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Philippine Institute for Development Studies
Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

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Innovation Activity of Firms in the Philippines

Francis Mark A. Quimba
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Abstract

Set against a rapidly changing global environment, Philippine industries now, more than ever, are facing new demands that will require more innovation for firms to remain competitive across the global market. The PIDS Survey on Innovation Activities (PSIA) conducted among firms in food manufacturing, other manufacturing, ICT, and BPO suggests that in 2015, about 43% of establishments in the Philippines were innovation active. Strikingly, the BPO sector spends the most for innovation activities despite it being the least innovation active among the various sectors at a rate of just 30%. Intellectual property applications have been very low across all industries in all types of intellectual property following firms' tendency to view their product innovations as trade secrets in order to maintain their competitive edge against rivals. Exploring further the conduct of knowledge management activities, we find that it is positively correlated with firm size. Moreover, larger firms tend to rely on internal sources for their information and innovation as is the case with the food processing and automotive sectors. Anchored from the results of a panel data model to explain innovative behaviour among 2015 PSIA firms that were also part of a pilot survey in 2009, the practice of knowledge management and firm size have both been found to be adequate determinants of innovation behaviour. Taking all these survey results into perspective, a national policy that veers away from a linear innovation model focusing only on R&D to one that is grounded on consultations with all stakeholders in the innovation ecosystem should be pursued. Enabling the business environment through stronger intellectual property rights can also encourage more firms to innovate especially among wary multinational companies.

Key Words: innovation, product innovation, process innovation, innovation, micro, small and medium enterprises, industry-academe collaboration

1. Introduction

[1] Authors are fellow, senior research fellow and president, respectively, of the Philippine Institute for Development Studies (PIDS).

Philippine industries are facing the challenge of a rapidly changing global environment brought about especially by developments in technology, as well as advancements in research and data science that have created new products and services. These forces have modified how Filipino firms do business. Now, more than ever, the innovation agenda is taking root, since there is growing recognition that innovation is a game changer, i.e. that firms practising innovative behaviour are more productive, and that the country and its people can remain competitive if more firms are part of an innovation ecosystem (Llanto and del Prado, 2015).

Often equated with research and development (R&D), innovation is actually distinct from R&D; it is better viewed as the application of new products, process, or method in business, the workplace, or external relations (OECD, 2005). In developing countries such as the Philippines, innovation is often not about something brand new but something new to society, which, if and when broadly disseminated, brings significant economic, social, or environmental change. It can lead to the establishment of new businesses and new business processes, consequently contributing to growth through increased employment opportunities in firms that practice innovation. New processes can lead to production techniques that make more efficient use of the country's resources. In order for the Philippines to reap the potential benefits of an innovative industrial sector, a national innovation strategy is critical. The strategy would identify the roles and links of key stakeholders in the innovation ecosystem – academe, industry, government, and the external sector.

This paper aims to provide inputs for the formulation of an innovation strategy for the Philippines by firstly looking at the current status of innovation activity across business and industry in the country based on a survey conducted by the Philippine Institute for Development Studies (PIDS). It will also review past policies and discuss exemplary cases of innovation activities that can be helpful to draw lessons for formulating a coherent set of policies that foster innovation.

1. 2. Outline

The paper is organised as follows: Section 2 presents an overview of innovative behaviour among local firms using the results of the 2015 PIDS Survey of Innovation Activities (PSIA). Section 2 also describes the determinants of innovation activity (including wider forms of innovation), making use of firms that responded to both the 2015 PSIA, and the pilot 2009 Survey of Innovation Activities (SIA).[2] Section 2 also discusses the importance of knowledge management activities, cooperation partners, and sources of innovation of firms. Building on the profile of

[2] See Albert et al. (2013) for the details of the 2009 SIA.

innovation activities in Philippine firms presented in Section 2, Section 3 presents the evolution of innovation policy in the country from the 1990s to the present. Section 4 then describes notable cases of innovation policy or innovation activity from which lessons on building a national innovation strategy can be drawn. The last two sections summarise lessons from the earlier sections and provide some concluding remarks.

2. Current Situation of Innovation of Local Firms

2.1. Description of innovation activity

In 2009, the Department of Science and Technology (DOST), in cooperation with the then National Statistics Office and the PIDS, and with funding support from the International Development Research Centre, conducted a pilot SIA. More than 5 years later, the PIDS conducted the 2015 PSIA,[3] with the assistance of the Philippine Statistics Authority.

The results of the 2015 PSIA show that about two-fifths (43%) of establishments in 2015 are innovation active (Table 1). A firm is deemed to be innovation active if it is:

(i) a product innovator that introduced new or significantly improved goods or services;
(ii) a process innovator that introduced (a) new or significantly improved methods of manufacturing or producing goods or services; (b) new or significantly improved logistics, delivery, or distribution methods for their inputs, goods, and services; (c) new or significantly improved supporting activities for their processes such as maintenance systems or operations for purchasing, accounting, or computing;
(iii) engaged in innovation projects that are either not yet complete or abandoned; or
(iv) engaged in expenditure on innovation activities for internal or outsourced R&D, training, acquisition of external knowledge, machinery, equipment, or software linked to innovation activities, market introduction of innovations, and other preparations to implement innovations.

Table 6.1: Key Statistics on Innovation by Activity by Major Industry

Innovation Activity	Food Manuf.	Other Manuf.	ICT	BPO	All Firms
Proportion (%) of establishments that are/have:					
Innovation active	35	47	57	34	43

[3] See Albert et al. (2017) for a discussion on the results of the 2015 PSIA.

Product innovators	24	35	38	13	31
Of which share with new-to-market products	21	21	23	7	21
Process innovations	27	37	26	10	31
Of which share of those that developed process innovation within the establishment or enterprise	27	36	25	10	30
Both product and process innovators	23	30	17	10	25
Either product or process innovators	29	43	47	13	37
Ongoing innovation activities	27	32	36	26	30
Abandoned innovation activities	9	10	11	4	9
Innovation-related expenditure	26	24	36	27	27
Memo note:					
Average annual expenditures for innovation activities (₱'000)	855	4,185	3,724	12,462	2,935
Proportion of expenditure on innovation from total gross sales	5	3	16	3	6
Proportion (%) of establishments that are/have:					
Public financial support for innovation	2	4	4	2	3
Innovation cooperation	37	45	38	55	41
Organisational innovations	34	39	47	21	38
Memo note:					
Average percentage of employees affected by establishment's organisational innovations	55	48	62	67	54
Proportion (%) of establishments that are/have:					
Marketing innovators	38	38	48	16	39
Knowledge management practices	44	38	51	59	43
Government support or assistance to innovation	38	31	24	42	32

BPO = business process outsourcing, ICT = information and communication technology, manuf. = manufacturing.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

The 2015 figure is lower than the corresponding statistics from the 2009 SIA, which suggests that 54.4% of sampled firms in 2009 are innovation active. The difference in the survey results is partly a result of the lack of comparability in survey designs. The 2009 SIA, being a pilot run, only targeted about 500 firms among four select study areas in three purposely chosen industries – food manufacturing, electronics manufacturing, and information and communication technology (ICT) – that were likely to practice innovative behaviour. The 2015 PSIA, on the other hand, is designed to be more nationally representative, with sampled firms chosen from four industries –food manufacturing, other manufacturing, ICT, and business process outsourcing – with twice the

sample size of the 2009 SIA, and with all of the 2009 SIA firms targeted for interview. Consequently, the results for the 2009 survey are descriptive, while those in 2015 may be inferred across a broader population of firms in the country.

Disaggregating by establishment size shows that in 2015, large establishments are more likely to engage in innovation activities than micro, small, and medium-sized establishments (MSMEs), given that two-thirds of large establishments are innovation active. In contrast, only about one-third of micro establishments are innovation active (Table 6.1). Similar findings are observed in the 2009 SIA.

