the overall enabling environment—the formal and informal laws, rules, and norms—in which these processes unfold. Failure to address any of these aspects can lead to less than optimal yields from investments in strengthening the ecosystem.

Therefore, to enrich our framework, STRIDE has focused this innovation ecosystem assessment on the supply, demand, and enabling environment for each of the first five dynamic factors, and on the *overall context* for collaboration.[2] This allows us to construct a scorecard (***Exhibit 2***) reflecting all relevant factors in the model in sufficient depth to identify the source of strengths and weaknesses in the innovation ecosystem at a granular and actionable level.

Exhibit 2. Innovation Ecosystem Scorecard with Illustrative Values

Factor	Supply	Demand	Enabling Environment
Education and Human Capital Development	○	○	○
Research and Knowledge Creation	◔	◔	◔
Transfer of Know-How between Universities and Industries (Extension)	◑	◑	◑
Intellectual Property: Protection, Licensing and Commercialization	◕	◕	◕
Startup and Spin-off Companies	●	●	●
Collaboration: Knowledge Sharing, Trust, Social Capital	○		

Key

○	◔	◑	◕	●
Poor	→	→	→	**Excellent**

Each of the 16 cells of the scorecard contains a (qualitative) rating, which is derived from the interviews conducted by STRIDE with more than 70 knowledgeable individuals from 55 stakeholder organizations involved in the Philippines innovation economy including Filipino and international business, government, academia, and non-governmental organizations. (See list of organizations consulted in **Annex A**). STRIDE conducted in-depth interviews with each stakeholder organization in Metro Manila, Cebu, and Cagayan de Oro on five separate research missions between December 2013 and September 2014, as well as limited telephone interviews. Average interviews were of ninety minute duration, a few large group interviews lasted more than two hours, and a very small number of interviews lasted one hour or less.

Each interviewee was presented with the factors in the assessment model and asked to comment on those about which he or she had specific expertise or experience. In addition to the assessment model factors, STRIDE also asked stakeholders to share their experiences with successes and failures in the innovation ecosystem, particularly where industry-academe

[2] Complete definitions for each factor and sub-factor are presented in **Annex B**.

interactions were involved. Interviewees were assured that their remarks would be reported accurately but not attributed specifically in the publication without specific permission. The format of reporting conclusions in this assessment reflects this assurance.

III. Key Findings by Factor/Process

This section provides summary tables followed by the most important findings in each of the six factors we assessed. The summary tables (***Exhibit 3 through Exhibit 8***) throughout ***Section III*** present ratings and evaluation factors for each sub-factor (supply, demand, and enabling environment). The first (top) row presents the sub-factors. Immediately beneath, the final ratings for each sub-factor appear. These ratings are also presented in the scorecard at the end of this section. The bottom row presents the sub-factors that comprise the "definition" we used as a starting point for assessing each of the sub-factors. We also encouraged interviewees to suggest other issues that they perceived as important.

Education and Human Capital

While the quality of STEM-related training is acceptable by global standards, the supply of STEM graduates continues to exceed local demand, leading to continued out-migration of skilled people and under-employment of many locally trained scientists and engineers. At the same time, there are reported acute shortages of training for critical innovation-driven fields, particularly in high-demand IT occupations. The higher education environment—including both public and private—is perceived to be working, as evidenced by strong global demand for Filipino graduates, but should be more aggressive coordinating with employers to ensure that course content and professional licensing keep pace with emerging technology trends. Additionally, important questions have been raised about whether the lack of a strong research culture in universities, when combined with limited opportunities for specialization, leaves students ill prepared for the most demanding aspects of science and technology innovation.

Exhibit 3. Assessment Sub-Factors and Rating: Education and Human Capital

Supply	Demand	Enabling Environment
◑	◔	◕
STRIDE assessed the quality and quantity of training: • Postgraduate STEM training • Undergraduate STEM training • Technical training • Foundational STEM education	STRIDE assessed the demand for STEM skills: • Financial returns to education • Student & family preferences • Employers: Domestic • Employers: Foreign investors • Employers: Overseas	STRIDE assessed the rules, regulations, and enablers, including: • Accreditation and standards • Results-based quality control • Labor market information (occupational & demand) • Education finance

Supply-Related Findings

Graduates from Philippine universities continue to "staff the world," according to stakeholders, with the country exporting skilled technical personnel in abundance to companies worldwide and attracting significant offshore technology and engineering research operations. Moreover, many institutions succeed in this mission without either sophisticated laboratory resources or faculty with advanced degrees. Both domestic employers and international businesses operating in the Philippines rated entry- and mid-level technical personnel (bachelor's and master's level) as technically capable and well trained; they attributed this relatively high rating to good foundational classroom instruction and the strong priority that students and their families place on the educational work ethic. Food industry representatives, in particular, were highly complimentary of master's-level training. Several employers in IT, electronics, and food products noted that not only the "top universities" are producing highly skilled technical graduates. Philippines' provisional membership in the Washington Accord, under which numerous engineering schools will gain global accreditation equivalency, substantiates claims of rising quality, a notable achievement for a system that has until recently trained graduates with only a K to 10th grade educational foundation.

At the same time, STEM graduates are perceived as lacking exposure to "current best practices" and to the creative possibilities of technology, and this in part creates the need for significant (6 to 18 months) additional training for technical employees hired in multinationals. One informant also commented on declining interest in STEM careers and weakening foundational skills, though STRIDE could not confirm this. At the very advanced level, the relative lack of STEM-oriented PhD programs, and the near-total absence of post-doctoral research training, constitute important limitations to the innovation ecosystem. Representatives from several companies from the chemical, microelectronics, and IT industries noted that the absence of specialized technical talent at the PhD level reduces innovation in their products and services. They also noted that top master's-level scientists frequently leave to do PhD studies abroad. One noted that universities often do not have the resources to offer a diversity of the permitted specializations that were created specifically to provide flexibility under current professional licensing arrangements.

Demand-Related Findings

Demand for education and human capital development refers to two audiences: student demand for STEM-related training and employer demand for students with this training. We have alluded to several positive factors related to demand in the prior section. First, education is highly valued among Philippine students and their families, who are also relatively receptive to official messages about the opportunities in specific careers (if somewhat risk averse). Families are seen as actively involved in the career choices of students. Second, domestic and foreign companies appreciate the quality of Philippines' technical workforce, and in many cases must compete with employers abroad who are also recruiting technically skilled Filipinos. Additional demand for technical personnel at the BS/MS level is evidenced by renewed growth of employment in multinational R&D operations in Luzon and Cebu such as Dash Engineering (≈500 R&D employees), Leer Philippines (≈600), NCR (>600), HGST (>200), Fluor Daniel (estimated 200–2000 R&D employees), Shell, Tsuneishi, and others.

Uptake of technical personnel by less advanced domestic industries is more limited, however, and overall, the impression created by interviewees is that the supply of technical personnel far outstrips local demand *and* that many local companies that would hire technical personnel cannot compete with overseas employers or the Business Process Outsourcing (BPO) sector. Evidence for low demand for technical personnel is found in the observation that many engineers, particularly from universities outside of the first tier, are working upon graduation as technicians, and competing with graduates of technical training programs such as those offered through Technical Education and Skill Development Authority (TESDA) training institutions. At the same time, many Filipino scientists, particularly after completing PhD studies, choose to remain abroad to work, where there is higher demand and richer pay. Exacerbating this problem, inflexible government human resources regulations designed to limit the growth of bureaucracy are reportedly preventing public universities from hiring talented PhD graduates wishing to return from abroad, impeding the growth of the research enterprises and leaving many universities without the teaching resources they need. Several companies also reported that strong demand from overseas companies with higher pay scales makes *retention* of talented Filipino scientists difficult. These findings suggest that local companies may not be adding enough value through innovation to pay the wages required to retain advanced technical personnel, and this is highly discouraging. It also suggests that STRIDE and key stakeholders need to be careful in ensuring that new PhDs/researchers align well with actual industry needs *revealed by willingness to pay for skills*.

Finally, strong demand for technical personnel in the rapidly growing IT-related industries may be beginning to crowd out other technical interests such as chemical, mechanical, and industrial engineering, and this further threatens the skill base required for diffusion of innovation throughout the Philippine economy. Three interviewees reported that higher paying jobs in BPO operations (call centers) are attracting skilled technical personnel away from the lower paying technical and technician jobs that are more prevalent in the manufacturing sector. Government initiatives to grow the Knowledge Process Outsourcing (KPO) segment of the economy could exacerbate this trend, making it more difficult for domestic companies to find the technical personnel they need.