Roughly one-third of the establishments (30.6%) are process innovators (Table 6.2). A similar proportion of firms are reported to be product innovators (30.7%). While process innovations are more commonly engaged in by local firms than product innovations in the 2009 SIA, this is no longer the case in the 2015 PSIA. One observation that persisted from the pilot 2009 SIA to the 2015 PSIA is the concurrent conduct of product and process innovations during the same period for a number of firms. Of the establishments that had product innovation, a bigger share also had process innovation than those that only had product innovation. The same can be said for process innovations.

Across industries, manufacturing of goods and services other than food, and the ICT industry are the most innovation active, with about half of firms being innovation active. In contrast, the business process outsourcing (BPO) sector is the least innovation active among the four industries: about 3 in 10 firms reported to be innovation active. Despite this observation, BPO firms have an average annual expenditure for innovation activities of about ₱12.5 million – the highest expenditure for innovation activities across industries. Other manufacturing is a distant second with an average annual expenditure of ₱4.2 million.

Table 6.2: Key Statistics on Innovation by Activity by Size

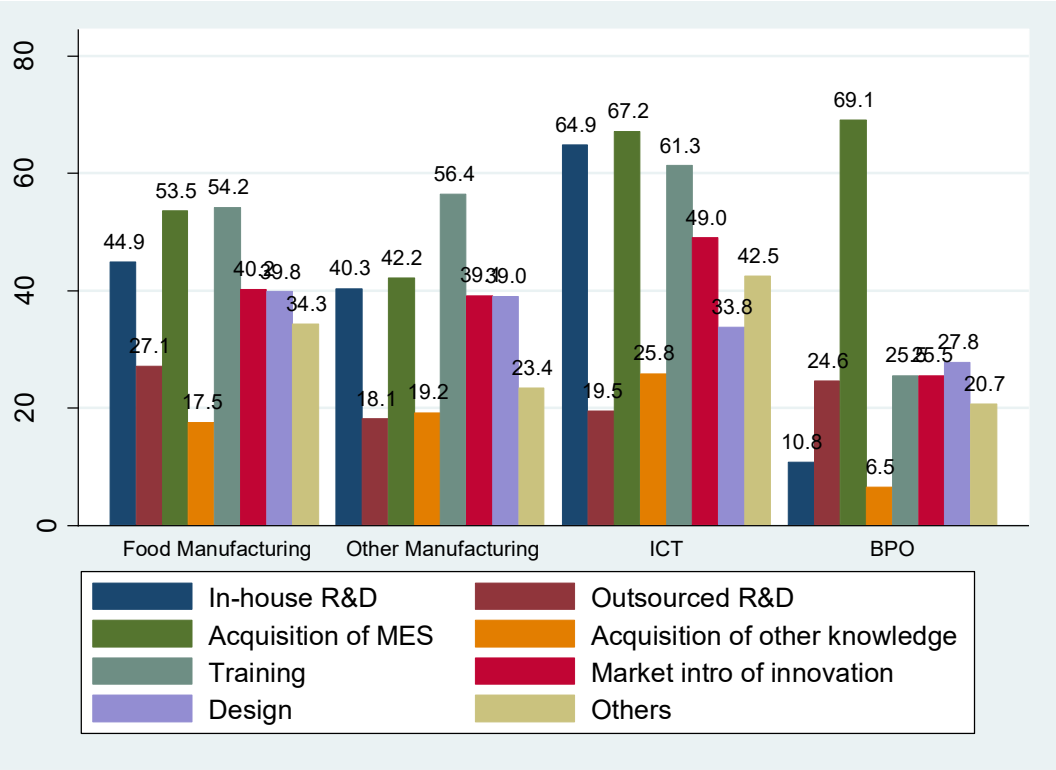
Innovation Activity	Micro	Small	Medium	Large	All Firms
Proportion (%) of establishments that are/have:					
Innovation active	34	50	46	63	43
Product innovators	27	34	30	39	31
Of which share with new-to-market products	19	23	19	23	21
Process innovations	23	37	36	47	31

Of which share of those that developed process innovation within the establishment or enterprise	22	36	34	44	30
Both product and process innovators	21	27	27	34	25
Either product or process innovators	29	43	39	52	37
Ongoing innovation activities	20	38	36	51	30
Abandoned innovation activities	8	10	5	16	9
Innovation-related expenditure	21	30	29	43	27
Memo note:					
Average annual expenditures for innovation activities (₱'000)	209	2,392	7,547	30,494	2,936
Proportion of expenditure on innovation from total gross sales	10	3	2	3	6
Proportion (%) of establishments that are/have:					
Public financial support for innovation	1	5	1	4	3
Innovation cooperation	35	47	44	32	41
Organisational innovations	34	40	41	53	38
Memo note:					
Average percentage of employees affected by establishment's organisational innovations	60	49	47	55	54
Proportion (%) of establishments that are/have:					
Marketing innovators	37	40	37	43	39
Knowledge management practices	35	47	60	67	43
Government support or assistance to innovation	25	37	43	37	32

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

In 2009, 40% of all establishments have some innovation-related expenditure, but in 2015, the corresponding proportion is only 26.7%. How innovation-related expenditure is allocated is presented in Figures 6.1 and 6.2. In general, training is the most common innovation activity in which firms invested during the survey period. For BPO firms, the acquisition of computer hardware is the most common innovation activity, while in-house R&D and acquisition of knowledge from other sources is the least common. For the other industrial groups, the most common innovation activities are training; acquisition of machinery, equipment, and software; and in-house R&D. Regardless of industry group, the acquisition of knowledge from other sources is the least common innovation activity for firms (Figure 6.1). Training, acquisition of machinery, equipment, and software, and in-house R&D are common innovation activities for all firms, regardless of size (Figure 6.2). For micro and small establishments, allocating innovation expenditure to the introduction of innovations to the market is quite common; something which, in contrast, is not observed for medium-sized or large firms.

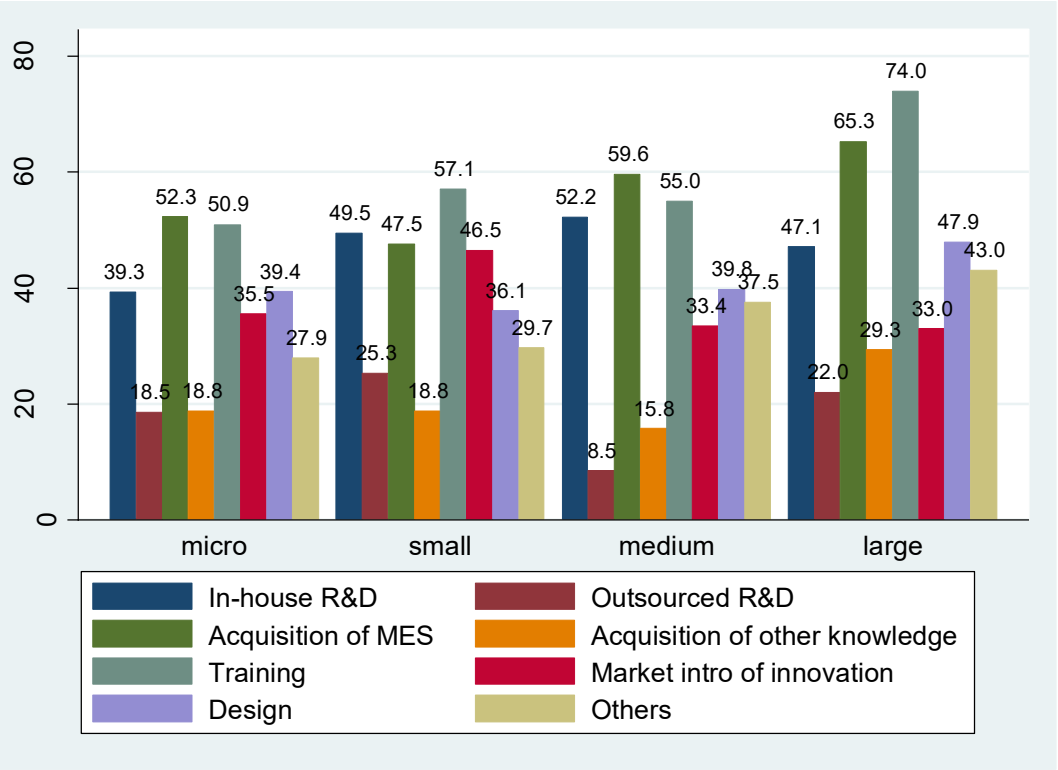
Figure 6.1: Breakdown of Innovation Activities, by Industry Group (%)



BPO = business process outsourcing; ICT = information and communication technology; MES = machinery, equipment, and software; R&D = research and development.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

Figure 6.2: Breakdown of Innovation Activities, by Size (%)



BPO = business process outsourcing; ICT = information and communication technology; MES = machinery, equipment, and software; R&D = research and development.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

2. 2. Sources of information, cooperation, and knowledge management

Technical advice, guidance, or even inspiration for innovation may come from a number of sources, both internal and external. In order for the government to formulate policies and interventions for improving information exchange, it is necessary to obtain information on the degree to which firms engage with external sources of innovation-related information. Table 6.3 presents firms' responses regarding the degree of relationship with their sources of information on innovation. The sources of information can be grouped into four main categories: internal sources of information, market as an information source, institutional sources of information, and other sources of information.

For all establishments, regardless of size, sources of information that are most important for the firms are the firm itself (internal), its customers, and its suppliers. Also, regardless of size, the least important sources of information are institutional: universities and government. Interestingly, 30%

of micro establishments – a rather large proportion – see government or public research institutes as important sources of information because, given their limited resources, these firms find value in receiving free assistance from government or public research institutes (Table 6.3).

Table 6.3: Proportion of Establishments Rating Information Sources as of Medium or High Importance by Size of Establishment (%)

Information Source	Subcategory	Micro	Small	Medium	Large	All Firms
1.Internal	a. Within this establishment or enterprise	68	64	72	75	67
2. Market source	a. Suppliers of equipment, materials, components, or software	75	58	61	60	64
	b. Clients or customers	72	69	63	63	69
	c. Competitors or other establishments in its sector	53	42	58	45	47
	d. Consultants, commercial laboratories, or private research and development institutes	25	24	41	36	26
3. Institutional source	a. Universities or other higher education institutions	21	17	17	18	19
	b. Government or public research institutes	30	13	26	19	20
4. Other source	a. Conferences, trade fairs, exhibitions	44	40	52	51	43
	b. Scientific journals and trade/technical publications	32	21	34	36	26
	c. Professional and industry associations	32	30	48	39	32

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

For most establishments, information on innovation and technology is sourced internally (67%) or from the market, i.e. clients (69%) followed closely by suppliers (64%) of equipment, components, materials, or software (Table 6.4). Similar patterns can be seen in almost all industries. The exception is the BPO sector, where the most important sources of innovation information are suppliers, clients, and competitors. These survey results echo those of the 2009 SIA: for innovation-related information, firms tend to rely on their own experience and knowledge as well as information from customers and suppliers.

Table 6.4: Proportion of Establishments Rating Information Sources as of Medium or High Importance by Type of Industry (%)

Information Source	Subcategory	Food Manuf.	Other Manuf.	ICT	BPO	All Firms
1.Internal	a. Within this establishment or enterprise	65	73	57	32	67
2. Market Source	a. Suppliers of equipment, materials, components, or software	70	62	55	78	64
	b. Clients or customers	74	68	64	78	69
	c. Competitors or other establishments in its sector	48	45	48	74	47
	d. consultants, commercial laboratories, or private research and development institutes	20	28	32	25	25
3. Institutional source	a. Universities or other higher education institutions	16	17	29	15	19
	b. Government or public research institutes	29	16	14	15	20
4. Other source	a. Conferences, trade fairs, exhibitions	52	38	38	25	43
	b. Scientific journals and trade and technical publications	30	25	22	25	26
	c. Professional and industry associations	31	32	38	26	32

BPO = business process outsourcing, ICT = information and communication technology, manuf. = manufacturing.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

For innovation-active establishments, about two-fifths (42%) cooperated with other establishments or with non-commercial institutions when they implemented their innovation activities. Cooperation in innovation is highest among BPO firms and least common in food manufacturing establishments (Table 6.1). Examining cooperation by firm size, we find that small and medium-sized firms have more frequent cooperation engagements than micro or large firms (Table 6.2).

Among innovation-active collaborators, most had agreements that operated within the country (domestic agreements). These firms were least likely to cooperate with companies in the Association of South East Asian Nations (ASEAN) Member States. The most common partners or cooperation among innovation-active firms are their suppliers (93%), other establishments within its enterprise (90%), and private sector clients (85%). Government or public research institutes

(61%), and universities or higher education institutions (64%) are the least likely partners for cooperation on innovation (Table 6.5).

Table 6.5: Proportion of Innovative and Cooperative Firms by Cooperation Partner (%)

Cooperation Partner	Local	Other ASEAN	All Other Countries	Any
1. Other establishments within its enterprise	87	2	9	90
2. Suppliers of equipment, materials, components, or software	81	10	21	93
3. Clients or customers from the private sector	78	2	8	85
4. Clients of customers from the public sector	70	0	2	72
5. Competitors or other establishments in your sector	75	1	5	79
6. Consultants, commercial laboratories, or private R&D institutes	68	–	3	69
7. Universities or higher education institutions	64	–	1	64
8. Government or public research institutes	61	–	1	61

ASEAN = Association of Southeast Asian Nations.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

Since innovation is driven by the generation and diffusion of knowledge, it is also important to look at knowledge management practices as these practices involve activities related to the capture, use, and sharing of knowledge in the organisation. Almost 30% of all firms perform regular updates of internal databases and manuals of good practices, lessons learned, or expert advice, while about 28% of firms have a written knowledge management policy. Also worth highlighting is that the proportion of BPO firms that regularly updates their internal databases of good work practices, lessons learned, or expert advice (56%) is much higher than the corresponding proportion of firms in other industries (Table 6.6).

Table 6.6: Knowledge Management Practices, by Sector

Proportion (%) of firms having:	Food Manuf.	Other Manuf.	ICT	BPO	All Firms
1. A written knowledge management policy	28	26	26	42	28
2. Incentives for employees to share knowledge within this establishment	27	20	32	44	25
3. Dedicated resources to monitor and obtain knowledge from outside this establishment	24	19	23	41	22
4. A policy to bring in external experts from universities, research institutes, or other establishments to participate in project teams as needed.	17	14	13	34	15

5. Regular updates of internal databases or manuals of good work practices, lessons learned, or expert advice.	26	30	35	56	30

BPO = business process outsourcing, ICT = information and communication technology, manuf. = manufacturing.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

As firm size increases, the conduct of knowledge management activities also tends to increase. For instance, fewer than 23% of micro firms have a written knowledge management policy or regularly update databases or manuals of good practices, but for small, medium-sized, and large firms, the proportions undertaking such knowledge management activities are about 34%, 44%, and 57%, respectively. The least-popular practice across all firms, regardless of size, is having a policy on the use of external experts from universities, research institutes, or other establishments (Table 6.7).