Enabling Environment-Related Findings

There has been a lot of change in the enabling environment for education in recent years. Interviewees reported generally positive impressions of the Commission on Higher Education's (CHED) initiative to rationalize the higher education marketplace by imposing research and publishing requirements on higher education institutions (HEIs) designating themselves as universities. Initiatives to reform the professional licensing system, increasing the labor market relevance of education for science and engineering professions and offering universities more flexibility in defining specializations for undergraduates are viewed positively as addressing an important and longstanding need. Philippine accession to the Washington Accord, which aims to harmonize engineering education standards with those in key markets around the world, also suggests an encouraging level of university leadership commitment to upgrading. Each of these initiatives addresses one or more widespread concerns among interviewed stakeholders, though none is yet complete enough to determine its ultimate success. Interviewees also praised CHED in particular for its ability to respond relatively decisively to concrete opportunities identified by the private sector, the most recent example being the curriculum initiative on analytics (in partnership with IBM).

Nonetheless, two concerns raised by interviewees in particular deserve attention. First, it is difficult for accreditation systems worldwide to keep up with changing skill requirements of employers, especially in rapidly evolving technology industries. Interviewees noted that CHED in particular must be vigilant in coordinating with employers regarding changing skill needs and must pay particular attention to the needs of emerging (local) industries as well as large global players in defining and approving courses and initiatives. Second, some researchers reported that inflexibility in thesis/dissertation research requirements and formats actively limits innovation and makes it extremely difficult for graduate students to advance interdisciplinary science through their research. Addressing these issues could strengthen innovation capacity.

Research and Knowledge Creation

Although the Philippines is widely perceived as lacking a strong culture of research, young researchers in particular are seen as interested in and capable of important innovations and offer great hope for building a stronger ecosystem. An important and largely hidden concentration of multinationals' engineering research centers also suggests that more applied research happens in the Philippines than is typically acknowledged. Unfortunately, the university system lacks the appropriate *incentives,* both for individuals to consider research as a career, and for institutions to produce *globally competitive and commercially relevant* research outcomes. In particular, more strategic targeting of government research funding priorities and critical improvements in the enabling environment for research are necessary to unleash the system's potential.

Exhibit 4. Assessment Sub-Factors and Rating: Research and Knowledge Creation

Supply ◑	Demand ◔	Enabling Environment ○
STRIDE assessed the: • *Researchers, graduate students, university research labs, research networks and Centers of Excellence (COEs) • *Research management capabilities, corporate/business R&D • *Private research entities, government research centers, international research networks, including those in the Philippines	STRIDE assessed the: • *Government funding agencies, • domestic private sector funders and collaborators • *International private sector funders and collaborators • *International academic/ foundation/multilateral funders and funding networks	STRIDE assessed the: • *Regulatory framework, • specific regulatory barriers (procurement/purchasing) • *Institutional support systems and rules/incentives (e.g., costing of research) • *Inter-university networks for research collaboration

Supply-Related Findings

At the leadership level, an institutional consensus on the importance of research in Philippine development is emerging, and there is as a result, a renewed and widespread effort to increase research output and quality by government agencies, though it is too early to claim that a critical mass of research is occurring. Interviewees noted, though, that the younger generation of university faculty, especially returnees from graduate studies abroad, is very engaged with and interested in conducting research. As such, these faculty members make attractive hires. De La Salle University is, for example, creating research-focused staff positions to attract and retain talented young researchers until appropriate full-time faculty positions become available—a novel form of supply cultivation. Interviewees held mixed opinions on the quality of supply: some noted that Philippine universities are "great at research, but not so great at productizing their research," while others cited the presence of a few very strong researchers in key departments. Finally, outside of the university sector, there is an important concentration of U.S. and Japanese multinational companies' regional and global engineering R&D centers in the Philippines in several industries, including aerospace, automotive, construction engineering, microelectronics, and petroleum, as mentioned above. These activities are relatively hidden from the public view, and many remain disconnected from most local industries. Nonetheless, their scale, diversity, and continuous presence since the 1990s are positive indicators of innovative activity.

Challenges on the supply side fall into three categories—cultural, institutional, and faculty. The lack of a highly developed *culture of research* in the Philippines relative to regional peers including Thailand, Malaysia, and Singapore was a common refrain among stakeholders. Interviewees also agreed that highly visible successes in research will contribute to changing this culture, and that a key challenge is working towards this goal through scientific, entrepreneurial, and public relations vehicles. At the institutional level, we note that prior to CHED accreditation reforms, there have been few permanent incentives and many disincentives for administrators for promoting research. This observation is discussed in detail in ***Section IV*** of the assessment. Interviewees representing academia observed that the best researchers are typically promoted to administration roles, losing the time and incentive for research relative to other priorities. Public institutions in particular are also seen as frequently failing to provide appropriate start-up funding and equipment packages for young researchers, particularly those returning from PhD studies abroad with more advanced research agendas. The Philippines' leading research institutions also remain concentrated in Luzon, though important clusters of marine, environmental, and agricultural research throughout the country means that this concentration is less pronounced than in other fields. At the level of individual faculty, the continued perception of greater prestige in basic research than in more applied areas of interest to Philippine concerns continues to influence the supply of research, and very few universities or faculty members are seen as striking the right balance. Several interviewees observed that older faculty members are much less interested in research than the very young, but that mid-career researchers are notably absent, perhaps because limited research budgets cannot yet sustain them. Others noted that research teams tended to lack the depth required for institutionalization and sustainability except in a few outstanding research centers within the University of the Philippines (UP) system. Finally, new faculty returning from abroad are perceived as overly tied to continuing their PhD research agenda rather than shifting to topics that are of more direct relevance to Philippine industry or development challenges.

Demand-Related Findings

Total demand for research as measured by public and private expenditure is rising from an extremely low base relative to most regional peers. A government official emphasized that the Philippines has not reached critical mass with respect to the volume of research conducted in order to drive an innovation economy. DOST sources reported that their research budget is doubling every year, but would have to increase by 300 times (30,000 percent) to achieve the 1 percent of the gross domestic product (GDP) benchmark. This too is common knowledge in the scientific community,[3] and most stakeholders have participated in discussions on strategies to increase public funding for research.

Even with significant advances, though, the *potential* supply of research still far outstrips demand and associated funding. Regardless of whether official or un-official estimates of gross expenditure on research and development (GERD) are used, Philippines total research expenditure is low, falling far short of the commonly accepted target of 1 percent to support a healthy innovation ecosystem.[4] One knowledgeable government official suggested that official figures underestimate public research spending, which he estimates at PHP 2 billion annually, while STRIDE believes that the GERD may be underestimated to some degree due to hidden R&D activities in multinational companies' Philippine operations.

Despite the limited scale of the research enterprise resulting from limited resources, interviewees cited hopeful signs throughout the ecosystem. They pointed to efforts by CHED and DOST to enhance the funding base and noted that the DOST program to provide seed funding sources for young researchers is extremely promising. Direct financial incentives to researchers provided by CHED—PHP 50,000 for ISI-listed publications and PHP 20,000 for international conference presentations—certainly constitute an important and direct demand-side stimulus for faculty involvement in the research enterprise, though one interviewee suggested that they also may suppress interest in applied research activities less likely to result in international publications. Key university departments and researchers are also successful in attracting not only domestic, but also US, Australian, and European funding as collaborators in international research programs, particularly in marine, environmental, and agricultural sciences. In addition, there is real, though difficult to quantify, demand in the Philippine private sector for research and development services, and these are currently met principally through scientists "moonlighting" as consultants.

A need for qualitative improvements in the structure of R&D funding—the demand side—was also noted. A number of interviewees from diverse organizations and interests noted the need for more *strategic targeting* of government R&D investments and greater *accountability for results*, particularly in DOST grant mechanisms. Interviewees called for broader representation in

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[3] See Clarete, R., Pernia, M., Gaduena, A, and Mendoza, A. (2014, June).The role of science, technology and research in economic development. Discussion Paper No. 2014-07. Quezon City, Philippines: University of the Philippines. Internet retrieval: www.econ.upd.edu.ph/dp/index.php/dp/article/view/1460

[4] For the source of this standard, see UNESCO, http://stats.uis.unesco.org; for a critical review of the measure, see Godin, B. (2004, October). The obsession for competitiveness and its impact on statistics: The construction of high-technology indicators. *Research Policy*, 33(8), 1217–1229.

http://www.sciencedirect.com/science/article/B6V77-4DB5BPY-1/2/3b70016507b4ff81bedc2e58aa499a7e formulation of research plans, with an emphasis on defining end-users' needs, particularly focused on the technology roadmaps of key Philippine industries. Some called for reducing academic influence in the definition of research agendas. One interviewee suggested that accountability means that funders should themselves better define key milestones in a multi-year research planning cycle and ensure that researchers deliver adequate progress. STRIDE notes that forcing accountability on scientists who cannot obtain equipment and supplies in a timely manner would not be entirely fair. Finally, slow application processes for key research funding and outsized compliance burdens were mentioned as weaknesses in the structure of demand.