Table 6.7: Knowledge Management Practices, by Size

Proportion (%) of firms having:	Micro	Small	Medium	Large	All Firms
1. A written knowledge management policy	23	30	41	42	28
2. Incentives for employees to share knowledge within this establishment	20	28	33	42	25
3. Dedicated resources to monitor and obtain knowledge from outside this establishment	17	25	35	37	22
4. A policy to bring in external experts from universities, research institutes, or other establishments to participate in project teams as needed.	11	19	21	20	15
5. Regular updates of internal databases or manuals of good work practices, lessons learned, or expert advice.	22	34	44	57	30

Note: Numbers are weighted shares.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

Another indicator of innovation activity is applications for intellectual property especially inventions and utility models. In general, intellectual property applications have been very low across all industries and all types of intellectual property. Utility model applications are lowest among the types of intellectual property applications, while brand names and trademarks are the highest (Table 6.8). This is understandable as it is quite common for firms to rely on secrecy to maintain or increase their competitiveness (Table 6.9).

Table 6.8: Percentage of Firms with Intellectual Property Applications

Type of Application	Food	Electronics and Other Firms	ICT	BPO	All Firms
Patent	6	6	7	3	6
Trademark	12	10	11	3	11
Copyright	1	6	10	5	5
Utility model registration	1	7	4	3	4
Design registration	3	8	4	3	5
Brand name	19	11	16	3	14

BPO = business process outsourcing, ICT = information and communication technology.

Note: Numbers are weighted shares.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

Table 6.9: Percentage of Firms Using Intellectual Property Products to Maintain or Increase Competitiveness

Intellectual Property Product	Food Manuf.	Other Manuf.	ICT	BPO	All Firms
Patents	14	10	16	5	12
Utility model registration	9	11	14	3	11
Design registration	12	12	15	3	12
Copyright	8	12	21	3	12
Trademarks	20	15	22	1	18
Lead time advantages	19	18	25	5	19
Complexity of goods	24	16	28	8	21
Secrecy	16	15	20	8	16

BPO = business process outsourcing, ICT = information and communication technology, manuf. = manufacturing.

Note: Numbers are weighted shares.

Source: 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

2.3. Determinants of innovation activity

To obtain information on the determinants of innovation activity, panel data analysis was conducted on firms that were interviewed in both rounds of the innovation surveys (2009 and 2015). Using panel logit random effects models, we identified whether or not a variable helps explain likely it is that establishments will be product innovators, process innovators, or innovators in general. Econometric models also examined the likelihood of firms having wider forms of innovation such as marketing innovations or organisational innovations. Following Albert et al.

(2013), the following variables were included in the panel logit model: employment size, age of the firm, geographic market, share of foreign capital participation, major industry group, location (i.e. whether or not a firm is in an export processing zone), and engagement in knowledge management practices.

The results of the panel data estimation are presented in Table 6.10. The practice of knowledge management is found to be an adequate determinant of innovation behaviour: innovation active, product innovator, process innovator, marketing innovator, and organisational innovation. The size of the company is also a significant determinant of being innovation active, and particularly of process innovation. All other things being equal, establishments in food manufacturing are more likely to be innovation active, product innovators, or process innovators relative to BPO firms. Electronics manufacturing or ICT establishments are equally likely to innovate as BPO firms, all other things being equal. The area where firms are located, particularly whether or not the establishment is located in an export processing zone, is not a significant determinant of innovation activity, product innovation, or process innovation, but it is marginally significant in explaining marketing innovation behaviour.

The earlier discussion raises important policy issues, particularly about cooperation between university, government, and the firms. The following sections provide the context on how the policy environment might affect the innovation behaviour of firms.

Table 6.10: Determinants of Innovation Activity Using Panel Data, Odds Ratio

		Odds ratio estimated using panel logit regression				
	Variables	Innovation Active	Product Innovator	Process Innovator	Marketing Innovator	Organisational Innovator
Km	Indicator variable whether or not firm practices knowledge management	4.718***	4.177***	5.046***	4.869***	10.43***
		(1.33)	(1.09)	(1.40)	(1.37)	(3.06)
Local	Indicator variable whether or not firm's geographic market is only local market	1.20	0.96	1.36	1.01	1.32
		(0.37)	(0.27)	(0.37)	(0.27)	(0.35)
Foreign	Share of foreign capital participation in establishment	1.00	1.00	1.00	1.00	1.000**
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Femshare	Share of employment of women to total employment	1.00	1.00	1.00	1.00	1.01
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Age	In years since establishment of firm	1.00	1.00	1.01	1.00	0.99
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Foodgrp	Indicator variable whether or not firm is in food manufacturing	3.270**	2.671**	2.251*	1.69	1.49
		(1.62)	(1.32)	(0.93)	(0.70)	(0.61)
Othmanufgrp	Indicator variable whether or not firm is in other manufacturing including electronics manufacturing	1.48	1.95	1.52	0.80	1.29
		(0.68)	(0.91)	(0.63)	(0.32)	(0.55)

Table 6.10: Determinants of Innovation Activity Using Panel Data, Odds Ratio (continued)

		Odds ratio estimated using panel logit regression				
	Variables	Innovation Active	Product Innovator	Process Innovator	Marketing Innovator	Organisational Innovator
Ictgrp	Indicator variable whether or not firm is in ICT	1.87	1.92	1.68	1.09	0.95
		(0.77)	(0.91)	(0.65)	(0.39)	(0.40)
Logsize	Log of employment size	1.218**	1.11	1.162**	0.91	1.10
		(0.11)	(0.10)	(0.09)	(0.08)	(0.09)
Peza	Indicator variable whether or not firm is located in an export processing zone	1.22	1.01	1.15	0.576*	0.82
		(0.40)	(0.33)	(0.32)	(0.17)	(0.27)
Constant	Constant	0.0658***	0.0594***	0.0562***	0.469	0.109***
		(0.05)	(0.05)	(0.04)	(0.31)	(0.07)
Observations		464	464	464	464	464
Number of id		232	232	232	232	232

( ) = robust standard error, ICT = information and communication technology.
*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations using 2009 Survey of Innovation Activities and 2015 Philippine Institute for Development Studies Survey of Innovation Activities.

3. History of Innovation Policies in the Philippines

A survey of Philippine development plans from the 1990s reveals that the country's planners did not see the need for an explicit national innovation strategy until lately.[4] Even the measurement of innovation has been only conducted lately in the country, starting with the pilot SIA in 2009, whereas ASEAN neighbours Malaysia, Singapore, and Thailand conducted their first innovation surveys in 1995, 1999, and 2003, respectively. The Government of the Philippines, however, recognised the importance of science and technology (S&T), especially in terms of the sector's contribution to industrial development and poverty reduction. Fiscal constraints have led public expenditures in R&D in the country (in relation to gross domestic product) to fall behind the corresponding spending rates in Malaysia, Singapore, and Thailand.

Since the Ramos administration (1992–1998), many S&T plans and projects have been formulated. In 1993, the Science and Technology Agenda for National Development Plan was initiated. The goal of the plan was to support the seven sectors identified by the by the Department of Trade and Industry (DTI) as export winners: computer software; fashion accessories; gifts, toys, and housewares; marine products; metal fabrication; furniture; and dried fruits. The plan also identified, through the Presidential Council or Countryside Development, 11 key domestic needs: food, housing, health, clothing, transportation, communication, disaster mitigation, defence, environment, manpower development, and energy. Three supporting industries, packaging, chemicals, and metals, were also identified to be key sectors because of their link with most, if not all, of the sectors mentioned. Finally, the coconut industry was especially identified for support. Also during the Ramos administration, several key pieces of legislation related to S&T were passed: the Magna Carta for Scientists, Engineers, Researchers, and Other Science and Technology Personnel in Government, or Republic Act (RA) 8439; the Science and Technology Scholarship Act of 1994 (RA 7687); the Investors and Inventions Incentives Act (RA 7459); and the Intellectual Property Code of the Philippines (RA 8293) (Cororaton, 2002; Ancog and Aquino, 2007).

The Estrada administration (1998–2000) built on the work of the Ramos administration by incorporating the government's poverty alleviation agenda into its S&T plan, entitled Competence, Competitiveness and Conscience: The medium-term plan of the DOST (1999–2004) (Cororaton,

[4] Macapanpan conducted an innovation survey in 1999 covering food processing, textile and garments, metals and metal fabrication, chemicals, and electronics and electrical sectors. However, documentation of sampling design is not available in the final report. Thus, the first national survey of innovation activity that is considered in this review is the SIA conducted by the then National Statistics Office.

2002). Programmes under this Estrada S&T plan included S&T interventions for the poor, vulnerable, and disabled and those for the development of Mindanao, acknowledged then as one of the poorest areas in the country. Despite being short-lived, the administration saw the passage of the Electronic Commerce Act (RA 8792), which provided opportunities for the emergence of the new internet-driven businesses.

During the Arroyo administration (2000–2010), the National Innovation Strategy was coined as 'Filipinnovation' (Albert et al., 2013; Llanto, 2013). It focused on four components: strengthening human capital investments; stimulating science, technology and innovation (STI); enhancing the management of the STI system; and upgrading the Filipino mindset. Table 6.11 presents specific courses of action for each of these components.

Table 6.11: *Filipinnovation* Strategies, Tactics, and Action Agenda

Strategy	Tactics	Action agenda
Strengthening human capital	Formation of multi-sectoral consortia of institutions and/or experts working towards achieving strong technological research and development capabilities (tech) and management or services skills (non-tech) that will influence industries and public policy	1. Initiating competitive innovation in basic education 2. Establishing multi-stakeholder links 3. Upgrading skills and knowledge to better adapt to local and global demands through postgraduate education and other forms of lifelong learning 4. Developing human resources with advanced knowledge and expertise
Supporting business incubation and acceleration efforts	Encourage industry participation in incubation and human capital collaboration to ensure productivity and returns through innovation	1. Identifying and managing avenues for collaboration 2. Increasing government investments in physical infrastructure to support business technology innovation and acceleration 3. Engaging available existing Filipino talents and resources for business incubation and acceleration, including those of the overseas Filipino community 4. Adopting a new business incubator model
Regenerating the innovation environment	Engage stakeholders in the creation of clear government policies and efficient procedures that encourage innovative behaviour	1. Creating an innovation strategy championed by public and private sector executives 2. Increasing innovation awareness and understanding in legislation 3. Levelling the playing field by setting a policy environment that supports competition (i.e. a sound intellectual property regime)
Upgrading the Filipino mindset	*Filipinnovation*: branding Filipino competitive innovation for sustainable development and global positioning	1. Increasing the role of multimedia in highlighting the essence and benefits of innovation in society 2. Having an intellectual property regime that is neither restrictive nor regulatory, but rather serves as a repository of innovative ideas which can inspire others to innovate competitively as well 3. Aid in increasing public awareness that competitive innovation entails a multidisciplinary approach 4. Foster a culture of entrepreneurship through innovation

Source: Velasco (as cited by Llanto, 2013)

The DOST also spearheaded several programmes aimed at achieving the aforementioned components through the Small Enterprise Technology and Upgrading Program (SETUP), which aimed to improve productivity and efficiency of MSMEs by addressing the firms' technological

needs and limitations. The program's innovation support system allowed MSMEs to acquire industry-standard equipment, thereby, upgrading their facility and production efficiency (Alabastro, 2004). The Technology Incubation for Commercialization (TECHNICOM) Program was launched in response to the need to fast track the transfer and commercialisation of promising R&D results.

For the administration of Benigno Aquino III (2010–2016), innovation policy was subsumed within the goal of achieving globally competitive and innovative industries and services sectors (NEDA, 2014). To improve local industries' competitiveness, four specific strategies were identified in the Philippine Development Plan (PDP) 2011–2016: (i) broadening the access of small-scale entrepreneurs to modern, cost-effective, and appropriate technologies; (ii) providing publicly funded state-of-the-art facilities open to local companies pursuing the creation of new products or other innovation activities; (iii) leveraging ICT as a means of providing more economic opportunities; and (iv) strengthening networks to foster the exchange of information and cooperation among Filipino scientists and engineers.

Also during the Aquino administration, the DOST released the Harmonized National R&D Agenda 2013–2020, which aligned R&D policy with that of the PDP 2011–2016. It also updated the National Science and Technology Plan 2002–2020, providing more substance to the long-term plan. Innovation policy was also embedded in the use of S&T for attaining the following key results areas: poverty reduction and empowerment of the poor and the vulnerable, rapid and inclusive and sustained economic growth, and integrity of the environment and climate change adaptation and mitigation. Related to the strategy for poverty reduction, the government identified eight key industries where STI was expected to have large contributions: semiconductor and electronics, healthcare, IT and business process management, agriculture, mining and minerals processing, transport, manufacturing, and metals engineering. For climate change mitigation and adaptation, the key R&D areas included weather flood forecasting and climate change modelling, water security, climate-resilient agriculture, climate change mitigation, urban planning, and disaster risk reduction.

Related to these strategies was the establishment of government facilities to support domestic industries. Examples include:

- the Advanced Device and Materials Testing Laboratory, catering to needs of the semiconductors and electronics industry;

- the Die and Mold Solutions Center, which services needs of the metals industry; and,
- the Electron Beam Irradiation Facility at the Philippine Nuclear Research Institute, which caters to the needs of industries in the spices and dehydrated food, cosmetics, packaging, and medical devices sectors.

These publicly funded facilities aim to enable local industries to move up their respective value chains and become more competitive by providing services that might otherwise be too costly for MSMEs (DOST 2014).

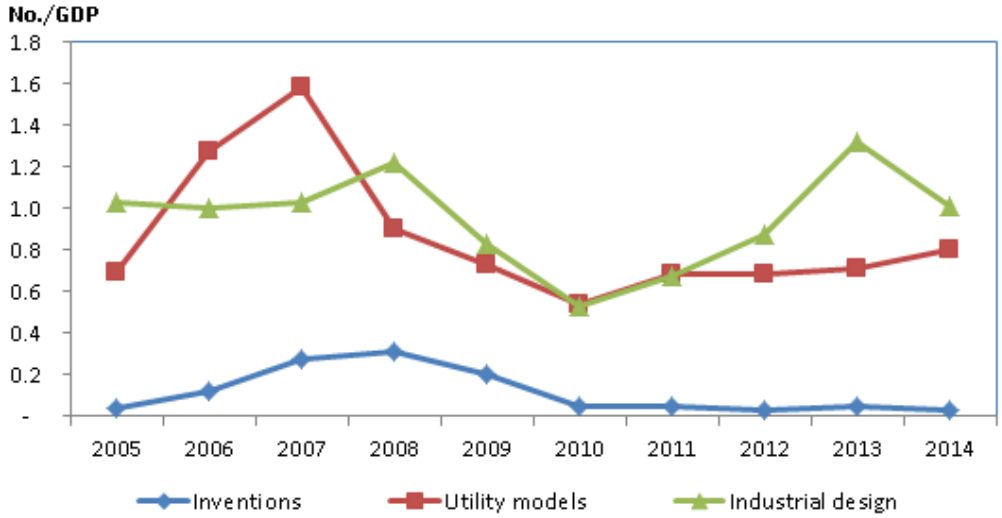
The current Duterte administration (2016–2022) sees STI as a means of establishing the foundation for strategic growth, a high-trust and resilient society, and a globally competitive knowledge economy. The strategy is two-pronged: to promote and accelerate the use of technology and innovation in all production sectors, and to increase innovation by enhancing the capacity to generate knowledge and strengthen collaboration across the STI ecosystem (NEDA, 2017). Under this administration, the DOST is implementing four new projects:

- Collaborative Research and Development to Leverage Philippine Economy (CRADLE) aims to create a synergistic relationship between academe and industry by providing funding to higher education institutions (HEIs) or R&D institutions undertaking research to solve problems troubling private sector industries.
- The Niche Centers in the Regions For R&D (NICER) Program intends to capacitate HEIs in regions of the Philippines to conduct quality research by providing institutional grants to improve the HEIs' S&T infrastructure.
- The R&D Leadership Program (RDLead) attempts to engage experts to be in charge of strengthening the research capabilities of the HEIs or R&D institutions. Together with the NICER Program, RDLead aims to help HEIs improve and hasten the use of research results that will contribute to the development of the country.
- The Business Innovation through S&T for Industry Program aims to facilitate Filipino companies' acquisition of strategic technologies by providing financial assistance that can be used for the acquisition of high-tech equipment and machinery, technology licences, and/or patent rights.

Despite these well-thought-out interventions and the accomplishments of major programmes of the DOST, S&T indicators have seen only very small improvements. For instance, gross expenditure on R&D as a percentage of gross domestic product has remained at about 0.15%, way below the

1% prescribed by the United Nations Scientific, Educational and Cultural Organization. Another tell-tale sign of a beleaguered S&T sector is the stagnant registering and granting patents for inventions and utility models (Figure 6.3).

Figure 6.3: Intellectual Property Rights Granted and Registered to Inventions, Utility Models, and Industrial Designs



GDP = gross domestic product, No. = number.

Note: GDP is measured in purchasing power parity. Bn (2010 = 100).

Source: Data for GDP obtained from the World Bank, World Development Indicators

There are bright spots, however. The number of graduates in science and engineering is increasing, as is the number of capable young researchers. A slight improvement in the number of collaborations among HEIs and industry has also been observed despite some industries finding collaborations with HEIs complicated (STRIDE, 2014).

Tracing the Philippines' STI policy through the years reveals several issues in STI governance. First, STI policy has always been viewed as a supporting actor in the quest for economic and social development. S&T programmes have always been viewed in relation to priority sectors in the Philippine development plans. Second, there is a dearth of empirical studies on the effectiveness of the plans, which has resulted in S&T development objectives being retained across administrations (Mani, 2002; Ancog and Aquino, 2007). Finally, the S&T plans by themselves are clearly not making a dent given the limited resources being incorporated in these plans. Often the plans already take into account the limited R&D spending in the country.

Regardless of the policy environment, the private sector has managed to conduct innovation activities. The following sections present successful cases of innovation collaborations from which lessons can be learned. These lessons can feed into new plans to foster the innovation ecosystem and mainstream innovation in the policy context.

4. Case Studies of Successful Innovation Activities and Polices

4.1. Framework for selection of case studies

This section presents case studies of successful innovation activities. The cases were chosen to illustrate some of the examples identified by Fukugawa (2017) on how to help firms innovate. Fukugawa (2017) identified the importance of a patent system that guarantees that inventors are able to exclude others from the patented technology, especially for technological fields where the social rate of return to R&D is high but the private return is low.

The cases of the automotive sector, food processing, and pharmaceutical sector illustrate how firms in these sectors use external sources of knowledge. They highlight how firms in these sectors learn from various channels. In several of these cases, public research institutes are important innovation intermediaries. Government projects, science parks, and innovation hubs function as innovation intermediaries that can facilitate innovation by providing physical and social capital, which the firm may be lacking. The case study of QBO and UP–Ayala Land TechnoHub shows how supporting entrepreneurship is a key to innovation.

4.2. Innovation in the automotive sector

Despite its relatively small contribution to manufacturing gross value added, the automotive sector is a key sector identified in the country's industrial plan because of its industrial links and the potential for employment generation. The case study of Quimba and Rosellon (2011) covering nine automotive firms (parts and components manufacturers and assemblers) urged the DOST to continue and strengthen its technology transfer programmes, such as SETUP and TECHNICOM, to assist automotive parts manufacturers in translating their awareness of the importance of technology and innovation to actionable plans and innovation activities (Box 1). Three firms rank high in assessing and selecting technology. This underscores the importance of having strong connections with local research institutions and government agencies as these are common sources of information on technology and innovation. External links helped build the capacity of the three high-ranking firms to improve the level of technology and expertise in their respective companies.

Box 1: Translating Innovation Awareness to Innovation Activity

Despite improvements shown by the Philippine automotive industry, it has lagged to those of neighbouring countries. Quimba and Rosellon (2011) presented some issues that might have contributed to the rather slow development of the automotive industry in the Philippines.[a] The study found that knowledge transfer and technology activities were critical in advancing the industry's development.

Nine automotive firms were interviewed in this case study by Quimba and Rosellon (2011). Using the instrument developed by Bessant et al. (2001), information on innovation activities within each firm was gathered, quantified, and analysed.[b] Information focused on aspects including awareness of the need to improve; ability to formulate technology strategies for business, assess technological solutions, and take advantage of links with a network of suppliers and collaborators; and implementation and effective use of technologies.

Results of this study show that all surveyed firms had relatively high awareness of the importance of technology but some were not able to use this to improve their technological competence or innovation. The study thus highlights the importance of technology transfer, which, to some extent, was addressed by different programmes initiated by the government through the DOST. Also, firms that relied on mother companies were observed to have less technology activity. These firms tend to be less innovative as they depended on the R&D activities of the mother company.

External links were seen to be utilised more by Filipino-owned firms. This might be explained by the absence of restrictions that would usually be imposed on foreign mother companies. The connections enabled Filipino firms to improve their level of technology and expertise. In addition, the study recognised the importance of creating an information environment where firms in the same type of product would affect other firms by benchmarking based on their knowledge of the types of technology that are available to it and its competitors.

Recognising the weakness of the Philippine automotive industry in terms of undertaking technology activities, the authors raised the need to strengthen innovation policy in the country. Improving links with R&D and higher education institutions was found to be critical. Strong R&D capacities contribute to the better flow of knowledge and technology transfer from the institutions to the industry. Aside from a focus on institutions, this study suggested the need for bigger investments on R&D personnel and scientists and increased public R&D spending.

[a] Quimba, F. & Rosellon, M.(2011). *Innovation in the automotive sector of the Philippines.* Philippine Institute for Development Studies. Retrieved from serp-p.pids.gov.ph
[b] Bessant, J., Rush, H., & Hobday, M.(2001). Assessing technological capabilities: An audit tool. Report to World Bank: Project on Korea and the Knowledge-based Economy.

Source: Adapted from Quimba and Rosellon (2011).

The case study also revealed the common issue of automotive parts manufacturers relying on parent companies for their technology upgrading. Parent companies choose to transfer technology, albeit with some apprehension, to their subsidiaries or affiliates in the country in order to improve their technical capabilities and production efficiency. To allay the concerns of foreign parent companies regarding the transfer of technology to local manufacturers, a consistent and reliable policy on intellectual property rights is required.

4. 3. Innovation in the food manufacturing sector

Del Prado and Rosellon (2017) identified a successful case of partnership between a firm and its suppliers, supported by government and other innovation intermediaries (Box 2). The experience of Firm B, a small, locally owned fruit juice manufacturer, highlights the value of engaging with government institutions. Firm B benefitted from its partnership with the Industrial Technology Development Institute, one of several R&D institutions under the DOST, by referrals for machine suppliers, and assistance for plant layout and for the development of new products.