To these ends, DOST's Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) indicated that it has re-structured grant programs away from academic-defined agendas and towards "directed R&D," which is intended to shift funding into more applied uses with higher commercialization potential. A CHED-sponsored process led by the Development Academy of the Philippines to help state universities and colleges (SUCs) conduct R&D *road mapping* also points to efforts to better organize the demand side in line with local industry and social needs. Activities in support of technology road mapping for Department of Trade and Industry (DTI) priority sectors can provide an information base for better aligning research funding with commercial priorities.

Enabling Environment-Related Findings

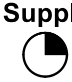
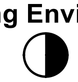
Despite an overall very poor situation, there are a few factors driving current or anticipated improvement, as cited by interviewees. First, CHED recently issued research and innovation productivity requirements for horizontal designation as a university. This constitutes an important new incentive for academic administrators to build research programs. Even prior to these requirements, key administrators from large and small public and private universities appear to be earnestly attempting to support an expanded research mission, despite many financial disincentives to doing so. They are experimenting with creating research-focused professorships; de-loading teaching to support faculty research, especially for research center heads; and establishing research foundations to channel funds to research activities, bypassing intractable legal and regulatory barriers.

Nonetheless, five significant challenges in the research enabling environment are discussed openly, as "common knowledge," among stakeholders, and no stakeholder suggested that viable solutions to these issues are in play. First, inflexible purchasing and procurement laws under the 2003 Government Procurement Reform Act (Republic Act 9184), and implemented through Government Procurement Policy Board (GPPB) regulations, are widely cited as slowing research progress to a crawl, with far-reaching impacts throughout the ecosystem. Competitive bidding and procurement processes for scientific equipment and consumables (chemicals, reagents, testing kits), which are either not available in the Philippine domestic market or are only available from a single supplier, result in debilitating delays. To describe the situation, scientists repeated the darkly humorous refrain, "My grant period has finished. Now I can receive my equipment." A second set of challenges exists in the national research system and its administration. These include the *serious* issues in allowable *costs* and *overheads* with far-reaching impacts that undercut institutional commitment to the research mission in universities by creating unnecessary conflict between the research and overall institutional missions. These two critical issues are discussed extensively in ***Section IV***. Other widely cited elements of the national research system are the widespread perception of unproductive competition between key actors and the need to be more strategic about the roles of government agencies, the private sector, and university sector research. Additionally, within universities, administrators, faculty members, and external stakeholders alike lamented that the related institutional procedures to support research are lacking or nascent. This includes the misalignment of incentives for faculty members that strongly favors teaching and consulting rather than research to supplement modest base salaries. Finally, faculty promotion systems appear to be misaligned, as it was reported that strong researchers are often promoted into administrative roles that interfere with their ability to conduct research without accompanying de-loading.

Knowledge and Know-How Transfer between Universities and Industry (Extension)

With notable exceptions, particularly among smaller universities and colleges outside of Metro Manila, universities perceive direct collaboration with industry as yielding neither publications nor prestige, nor patents, and direct income from these activities has not yet been seen as sufficient to motivate active marketing of these services. Industry also sees direct collaborative relationships as complicated relative to their other options—principally consulting arrangements with faculty—because of universities' competing priorities, unrealistic expectations of intellectual property ownership and future patenting revenue, and burdensome administrative procedures. Effective models for structuring such collaborations do exist, and nothing in the enabling environment directly prohibits the formation of productive direct relationships. However, companies' interest in contributing financially to government-funded research may be diminished by the perceived lack of any legally sanctioned payment mechanism to use for such contributions.

Exhibit 5. Assessment Sub-Factors and Rating: Knowledge and Know-How Transfer between Universities and Industry

Supply	Demand	Enabling Environment
		
STRIDE assessed: • Applied research services • Technology extension services • Other services to industry	STRIDE assessed technology users/acquirers in industry: • Filipino • International	STRIDE assessed the • Legal/institutional framework (permission and rewards) • Quality of the relationship framework

Supply-Related Findings

A few public and private (not-for-profit) universities house industrial extension programs or centers that demonstrate that successful university-industry collaboration is possible and that some effective frameworks and models are in place on the supply side. Widely cited examples are the Integrated Research and Training Centers at the Technological University of the Philippines, which was established with funding from the Japan International Cooperation Agency (JICA) in 1980, and UP Diliman's Marine Science and Transportation institutes. UP Los Baños is widely cited as engaged with the private agriculture sector. Mapua Institute of Technology was also mentioned as highly engaged in knowledge transfer with the private sector. Collaborative efforts are underway to support the food industry through an industry-focused technology center in Northern Mindanao, with leadership from Mindanao University of Science and Technology (MUST) and including Xavier University, in cooperation with DOST Region X. This example in particular provides a concrete example of a pathway for universities into an important scientific and technical role in the food industry's global value chain. Since the 1990s, many universities have also established Industry Liaison Offices, though stakeholders report that their effectiveness has not been rigorously evaluated.

Nonetheless, it cannot be said that direct services to industry and/or extension have been high priorities for most university leaders. Several informants stated that universities do not generally treat research collaboration as a core mission alongside teaching and publishing, again, with notable exceptions. Despite significant pressure for universities, particularly SUCs, to engage in income-generating activities to supplement government budgets, there appears to be an aversion to consulting or work for hire that does not generate intellectual property to be owned by the university. Instead, many universities are pursuing income-generating activities focused on monetizing land holdings, rather than on providing technical services that are closer to their core competencies. Several interviewees expressed some bewilderment at the range of business activities universities are pursuing that are unrelated to the research, teaching, and regional development missions of the universities.

As we discuss elsewhere, one other negative issue related to supply arises from the relative unfamiliarity of many professors with Philippine industry in general, and with the technical needs of industries related to their scientific and technical disciplines in particular. This is attributable to a variety of factors discussed elsewhere in this assessment, but constitutes an important limit to the current abilities and inclination of universities to provide technical services, though one relatively easily remedied through exposure. Sector development activities such as faculty externships/immersion, financial support for collaborative research, and collaborative *technology road mapping* with industry, are directly tackling this issue, though there is room for more opportunities for faculty exposure to industry issues.

Demand-Related Findings

Widespread demand for university faculty to serve as consultants evidences diverse technical needs in Philippine industry and among international investors (locators). Reportedly, consulting arrangements of these types can be quite lucrative for contracted faculty. One informant indicated that public university faculty members receive from 3 to 10 times their regular salary through consulting arrangements. Some universities (rightly) perceive this as a very positive statement on their faculty's capabilities, and most universities specifically permit faculty to spend 10 to 20 percent of their work time consulting to industry, recognizing that it is otherwise inevitable. Within the IT, electronics, and food products industries, a number of companies and industry associations are pursuing institution-level partnerships that focus on building familiarity with industry issues among both faculty members and students. Interviewees mentioned that faculty immersion programs, stand-alone or as part of student on-the-job-training programs, are run by Texas Instruments, HGST, and Cebu's EMC, among others. There also appears to be regular demand for institutionally provided technical services from some industrial users, particularly where universities have established centers or procedures and are clear in their mission of providing extension on a fee-for-service basis (e.g., without claims on intellectual property). One observer characterized collaboration with universities a deliberate strategy of Philippine managers who are eager to preserve their international companies' presence by "moving up the value chain," and who see university collaborations as essential to achieving this progression. In addition, in our field research, STRIDE found that many grassroots users, particularly smaller food-related businesses, are *interested* in obtaining technical service from universities to solve pressing production- and packaging-related issues, for example, and these interests were reasonably well aligned with the agendas of larger international companies.

At the same time, most industry spokespeople we interviewed were not convinced that universities can do commercially relevant research, or that researchers will not go off in less applied, less practical directions once under contract. All industries consulted expressed theoretical openness to institutional partnership with universities and expressed enthusiasm for engagement with faculty as a means of strengthening students' knowledge of industry issues and preparedness for work. However, when the discussion turned to specifics, companies consistently reported preferring employment or consulting arrangements with current or retired faculty members, in which the ownership of resulting intellectual property clearly rests with the company. In purchasing scientific and technical research services, companies wish to avoid struggles over IP and benefit sharing and see these struggles as an unacceptable cost of doing business with Philippine universities.

Enabling Environment-Related Findings

There do not appear to be formal legal *obstacles* or official prohibitions of direct consulting and extension relationships between university and industry, and the existence of at least one consistently successful and long-lived institutional model suggests that the formal enabling environment is not prohibitive. Neither is the enabling environment particularly supportive, however. Institutional rules and procedures appear to create implicit (indirect) disincentives to successful relationships. For example, while financial incentives to faculty for published research and international presentations are tax-free and immediate, benefits from direct research relationships do not accrue to faculty members quickly, are highly taxed, and are quite small in comparison to the financial benefits of independent consulting arrangements. One corporate purchaser of technical services indicated that this resulted in poorer quality delivery of technical services through universities than through direct consulting relationships, since incentives are less direct. Another reported that in many cases, payment for these technical services, both with public universities and with government laboratories, frequently is routed through the national treasury (in the absence of a university research foundation, for example), and that the benefits to the specific department or lab would be diluted at best, thus distorting incentives. Generally, businesses felt that the lack of clarity and standardization in financial relationships and intellectual property ownership makes direct partnerships difficult, especially where future rights are potentially at stake. One international business indicated that its experience has led to the conclusion that no clear or safe way exists for business to pay for research services with the necessary legal certainty about IP ownership rights where Philippine government entities (or funding) are involved, and that these firms are often uncomfortable with the legal status of workarounds offered by universities and government departments to more efficiently accept payment.

Intellectual Property: Protection, Patent Licensing, and Commercialization

A recent period of intensive focus on intellectual property catalyzed by IPOPHIL has drastically expanded patenting activities and broadened awareness of the potential value of scientific discoveries that are properly protected. Yet universities in general do not possess the specialized expertise to effectively market their patent portfolios for commercial use. There is also very little current demand from local companies/industries due to a widely expressed desire for total control of intellectual property as an element of business strategy, and due to lack of familiarity with and trust of legal mechanisms for licensing. In most respects, the regulatory environment, currently attuned to international standards, is not an obstacle to licensing, though companies do report that they do not always trust that confidentiality can be maintained in the patenting process. Some also report the need for legislation to establish an officially sanctioned payment mechanism for, acquiring rights to, or licensing, government-funded innovations from universities and agency laboratories.

Exhibit 6. Assessment Sub-Factors and Rating: Intellectual Property Protection, Patent Licensing, and Commercialization

Supply	Demand	Enabling Environment
STRIDE assessed: • Commercially viable IP • Assessment of market viability • Marketing expertise • Inclination to patenting • ITSOs and peers • IP Protection expertise (disclosure through international protection)	STRIDE assessed: • Technology users/acquirers (PH and international) • Businesses' licensing expertise *Open innovation strategies *Entrepreneurs: PH and international)	STRIDE assessed: • Patenting regime • IP law • IP enforcement • Court/judicial system

Supply-Related Findings

Due to concerted efforts of IPOPHIL and other stakeholders in the ecosystem, universities and government laboratories are becoming aware of IP and developing capabilities to conduct patent searches; file invention disclosures; develop patents, copyrights, and trademarks; and perform other IP protection functions. Clearly, awareness of the domestic and global intellectual property regimes is a significant step forward, both for those intent on protecting Philippine intellectual property from exploitation, and for foreign industries and entities encouraging Philippine authorities to enforce their own intellectual property claims. CHED guidelines on horizontal designation of HEIs also explicitly recognizes patenting as evidence of "Viable research programs in specific (disciplinal and multidisciplinary) areas of study that produce new knowledge,"[5] a further stimulus to a more robust formal focus on intellectual property in universities. It should be noted that many engineers working in foreign-owned R&D centers in the Philippines are trained in and directly involved in patenting, although most of these patents are initially filed in the companies' home countries and key markets, obscuring the Philippine role in patenting.

While more than 70 universities today have established Innovation and Technology Support Offices (ITSOs) in collaboration with IPOPHIL, only a few have significant capabilities for assessment of commercial applications and marketing capabilities. Interviewees noted that many academics do not know or understand the practical application of their work, while most of the people who are responsible for marketing the technologies are not scientists, and may not well understand the research underlying new patents, or its applications. The need to improve institutional capacity in this respect is widely recognized.[6] De La Salle University noted the recent introduction of a program to study commercial potential prior to patenting, and this could provide a model for capacity development in other HEIs. Faculty members may also see a conflict between patenting and publishing, particularly because the financial incentives for publishing are immediate and substantial, while financial returns to patenting are less defined. One well-placed observer described a "Nascent process of changing the academic mindset," and lamented, "I wish it could be faster...it takes a while."

Expectations have also grown that universities' patent licensing revenue will be a means of funding the research and education enterprise, and at this point, speculation outpaces development of capacity to realize the expectations. These heightened expectations create significant short-term pressure, both within and outside of the universities. As one stakeholder noted, "administrators are now aiming at blockbuster patents, but those are built on a broad foundation of more mundane patents—capability models and simpler patents. Intellectual property regimes don't start with blockbusters. These 'blue sky' patents will come, but they will be built on a very big base of simple, mundane incremental improvements with immediate industry applications." We further discuss some of the negative impacts of these expectations in ***Section IV.***

Demand-Related Findings

Unfortunately, most of the domestic market is not prepared to take advantage of universities' new focus on intellectual property. A handful of university-developed technologies, most notably

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[5] Commission on Higher Education (CHED). (2014). Handbook on typology, outcomes-based education, and institutional, sustainability assessment. Quezon City, Philippines: CHED.

[6] This is a programmed area of activity for STRIDE in 2014–2015.

Pascual Labs' *Ascof*, have resulted from licensing agreements. A potentially receptive market for commercially relevant patents does exist in the Philippines today, principally in the form of a new generation of returnee managers in Philippine conglomerates who are technology-savvy and knowledgeable about IP. However, for these buyers, patent licensing from Philippine universities is not a high priority relative to other means of acquiring technology for a number of reasons articulated by interviewees. First, most companies prefer to own or control intellectual property outright, even if some express willingness to let their academic research partners publish on the findings for academic purposes. Second, few are licensing technologies that are not well proven in the marketplace: demand for acquisition of startups with proof of concept and revenues far outstrips interest in pure technology licensing. Finally, several companies explicitly mentioned that they consider university revenue (royalty) expectations unrealistic and have become disheartened by negotiating "stalemates" with university representatives who do not fully understand the relative value of their intellectual property.

Enabling Environment-Related Findings

The enabling environment has evolved rapidly in a positive direction in Philippines, with the system now attuned to international standards and rising rapidly in Asian and global rankings for IP protection. IPOPHIL notes that the Philippines now ranks second in patent protection in Asia, and eighth in copyright materials overall,[7] and has the fastest turnaround time in patent and trademark applications in Asia, as well as a number of other positive indicators. Agreements with the U.S. and Japan around provisional patent applications also make it easier for Philippine inventors to secure international protection. Universities are aware of the need for clear IP policies, and several, including the UP system, have policies in place that can serve as models for other institutions.

Yet, these improvements are recent and have not yet overcome hesitancies around filing Philippine patents among private-sector interviewees. Two specific fears mentioned were, first, that of "mining" by foreign competitors, particularly when products might have applications in Chinese or Indian markets. They note that for technologies of relevance to these markets, they are more comfortable maintaining technologies as trade secrets, knowing that these countries will not enforce their intellectual property claims. Second, some expressed concerns about the confidentiality of the patenting process itself.

Finally, the development of a more robust intellectual property culture has caused some growing pains related to rapidly increasing revenue expectations and expanded awareness of legal issues related to IP ownership. An interviewee explained, "the Philippines has moved from lax to over-protective treatment of intellectual property, to the detriment of collaboration and speed to market. But we are moving to a happy medium. Those with less experience will be over-protective of their intellectual property. This is more of a mentality rather than a regulatory policy restriction."

[7] World Intellectual Property Organization, 2013.

Startup and Spinoff Companies

Rapidly growing demand from venture capitalists and Philippine conglomerates for profitable technology startups and spinoff companies outstrips the current supply, which is concentrated in small but coherent ecosystems principally in Metro Manila and Cebu. While there remains a dearth of experienced technology entrepreneurs, and a general aversion to risk among professionals, interest among potential entrepreneurs is being stimulated nationwide through deliberate efforts by entrepreneur education and support organizations and numerous corporate initiatives. Enabling factors such as finance, mentoring, matchmaking and incubation are also improving rapidly through strategic efforts of domestic and international stakeholders. Yet, basic business regulation issues remain very challenging to growth companies, and many of the entrepreneur-specific business services and expertise necessary to grow the startup ecosystem remain absent.