Box 2: Technology Transfer in the Food Manufacturing Sector

The food manufacturing sector is the largest manufacturing subsector in the Philippines, with a 39% share of total establishments in 2012. The subsector also contributes 21% of the manufacturing sector's total employment and 16% of its total value-added.

Despite the contribution of the sector to total employment generation and manufacturing value-added, the sector is viewed as a low-technology subsector because it is less capital-intensive and does not require high-skilled workers. The sector also has difficulty establishing strategic and efficient partnerships because product development and production processes are driven by secret recipes and family-grounded procedures. The risk of appropriability and leakage of highly specific assets deters firms from embracing collaborative arrangements and developing external ties even though the potential benefits to business expansion and growth is greater.

The case of a large, locally owned, export-oriented food manufacturer (Firm A) and that of a small, locally owned, fruit juice manufacturer (Firm B) are compared and contrasted.

Firm A, a large, locally owned manufacturer of fruit purees and concentrates, caters to other food companies in China, Hong Kong, and Japan. Information from their international customers' knowledge on new products and technology is transferred through product samples. Firm A's local customers are also able to obtain some nontechnical knowledge from Firm A in the form of product development support. Firm A's production processes and techniques are not shared with their customers, local or international. Because of the international links, Firm A is able to learn about the taste preferences of customers from other countries and its processes are upgraded to cater to international standards and preferences.

Firm B, on the other hand, is a small, locally owned manufacturer of ready-to-drink fruit juices, concentrates, and purees. Most of its production is exported to Canada, the United Arab Emirates, and the United States, while about 40% is sold to the domestic market. Firm B's major partner in knowledge sharing is a local small-scale machine supplier that it has worked with for some time. Transfer of knowledge related to the machine involves training the operator and after sales service personnel. Firm B shares specific details of machine parameters with its supplier in order to obtain equipment calibrated for new product variants. Firm B has benefitted from the knowledge-sharing partnerships with the supplier by obtaining specially calibrated machines based on the firm's needs.

One of the key findings is that there is great potential for businesses to share knowledge and upgrade the capability of local firms. The transfer can be from a big foreign company to a big local company (Firm A) or from one small firm to another (Firm B). For the large firm, support from the government may not be expected but the policy environment for large firms should be conducive to technology transfers. For a small firm, support from the government is needed especially on getting access to technological knowledge.

Source: Adapted from del Prado, F. & Rosellon, M.(2017). *Achieving innovation without formal R&D:*

Philippine case study of garment firms. Philippines Institute for Development Studies. Retrieved from serp-p.pids.gov.ph

Unfortunately, the case of Firm B may not be generalised to all firms in the food manufacturing industry. Innovation in Firm A, a large, locally owned, export-oriented enterprise, is driven by the specific need of its customers. Firm A's international customers shared with it information on taste and preferences of their end buyers. Firm A is then put to task to meet these requirements but limited technical support or knowledge is transferred from the international customers. Despite this less-than-ideal situation, Firm A is able to meet its international customers' requirements, an indication of Firm A's high level of (internally sourced) innovation capability.

Common to both firms is the role of trade shows and food fairs, which are important sources of information for both firms. Firm A gains new clients by participating in food fairs, while Firm B obtains ideas for improving production processes and information on the latest machinery and equipment available. For Firm B, these pieces of information are then passed on to its local machine supplier whenever it wants to upgrade its production processes.

4.4. Technology transfer and innovation in the pharmaceutical industry

The experience of the DOST's National Integrated Research Program on Medicinal Plants (NIRPROMP) in the commercialisation of *lagundi,* a native shrub called traditionally used as herbal medicine, presents several lessons on innovation. One of these lessons is that innovation begins with good research that is rooted in the culture and experiences of the society and that is trying to address society's needs. The establishment of the NIRPROMP was motivated by the need for a more affordable source of medicine. Recognising that herbal medicine has been the go-to medication for many Filipinos living in rural areas, the NIRPROMP investigated the medical composition several herbal plants with the goal of improving the formulation of herbal medicine in the country and consequently, providing cheaper alternative medicines for Filipinos (Box 3).

The foresight of researchers to conduct studies on commercialisation and consumer preferences in the early stages of the research process benefitted the translation of the research from product development to commercialisation. The underlying principle behind this foresight is the understanding that research should result in an innovation – a product or process that would benefit the society.

Box 3: Innovating Herbal Medicine

The traditional knowledge in the use of *lagundi* (Vitex regundo), passed on through *herbolaryos* (traditional herbalists), was developed into modern medicine when the National Integrated Research Program on Medicinal Plants (NIRPROMP) successfully identified the medicinal properties of each part of the plant, paving the way for the development of a *lagundi*-driven formula for a clinically tested cough and asthma medicine.

The research and development work that went into the development of the symptomatic drug, including the clinical trials, was spearheaded by researchers Dr Nelia Maramba and Dr Conrado Dayrit, both of the University of the Philippines Manila campus. Dr Dayrit also conducted research on commercialisation, as well as on the leading causes of morbidity during that time.

Lagundi has four active ingredients that could be used as a powerful cough syrup without any side effects. By 1993, the researchers from NIRPROMP had developed a *lagundi*-based cough medicine in tablet form. They further worked to develop a formulation for *lagundi* cough syrup to cater to children and the elderly.

Because NIRPROMP researchers were funded by the Department of Science and Technology (DOST) and the work was a collaboration between the University of the Philippines and the Philippine Council for Health Research and Development (PCHRD), all intellectual property was managed and owned by the DOST. To protect the intellectual property behind the *lagundi* cough syrup formula and promote its commercialisation, DOST applied for a utility model with the Intellectual Property Office of the Philippines for a herbal pharmaceutical composition based on *lagundi*. The utility model was approved and issued in February 2001. Because the PCHRD was responsible for the commercialisation of *lagundi* cough medicine, they organised information fora to pique the interest of local pharmaceutical companies. Many of them expressed interest, prompting the PCHRD to adopt a nonexclusive agreement. Under the agreement, the licensee pays an upfront fee for technology, and royalties are paid based on gross revenues less taxes and discounts.

Despite not being the first licensee, Pascual Laboratories, a large Filipino pharmaceutical company, is arguably the most successful licensee of *lagundi* technology. Pascual's product based on the PCHRD *lagundi* formula was approved by the Bureau of Food and Drugs in 1996. To overcome scepticism about the product's efficacy, Pascual Laboratories submitted the drug to the 1997 International Exhibition of Inventions, New Techniques and Products in Geneva, Switzerland. The silver certificate for research and development awarded for the drug was used to help win over medical professionals and sceptical consumers.

Inspired by Pascual Laboratory's success, other companies joined the fray prompting Pascual Laboratory to apply for a trademark in January 2011. By early 2011, the company's *lagundi* cough medicines had become the second-most-popular cough medications in the Philippines.

Source: World Intellectual Property Organization. From Herbal Folklore to Modern Medicine: National Integrated Research Program on Medicinal Plants, Philippines. Retrieved from www.wipo.int

Innovation takes a long time to materialise and can be very challenging. The NIRPROMP was established in the 1974, a survey of *herbolaryo*[5] was undertaken in the 1980s, the medical compound was isolated in 1995, and the utility model for the herbal pharmaceutical composition based on *lagundi* was issued in 2001. The entire process took about 37 years. Also, a number of companies expressed interest and proceeded with commercialisation, but, during the early stages

[5] Traditional healers who use their knowledge of herbs to administer herbal medicine

of commercialisation, the DOST's royalties were small. An environment that is tolerant of long-gestating R&D projects is necessary to allow the product to penetrate the market, otherwise the full potential of the product might not be realised.