Exhibit 7. Assessment Sub-Factors and Rating: Startup and Spinoff Companies

Supply ◔	Demand ◑	Enabling Environment ◔
STRIDE Assessed: People • Potential entrepreneurs (pipeline) • Experienced entrepreneurs (existing talent) Companies • Firm creation and growth • Churn (entry/exit) • Basic capabilities • Business planning • Execution	STRIDE assessed "opportunities" that can be accessed (OECD definition): • Opportunities in local supply chains for new ventures? • Opportunities in regional/ international supply chains for new ventures? • Opportunities in local final markets (e.g., retail channels) for startups?	STRIDE assessed: Supporting actors & services • Angels • Mentors • Venture capital • Incubation/acceleration • Business services Procedural/legal aspects of startup and exit, including • Administrative burden • Company startup barriers • Bankruptcy • Barriers to exit • University regulations Cultural issues and risk appetite

Supply-Related Findings

A diverse array of Philippine stakeholders has emerged in the past five years and is working hard to increase the prevalence and geographic spread of technology entrepreneurship. A number of important entrepreneurship incubation and acceleration initiatives have begun to build awareness of and participation in entrepreneurship. These include early efforts by Silicon Valley Science and Technology Advisory Committee (STAC), PhilDev, IdeaSpace, Kickstarter, and other less formal development systems. Initial successes of the STAC ON3 Technology Entrepreneurship Acceleration Program included bringing international venture funding to several supported companies and demonstrating opportunities for Philippine startups beyond the country's borders. There are currently multiple startup ecosystems in Metro Manila and Cebu, each with slightly different institutional affiliations, and growing but still limited interest among potential entrepreneurs across the country directly facilitated by active outreach of the aforementioned entrepreneurship support organizations (ESOs). Interviewees report that some of the obstacles to new company formation—in particular the stigma of failure—are beginning to diminish, and that supply is poised to grow as young people find opportunities at the intersection of the growing IT-enabled services industry and the integrating Association of Southeast Asian Nations (ASEAN) market. University-based business plan and "pitch" competitions find students enthusiastic to participate. At an institutional level, the University of San Carlos' Green Enviro Management Systems, Inc. (GEMS) spinoff-joint venture to create byproducts from the regional mango industry's waste also provides a widely celebrated example of a grassroots university technology spinoff.

Despite these very positive developments, interviewees note that there is still a very small volume of technology startups relative to what would constitute a healthy pipeline for an economy the size of the Philippines', particularly in a period of rapid economic growth. Furthermore, very few of the current crop of startups are university-based or count the involvement of a university faculty member in the executive team. There is a widely reported lack of entrepreneurial spirit among university faculty, indifference to entrepreneurial opportunities, and a great deal of fear and uncertainty about whether they can realistically keep their academic jobs while involved in launching a business. Furthermore, there are few highly visible success stories motivating current faculty members or company employees to leave secure employment to start a business. This appears to be equally true for university faculty and for staff in the Philippines' many international R&D centers. Finally, some entrepreneurship champions have noted that there is a widespread lack of business skills, particularly effective strategic and operational planning, and awareness of realistic timelines for business growth. Others noted more enthusiasm for the idea of entrepreneurship than for the actual demands of the process; in some cases founders see victory in winning business plan competitions and achieving funding rather than in actually growing new ventures to viability. Interviewees noted that these challenges are further compounded by a tendency for promising ventures to self-destruct due to conflicts between founding team members over equity ownership and other distributional issues. In sum, a number of challenges to supply remain.

Demand-Related Findings

Demand for startups and spinoffs should be thought of in terms of demand by potential risk capital investors and acquirers for viable business ventures, as well as, according to the Organisation for Economic Co-operation and Development (OECD), in terms of available market opportunities. By these definitions, demand conditions for entrepreneurship in the Philippines are quite strong. Most observers point to a massive increase in "demand for tech startups" by conglomerates in the last four years due to a need to incorporate value-added services into IT-enabled businesses, most notably telecommunications, to preserve profitability in the face of commodification of core businesses. This coincides with the general growth of the IT business ecosystem and the Philippines' growing profile as a destination for offshore IT services investments. Acquiring technology startups is seen as one of the most effective available means for companies to acquire market-tested innovations, permitting them to expand into new value-added business niches. Risk capital investors are also growing in numbers and prevalence. Interviewees observed that numerous successful Filipinos are returning from the U.S. as investors, demonstrating to local investors the opportunities in the market. Entrepreneurs note that early-stage (angel) investors are becoming more visible and better organized, facilitating access to early-stage (pre-revenue) funding.

While demand has grown rapidly, other stakeholders note that the total capacity and appetite for investment in early-stage companies is still quite small. Representatives of the investment arms of major Philippine conglomerates and their affiliates also explained to STRIDE representatives that the real demand is for startup companies that have already achieved revenues—later-stage companies that are ready to scale-up. While not unusual for corporate investors, this means that opportunities for pre-revenue funding, and particularly for early-stage university-based spinoffs, remain somewhat more limited. Finally, one observer noted that government procurement policies favor established companies and make it difficult for startups to provide pioneering technologies to government clients, dissuading startups whose products are focused on public markets.

Enabling Environment-Related Findings

Interviewees painted a decidedly mixed picture of the enabling environment for startups and spinoff companies. On the one hand, all agreed that substantial improvements in incubation, nationwide outreach to stimulate entrepreneurship, and exposure events such as "Geeks on the Beach" build linkages to and support of the global technology community, particularly the U.S. and Singapore. Entrepreneurs themselves reported the increased presence and availability of experienced entrepreneurs as mentors, mini-ecosystems built around these "entrepreneurial lineages," and other informal entrepreneurship support networks. High-profile returnees have increasingly dedicated themselves to supporting entrepreneurship, attracting greater interest and commitment from the broader business community—because contrary to popular mythology of the "lone wolf" founder, entrepreneurship is a highly socially embedded process, resting in large part on a supportive ecosystem.

On the other hand, interviewees consistently described three serious limitations in the enabling environment. Unsurprisingly, the first of these was the perception that burdensome bureaucratic requirements—particularly business registration and reporting requirements—slow the business formation process, and deter would-be entrepreneurs. These burdens are reported to be most extreme when a startup business cannot be classified in terms of existing industries or activities. In other words, the more innovative a startup, the more difficult it will find compliance tasks. Furthermore, requirements appear to vary significantly between jurisdictions. While in Metro Manila, company registration requirements are reported to be applied most consistently, the unfamiliarity of officials with startup businesses in next-wave cities results in much less predictable, and in some cases apparently improvised, requirements for registration. Stakeholders report that businesses cannot practically be formed in less than 30 days, while in ASEAN leader Singapore, business registration can be completed in less than 1 day, or within a week if the founder is not physically present. The second issue is that the professional services community, including accounting, banking and other financial services, and consulting, is unfamiliar with the needs of startups and unable to offer appropriate products and services. Most bank lending is based on collateral, for example, and the concepts of cash flow or purchase order financing, which are critical for startups to grow into larger companies, are unfamiliar. Businesses complain that accounting firms have little experience in valuing pre-revenue companies and are not aware of relatively standard procedures for evaluating goodwill, intellectual property, innovative capital goods built in-house, and other intangibles. The deficiencies in these services disadvantage startups in acquiring operational financing, in risk capital transactions, and in company exits.

Finally, interviewees identified specific accounting regulations as putting startups at a disadvantage. Specifically, the Philippine Securities and Exchange Commission is reportedly very restrictive in the distribution of equity to co-founders and employees, thus eliminating one of the major compensation vehicles available to startup companies worldwide. Overall, financial regulators were rated as very unfamiliar with startup ecosystems and perceived as choosing the most restrictive interpretations of laws and regulations, to the disadvantage of startups. It is expected that some of these issues may be addressed in a new "Law on Small and Medium Enterprises," but this had not materialized at the time of this writing.

Collaboration: Social Capital, Trust, and Knowledge Sharing

There are pockets of excellent collaboration among high-level business, government, and university executives, within scientific professions and networks, and among returned (Balik) scientists, entrepreneurs, and executives, and among organizations engaged in entrepreneurship support. Collaboration among key stakeholders also appears to be more routine in less well-resourced communities outside of Metro Manila. However, the national innovation ecosystem as a whole is characterized by widespread mutual mistrust and dismissiveness between university and industry communities, and more competition than collaboration, perhaps reflecting the historic conglomerate structure of the Philippine economy. Government departments were also described by several interviewees as being preoccupied with bureaucratic competition, to the detriment of collaboration and resource sharing. These factors introduce significant friction into the innovation ecosystem, limiting the growth of innovative research and businesses.

Exhibit 8. Assessment Sub-Factors and Rating: Collaboration: Social Capital, Trust, and Knowledge Sharing

Overall Rating

STRIDE assessed the culture of openness, inclination to share knowledge and information if relevant to others' needs and missions, responsiveness to proposed collaborations, prevalence of peer review and other forms of open or participatory knowledge creation, and assumption of goodwill from peers and system participants.

Additional Detail on Findings

Many of the vehicles needed to enable a collaborative ecosystem are in place. Professional associations and conclaves are in place and functioning. Professional societies, while somewhat "stove-piped" along disciplinary boundaries, promote networking and collaboration across universities. Where adequate funding is provided, such as in the DOST-financed Engineering Research and Development for Technology (ERDT) scholarship program, universities offering postgraduate training in engineering are highly capable of collaborating in pursuit of research excellence and relevance to Philippine development. We also note that where businesses are able to clearly articulate an opportunity that is relevant to national development and employment priorities—most recently where international companies identified the need for skilled personnel in data analytics and integrated circuit design—a collaborative response from CHED and the university system was forthcoming. Within the entrepreneurship ecosystem, "coopetition" (a mix of cooperation and competition) prevails, with organizations prepared to collaborate to grow the startup ecosystem, but willing to compete for good investments. This is healthy, as smaller startup ecosystems organized around resources and patrons allow for business-to-business collaboration and collective efficiencies on a scale manageable by startups.

Outside of Metro Manila, the collaboration environment appears to be healthier, at least at the level of planning and initial engagement. The Regional Development Plan for Region X (Northern Mindanao), was the first to include a science and technology chapter, thanks to stakeholder-inclusive efforts led by DOST. Personal relationships are often stronger between participants, owing in part to a lower density of organizations and professionals. Another example is that 15 of the nation's Regional Competitiveness Committees include a university partner, while this is not the case in the National Capital Region. One interviewee stated flatly that universities outside of Metro Manila possess relevant skill sets that are under-utilized and often un-recognized, and that this motivates them to step forward to collaborate more readily than better recognized HEIs in the capital region.

Yet stakeholders concurred that in core matters of business, mutual mistrust and dismissiveness are the norm for interactions between stakeholders. Universities and Philippine businesses continue to "miss" each other in most respects, with important (and occasionally outstanding) exceptions such as those mentioned above. Even where relatively successful and mutually beneficial collaborations have occurred leading to commercial success, as in the case of Pascual Labs' success with UP-Manila developed *Ascof*, an undercurrent of mistrust continues, signifying just how pervasive academia's mistrust of business remains. Academics consulted acknowledged a pervasive fear among faculty that relationships with business might lead to the "theft" of ideas, resulting in financial and reputational consequences, and this fear tends to structure academics' interpretations of all financial outcomes of industry-academic partnerships. Our conclusion is that in the current environment, it is impossible for most university leaders to satisfy all parties that any terms they secure with the private sector are good enough. Specifically mentioned was the fear that administrators of public institutions might be charged with breech of fiduciary responsibility by overzealous ombudsmen if they are perceived as "selling low." Facing the near inevitability of accusations of malfeasance or claims of exploitation, it is much "safer" for university administrators to avoid interactions with the private sector except in very limited contexts.

From the private sector's perspective, collaboration also appears to hold relatively low potential and to carry a number of unacceptable risks. We have noted previously that businesses feel that institutional relationships with universities are unnecessarily complicated, and that contentious negotiations around IP ownership undermine confidence. Relative to other service providers and consultants, they rate universities poorly on customer service, on-time delivery, and on the relevance of research to their needs. In the area of licensing and commercialization, business spokespeople expressed that universities do not understand or appropriately value their managerial and entrepreneurial competencies, without which the translation of innovative research into commercially viable products cannot occur. Companies are also well aware of the suspicion outlined above, despite feeling that their commercial motives are transparent and appropriate. Some company representatives also reported discomfort with the apparently widespread habit among universities of asking for "gifts" of equipment, labs, etc., in the context of what would otherwise be straightforward research relationships.

The strongest criticism from business and academia was reserved for government, however. Common sentiments expressed were frustration with intense competition for "turf" to the detriment of the overall research enterprise, and a degree of bewilderment at the competition for resources resulting from government's direct involvement in areas of research in which universities are attempting to build research competencies. Interviewees also characterized the conditions placed on access for faculty and students to government scientific resources (equipment and facilities) as restrictive to the growth of the research enterprise as a whole. It appears that the effectiveness of the departments' role as neutral referee and funder and facilitator of collaboration is compromised by direct involvement in conducting science.

The Innovation Ecosystem's Overall Performance

The aggregate results of the 2014 innovation ecosystem scorecard suggest positive momentum in several directions and a few clear strengths upon which to build, but also point to several issues that must be addressed in order for a fully functioning innovation ecosystem to develop in the Philippines (**Exhibit 9**).

Exhibit 9. Philippines Innovation Ecosystem Scorecard, 2014

Factor	Supply	Demand	Enabling Environment
Education and Human Capital Development	◑	◔	◕
Research and Knowledge Creation	◑	◔	○
Transfer of Know-How between Universities and Industries (Extension)	◔	◔	◑
Intellectual Property: Protection, Licensing and Commercialization	◔	○	◑
Startup and Spin-off Companies	◔	◑	◔
Collaboration: Knowledge Sharing, Trust, Social Capital	◔		

Key

○	◔	◑	◕	●
Poor	→			**Excellent**

We reiterate that this scorecard constitutes a baseline report on stakeholder opinions of the Philippine innovation ecosystem, rather than an authoritative diagnostic. It is intended to provoke discussion among interested stakeholders and to provide the opportunity for open dialog. Future versions of this scorecard may include momentum and/or direction indicators to ensure that progress towards a healthier ecosystem is appropriately recognized and celebrated.

IV. Addressing Cross-Cutting "Chains of Impact" to Strengthen the Ecosystem

STRIDE identified several issues that originate in a specific area of the ecosystem—represented by a "cell" of the report card—which create, or contribute to, a negative chain of causality that permeates several other areas of the ecosystem. In describing these "chains of impact," we attempted to understand how specific challenges ripple through different areas of the ecosystem and how these system-wide impacts can be addressed from the underlying causes to achieve durable improvements in innovation performance. In particular, STRIDE identified four areas of improvement that illustrate the dynamic interaction of factors in the model, and that warrant immediate attention from stakeholders.

1. ***Reform of procurement rules*** for research activities is needed to achieve speed, efficiency, and relevance.
2. Changes in *counterpart funding* in research grant structures are needed to align university-researcher incentives and potentiate R&D. Promote more ***realistic expectations of university IP revenue*** based on global benchmarks.
3. More ***appropriate expectations of university patent licensing revenue*** based on global benchmarks facilitate better industry-academe collaboration.
4. Building stronger university-industry relationships around shared missions and goals.

In each section, the related progression of impacts throughout the innovation ecosystem is illustrated in an accompanying table, which serves as an abbreviated version of the scorecard. The original issue is presented as "zero" ⓿ in its appropriate domain (cell of the table) and each subsequent step in the causal chain of impacts is represented by the subsequent number [❶❷❸❹❺] in the relevant impacted domain (cell of the table).

1. Reform of procurement rules for research activities is needed to achieve speed, efficiency, and relevance

Key cross-cutting finding

Restrictive regulations make the procurement of equipment and consumables for research extremely slow and unnecessarily complex, decreasing research productivity, publication potential, and speed-to-market of innovations.

Philippines' restrictive regulations on government procurement under Republic Act 9184 were widely reported as major barriers to the efficient conduct of scientific research. A number of legal and administrative factors conspire to slow the acquisition of scientific equipment and consumables (chemicals, reagents, etc.) necessary to conduct the research funded under public (government) grant mechanisms. The most widely heard complaint is related to the time required for equipment procurement to work through the legally mandated competitive bidding process and bureaucratic approvals before funds can be released. *Several researchers reported that equipment often arrives near the end of grants, or even after grants expire.* Closely related is the near impossibility of precisely anticipating needed consumables prior to beginning of research. A second issue is that the requirement to accept "lowest bid for comparable equipment" can obligate universities to purchase cheaper but less adequate equipment.

Impacts across domains of the ecosystem

In the context of single- or two-year research grants, the delays introduced into the research process can be significant, slowing or stopping research progress altogether ⓿. Where government funding supports university-industry research collaborations but falls under national procurement regulations, universities report that they are unable to deliver results in a timely manner due to these requirements,❶ undermining private-sector confidence and interest in collaboration with universities ❷❸. Finally, the global research "marketplace" is hyper-competitive, with success determined by speed of obtaining results. Researchers and companies alike have reported to STRIDE that procurement-related delays in research often make Philippine innovations "late to market" for licensing— ❹ and/or spinoff— ❹ and result in missed opportunities for researchers to be the first with results in top publications. In this environment, it is easy for researchers to become discouraged, in some cases reportedly abandoning the profession entirely❺, or moving abroad in search of a friendlier research-enabling environment. This chain of impacts is illustrated in **Exhibit 10.**

Exhibit 10. Chain of Impacts: Procurement Regulations

	Supply	Demand	Enabling
Education	❺		
Research	❶	❷	⓿
Extension		❸	
Licensing		❹	
Startups		❹	
Collaboration			

Recommended actions:

Science and technology stakeholders should work to build consensus around a *legislative strategy for procurement reform* to devise transparent mechanisms to acquire grant-stipulated research equipment and consumables at a pace more conducive to the research enterprise, while maintaining transparency and accountability with public funds. Providing input into the current Department of Science and Technology- (DOST-) led process of drafting a *science and technology bill* may offer one timely option.

Such a reform might take the form of exemptions for equipment and supplies named in successful grant proposals; maintenance of approved cost lists for research-related items by government or a third party, such as an audit firm or other neutral third party; or other pre-bidding mechanisms to permit accelerated delivery or provisioning. It appears that these might be permitted as exceptions under sections 48-54 of the original law, which outline alternative procurement methods in certain circumstances, though current implementing regulations do not address these provisions. A first step in this direction might be for STRIDE to provide research on how restrictive government procurement regulations have been addressed in countries with similar institutional arrangements and transparency concerns.

2. Changes in counterpart funding in research grant structures are needed to align university-researcher incentives and potentiate research and development

Key cross-cutting finding

Government research grants do not compensate universities for the salary of teaching faculty's research activities, an unusual practice outside of the Philippines. This creates unnecessary financial competition between research and teaching missions within universities and diminishing institutional commitment to the research enterprise, except in the presence of visionary university leadership.

Outside of the Philippines, universities and faculty members commonly seek grant funding to support the research mission, and successful (competitive) applications for research grants provide resources to institutions and for building the university research mission. Research grants typically compensate universities for both *direct* and *indirect* costs of research activities. Allowable direct costs normally include equipment, consumables, the relevant *portion of faculty members' salaries*, and salary or stipends for graduate research assistants, laboratory technicians, and other research staff. This grant structure permits universities to reduce the teaching load of funded researchers (de-loading), as the grant pays the university back for the faculty time devoted to research. With these grant funds, universities can pay other faculty members to teach additional units (courses), hire adjunct instructors for this purpose, or, in the case of stable long-term funding, expand the teaching faculty. Professors whose innovative research brings this grant funding are rewarded with promotions and more flexible teaching loads, and over the long-term, rising salaries that reflect their contributions to the university's research and teaching missions.

The Philippines is (relatively) unique, however, in that government research grants to universities do not compensate the university for the time of the faculty researcher if that faculty member is a *teaching* professor.[8] *While the desire to ensure that universities contribute to the research enterprise through counterpart funding is legitimate,* this particular mechanism results in an unnecessary financial conflict between the teaching and research missions of universities and creates powerful disincentives for administrators to pursue research. University administrators are effectively forced to choose between two bad options: requiring faculty to do research in addition to a full teaching load, which virtually guarantees poor quality research, or de-loading faculty members to allow them to conduct effective research, and then face an institutional budget crisis due to the lack of funds to pay for others to cover their teaching load.

[8] We understand that the current grant structure does permit grants to pay for faculty members who are classified as full-time researchers rather than teachers.

Because it relates to specific conditions of funding, the origin of this issue straddles the domains of research demand and enabling environment ⓿.

Exhibit 11. Chain of Impacts: Counterpart Funding Structures

	Supply	Demand	Enabling
Education			
Research	❶	⓿	
Extension		❸	
Licensing		❹	
Startups			
Collaboration	❷		

Impacts across domains of the ecosystem

In addition to directly reducing the supply of research ❶, this requirement sets up a chain of "behavioral" impacts throughout the innovation ecosystem. Faced with this conundrum, administrators rightly seek other options to recover funds. Potential future licensing and commercialization revenues from research discoveries are one area in which Philippine universities have begun to look, developing expectations for revenue recovery that are extremely *optimistic* relative to world benchmarks. They are also counterproductive because the resulting contentiousness in research and licensing agreement negotiations with potential private-sector partners continues to hamper relationship development between universities and the private sector ❷ and makes industries increasingly reluctant to enter any joint research ❸ or licensing relationships ❹. This chain of impacts is illustrated in **Exhibit 11.**

Recommended actions:

STRIDE recommends that stakeholders in the government-funded research system work to build a coalition to make small but important changes in counterpart funding practices in key funding agencies, which we understand to be administrative practices rather than legislative mandates. A first step could be for STRIDE to document successful alternative counterpart funding models that are better aligned with promoting the university research mission.

3. More appropriate expectations of university patent licensing revenue based on global benchmarks facilitate better industry-academe collaboration

Key cross-cutting finding:

Highly optimistic expectations of patent licensing revenue undermine collaboration between universities and industry at all levels.

Philippine universities face a number of mutually reinforcing revenue pressures. Growth in admissions in chartered public universities strains institutional resources, while the expansion of the SUCs with national budget allocations also spreads resources across larger student populations. New pressures to improve research output and performance, as noted in the previous section, create mission conflicts between teaching and research, as the full direct and indirect costs of the university research enterprise are not covered by research grants awarded by the Government of the Philippines.

STRIDE's observation, mentioned above, is that the demand for both public and private universities to find new sources of revenue, a feature of the enabling environment for education ⓿, has created a set of very difficult to achieve expectations about monetizing university research, particularly anticipated revenue derived from licensing of patents. These expectations are, in STRIDE's opinion, out of line with benchmark revenues in highly developed markets like the United States, where universities earn less than 4 percent of the value of their research portfolios back in fee and royalty revenue from licensing of patents.[9]

Impacts across domains of the ecosystem

This misunderstanding of the potential of licensing revenues appears to be one cause of universities' demanding disproportionally large shares of IP ownership in (simple) industry-led joint research and technical services projects. In turn, this leads businesses to favor the use of faculty members as consultants rather than the pursuit of institutional research relationships ❶. By alienating potential industry partners with unrealistic financial expectations, universities lose the chance for significant direct service ❷ and licensing/royalty revenues ❸. This, in turn, stunts the growth of the university research enterprise as a whole ❹, since both direct private sector funding and political support are diminished. Additionally, in the absence of proactive university policies that provide clear and reasonable frameworks for benefit sharing between inventors, investors, and universities, potential spinoffs are also discouraged ❺. The chain of impacts is illustrated in **Exhibit 12**.

Exhibit 12. Chain of Impacts: inflated patent licensing revenue expectations

	Supply	Demand	Enabling
Education			⓿
Research	❹	❶	
Extension		❷	
Licensing		❸	⓿
Startups		❺	
Collaboration			

Recommended actions:

All stakeholders in the university research enterprise can work to bring expectations of patent licensing yields (fee and royalty) in line with global benchmarks. Within universities, incentives should be re-focused on core competencies related to (1) producing knowledge through research and; (2) more productive partnerships with industry to raise revenue from direct provision of technical services, consistent with the university's core missions.

[9] The precise figure for 2012 was 3.76 percent net of $200 million in expenses for outside legal services. When administrative costs internal to the university are included, the percentage return is lower.

4. Building stronger university-industry relationships around shared missions and goals

Key cross-cutting finding

Widespread mutual distrust and disregard between universities and industry introduce significant friction into the innovation ecosystem. Most universities perceive assisting companies as outside of their core missions, and as risking exploitation. Businesses, in turn, report difficulty in convincing universities of their shared interests, resent the suspicion harbored by academia, and don't trust universities to deliver commercially relevant research in a timely fashion. The dynamics underlying limited collaboration are extensively detailed in ***Section III***.

Exhibit 13. Chain of Impacts: Environment of Distrust

	Supply	Demand	Enabling
Education	❷		
Research	❸	❹	
Extension	❶	❶	
Licensing		❺	
Startups			
Collaboration	⓿		

Impacts across domains of the ecosystem

From this nucleus of mistrust ⓿ spring several negative consequences for the innovation ecosystem. The first result of a poor collaboration environment is reduction in both the supply ❶and demand for direct collaboration and know-how transfer. The result is mutual ignorance and, most damagingly, a lack of knowledge about current industry trends and concerns among professors—yielding educational experiences for students that are less relevant to the labor market ❷. Universities' research agendas are, in turn, formed without regard for the scientific and technical needs of Philippine industry ❸, since *the relationships in which these needs are articulated, communicated, and translated into viable research projects do not exist*. Inevitably, then, research results ❹ and resulting patents are perceived by businesses as less valuable, the current situation of depressed domestic industry demand for licensing is perpetuated ❺, and financial returns on licensing of university patents continue to underperform (even in relation to realistic benchmarks). *Ironically, faced by this situation, universities are reported to negotiate even more tenaciously when any commercial interest is shown in licensing their patents, creating a self-reinforcing cycle of mistrust.* This chain of impacts is illustrated in **Exhibit 13.**

Recommended actions:

Stakeholders can promote better sharing of success stories through P-GUIRR and other public dialog mechanisms and can encourage spending on R&D through institutions. They can also work to create alternative narratives and showcase win-wins, for example, celebrating Balik/returnee scientists who have successfully engaged in creating commercial ventures in partnership with the private sector, and revealing the specific financial terms of these relationships to the extent possible, in order to adjust expectations. Stakeholders should also work to develop (voluntary) national revenue-sharing guidelines and protocols outlining reasonable university-industry revenue-sharing arrangements for each type and phase of research to provide guidance and "political cover" to administrators and researchers engaged in developing public-private partnerships.

V. Conclusions and Pathways Forward

STRIDE hopes that this study will stimulate better informed and more productive approaches to building Philippines' science, technology, and research enterprise. The assessment model and resultant scorecard are intended to highlight the complex interactions between supply, demand, and the enabling environment in each of the key areas comprising the innovation ecosystem. The assessment results emphasize the need for participatory solutions that address key challenges at the root causes and along the identified causal chains, and with an appreciation for the perspectives and experiences of all involved stakeholders.

Each of the major issues reported by STRIDE—especially the cross-cutting chains of impacts—also invites solutions emanating from different domains of action. For example, procurement rules may need to be addressed at the legislative level, through specific and careful changes to Republic Act 9184, although there may also be scope for the Government Procurement Policy Board to define changes in implementing rules and regulations. Others are clearly a matter of departmental regulations, as in the case of DOST and CHED counterpart funding requirements. Still others may be more issues of culture than of policy, but will benefit from changes in formal practices from across the spectrum of organizations involved in the ecosystem.

Our findings should also provide a modicum of caution even about the ability of key initiatives to provide "magic bullets" or quick fixes. There is consensus among stakeholders in favor of creating more PhDs, stimulating more public and private research funding, and bringing about more accurate costing of research overheads. Each of these is a necessary ingredient in the recipe for a stronger, more innovative university-based research system in the Philippines. Yet these efforts must be part of a holistic, stakeholder-led effort to build relationships, mutual understanding, and feedback loops that can make the system self-sustaining and self-correcting. The potential of a neutral consultative body of stakeholders such as P-GUIRR to support such efforts can be realized if it can be truly representative of the diversity of interests and perspectives in Philippine innovation.

Annex A. Stakeholder Organizations Interviewed for this Assessment

Ateneo de Manila University	Mindanao State University- Iligan Institute of Technology (MSU-IIT)
Awesome Labs	Mindanao University of Science and Technology (MUST)
Ayala Innovation Group	MITE Asia
Boysen	NarraVC*
Cagayan Electric Power and Light Company, Inc. (CEPALCO)	National Competitiveness Council of the Philippines
Carmen's Best	Nestlé Philippines
Cebu Educational Development Foundation for Information Technology (CEDFIT)	Pascaual PharmaCorp
Chemical Industry Association of the Philippines (SPIK)	Philippine Business for Education (PBEd)
Commission on Higher Education (CHED)	Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD)
De La Salle University (DLSU)	Philippine Development Foundation (PhilDev)
Del Monte Fruit	Philippine National Academy of Sciences (P-NAS)
Department of Science and Technology, Region VII (DOST-VII)	Philippines Institute for Development Studies (PIDS)*
Department of Science and Technology, Region X (DOST-X)	Science and Technology Advisory Committee (STAC) Silicon Valley
Department of Trade & Industry (DTI)*	Semiconductor & Electronics Industries in the Philippines, Inc. (SEIPI)
Enterprise Project	Sigmatech
Entrepreneurs' Organization (EO)	Technological Institute of the Philippines (TIP)
Far Eastern University	Technological University of the Philippines (TUP)
Farmers Community Development Foundation International (FCDF)*	Texas Instruments* (TI)
HGST	University of East Asia*
HOLCIM	University of San Carlos (USC)
IBM ISV and Developer Relations Group	University of the Philippines- Cebu
IBM Systems & Technology Group	University of the Philippines- Los Baños
IDEASPACE	University of the Philippines- System
Independent Technology Consultant	USAID COMPETE Project
Institute of Electronics Engineers of the Philippines (IECEP)	USAID IDEA Project*
Intellectual Property Office of the Philippines (IPOPHIL)	USAID STRIDE Project
Microsoft	Whoosh 3D

* Indicates that the interviewee had affiliations with multiple organizations listed here.

Annex B. Detailed Assessment Criteria by Factor

1. EDUCATION & HUMAN CAPITAL

Supply	Demand	Enabling Environment
Quality and quantity of training: • Postgraduate STEM Training • Undergraduate STEM Training • Technical Training (TESDA) • Foundational STEM education	Demand for STEM skills: • Returns to education • Student & family preferences • Employers-Domestic in PH • Employers- Foreign in PH • Employers- Overseas	Rules, regulations, and enablers, including: • Accreditation and standards • Results-based quality control • Labor market information (occupational & demand) • Education finance

2. RESEARCH & KNOWLEDGE CREATION

Supply	Demand	Enabling Environment
Researchers, Graduate Students, University research labs, Research networks and COEs, Research management capabilities, Corporate/business R&D, Private research entities; Government research centers International research networks including Philippines.	• Government funding agencies • Domestic Private Sector funders and collaborators • International Private Sector funders and collaborators • International academic / foundation / multilateral funders and funding networks.	• Regulatory framework; • Specific regulatory barriers (procurement/purchasing) • Institutional support systems and rules/incentives (e.g. costing of research), and about • Inter-university networks for research collaboration

3. KNOWLEDGE AND KNOW-HOW TRANSFER BETWEEN UNIVERSITIES AND INDUSTRY (EXTENSION)

Supply	Demand	Enabling Environment
• Applied research services • Technology extension services • Other services to industry	Technology users/acquirers in Industry: • Filipino • International	• Legal/ institutional framework (permission and rewards) • Quality of the relationship framework.

4. INTELLECTUAL PROPERTY: PROTECTION, PATENT LICENSING, AND COMMERCIALIZATION

Supply	Demand	Enabling Environment
• Commercially viable I.P. • Assessment of market viability • Marketing expertise • Inclination to patenting • ITSOs and peers • IP Protection Expertise (disclosure through international protection)	• Technology users/acquirers (PH and Int'l). • Businesses' licensing expertise • Open innovation strategies • Entrepreneurs (PH and Int'l)	• STRIDE Assessed: • Patenting regime • IP Law • IP Enforcement • Court/judicial system

5. STARTUPS AND SPINOFF COMPANIES

Supply	Demand	Enabling Environment
People • Potential entrepreneurs (pipeline) • Experienced entrepreneurs (existing talent) Companies • Firm creation and growth • Churn (entry/exit) • Basic Capabilities • Business Planning • Execution	• "Opportunities" that can be accessed (OECD definition) • Opportunities in local supply chains for new ventures? • Opportunities in regional/ int'l supply chains for new ventures? • Opportunities in local final markets (e.g. retail channels) for startups?	STRIDE assessed: • Supporting Actors & Services • Angels • Mentors • Venture Capital • Incubation/Acceleration • Business services Procedural/Legal aspects of startup & exit, including • Administrative requirements • Bankruptcy • Barriers to exit • University regulations • Cultural issues and risk appetite

6. COLLABORATION: SOCIAL CAPITAL, TRUST, AND KNOWLEDGE SHARING

STRIDE assessed the culture of openness, inclination to share knowledge and information if relevant to others' needs and missions; responsiveness to proposed collaborations, prevalence of peer review and other forms of open or participatory knowledge creation, assumption of goodwill from peers and system participants.