Innovation does not end with product development and commercialisation. Products need to be used by consumers in order to have an impact. Before consumers use the products, they need to be convinced about their efficacy. Pascual Laboratories' effort to advertise and promote the products gives an invaluable lesson on how to handle product innovations. Winning a silver medal in the International Exhibition of Inventions, New Techniques and Products, gave the product an international seal of product quality, helping to gain consumer confidence. The government, with its massive resources, can promote innovation by procuring the new product or service. This was the strategy used by Pascual Laboratories during the initial phase of commercialisation. The firm promoted the use of *lagundi* medication to government-funded rural clinics.

4.5. Supporting micro, small, and medium-sized enterprises

All of the development plans discussed earlier and even academic literature (Llanto, 2013; STRIDE, 2014) recognised the importance of MSMEs in development and the role STI plays in increasing their competitiveness. MSMEs drive innovation through their R&D and product and process development activities (STRIDE 2014, Albert et al. 2013). At the Inclusive Innovation Conference held on 31 May–1 June 2017, the DTI Secretary emphasised that government policy should focus on pushing MSMEs to innovate (Lopez, 2017). This case study highlights the SETUP Program, one of the government projects implemented to support MSMEs (Box 4).

The programme is worth highlighting because it implements the strategies that were laid out in the development plans. The components of the SETUP Program cater specifically to the support MSMEs need to upgrade their level of technology in order to improve their competitiveness. The programme has become the bridge to ensure that technological upgrading will result in economic development through the creation of jobs.

Box 4: Supporting Small and Medium-Sized Enterprises through the years

The Small Enterprise Technology Upgrading (SETUP) Program, launched by the Department of Science and Technology (DOST) in 2002 aims to help micro, small, and medium-sized enterprises (MSMEs) adopt technology to boost their productivity and competitiveness. The project also puts together in a single unit all existing programmes and projects, including the Manufacturing Productivity Extension for Export Modernization, Consultancy for Agriculture Productivity Enhancement, Science and Technology Enterprise Assistance Mechanism/DOST-Academe, and the Technology-Based Enterprise Development Program. The DOST regional offices implement SETUP and are primarily responsible for selecting client

MSMEs. They also manage the project interventions for the client, including innovation system support, the technology needs assessment, technical training of the MSME workforce, technical consultancy services, product improvement and development, and packaging and labelling.

Llanto (2013) found that innovation system support was the intervention most commonly accessed by MSMEs (76% of the total projects in the first half of 2010). Packaging and labelling services intervention was a distant second at 17.2%. In 2003, 781 small and medium-sized enterprises received assistance from SETUP, resulting in increased production and, consequently, the creation of 3,779 new jobs.

The Aquino administration has expanded the SETUP Program to priority geographic locations in order to address poverty. According to the 2015DOST annual performance report, the project has provided 1,021 technical interventions to 4,510 firms resulting in the creation of 34,512 jobs. The Philippine Development Plan 2017–2022 promises to expand the support to the SETUP Program so that it can cater to more MSMEs requiring government assistance.

Sources: Alabastro (2004); DOST (2014, 2015); Llanto (2013); NEDA (2017).

The concentration of industries in urban areas has been one of the factors cited for the lack of STI development in the country (Llanto, 2013). SETUP is implemented regionally, ensuring that all the areas outside Metro Manila also get access to innovation-related services.

The effectiveness of the SETUP Program is intensified because of its continuity. It has been providing services to Micro, Small, and Medium-Sized Enterprises (MSMEs) since 2002, encompassing more than two administrations. As a testament to the value of the programme, administrations have continued to expand its implementation to reach more MSMEs. SETUP has continued to deliver on its promise as evidenced by increasing the number of firms receiving support and, consequently, the number of jobs generated.

4.6. Supporting entrepreneurship

Innovation is at the core of entrepreneurship (Lopez, 2017). Thus, government has jump-started a number of technology business incubators in order to provide support to entrepreneurs who want to start their own company. Unfortunately, the performance of these publicly run incubators had been poor (Macdonald and Joseph, 2001). The two cases presented here are good practices from which a number of lessons may be learned (Box 5).

QBO and the UP–Ayala Land TechnoHub both offer opportunities to expand the network of start-ups. QBO's workspace allows start-ups to engage with one another and obtain mentors from established entrepreneurs. The management of QBO is handled by experienced people from the private sector who are extremely knowledgeable on issues pertaining to start-ups. The managers are always on hand to provide assistance to entrepreneurs. This addresses the issue raised by

Macdonald and Joseph (2001) of TBI managers' lack of qualifications and many responsibilities other than managing the TBIs.

The mixture of start-ups with established companies in the UP–Ayala Land TechnHub also fosters an environment where collaboration among the locators can be effectively pursued. Similarly, the common area provided by QBO allows the transfer of tacit knowledge to entrepreneurs. Allowing the private sector to manage technology hubs and TBIs as a business venture taking into consideration sustainability ensures that facilities and support services are accessible to locators or users of those TBIs. For the locators, these facilities and support services are at least as important as an indirect subsidy through lower-cost office space.

The management of the UP–Ayala Land TechnoHub also teaches locators how to become less dependent on support and learn the real-world situation of managing businesses. This helps incubators become more independent in managing their business through exposure to the real-world situations while at the same time having the advantages of the facilities and services offered in a TBI.

Box 5: Public–Private Partnerships in Business Incubation

QBO

The collaboration of the Department of Trade and Industry (DTI), the IdeaSpace Foundation, the Department of Science and Technology, and the JP Morgan Foundation gave birth to QBO. The QBO Innovation Hub, which is located in the DTI International building in Makati City, is the DTI's way of supporting the start-up community with particular attention to those that have viable business propositions. The QBO Innovation Hub is led by Rene 'Butch' Meilly, who also heads the Philippine Disaster Resilience Foundation, a private sector vehicle for disaster management that has become a role model for the United Nations' Connecting Business initiative. Katrina R. Chan of IdeaSpace serves as executive director of the hub.

The QBO Innovation Hub will also serve as the venue for micro, small, and medium-sized enterprises to explore the opportunities disruptive technologies bring. The hub is the logical next step in the IdeaSpace Foundation's efforts to elevate the Philippine start-up scene to global standards. QBO offers a range of programmes to the start-up community, such as networking events, mentor-matching (where entrepreneurs can consult with senor corporate executives), basic start-up classes, advanced workshops, and group feedback sessions. Qualified start-ups can also participate in the JP Morgan incubation program.

UP–Ayala Land TechnoHub

Ayala, a private business entity, established UP–Ayala Land TechnoHub as a facility for business incubation. The firm has also provided commercial spaces to generate income for sustaining the technology hub operations while providing a good venue for industry–academe links. The facility has been developed to be conducive to nurture family bonding, group meetings, and relationships between entrepreneurs and their employees. The hub not only provides locators with an environment conducive to growing their business, but also provides support in terms of modern facilities.

Unlike traditional one-phased incubation process, the UP–Ayala Land TechnoHub follows three major stages in its incubation process. The start-up would first be housed in the incubator area. After 3–4 years, the locator – if it becomes successful – would graduate and move to multitenant buildings where it would enjoy larger office space and can have more opportunities to expand. If the company grows further, it could eventually move to its own building, also in the vicinity of the UP–Ayala Land TechnoHub. At present, the technology hub has available facilities for small, medium-sized, and large businesses to accommodate the changing needs of start-up businesses.

By allowing big and established companies to locate in the facility, the UP–Ayala Land TechnoHub is able to maintain the conveniences they provide to their locators and at the same time provide locators with opportunities to expand their business networks, which is crucial for building their capacities and capabilities.

Sources: Department of Trade and Industry (DTI).(n.d.). *DTI, IdeaSpace launch the QBO innovation hub*. Retrieved from www.dti.gov.ph

Beng Hui et al. (n.d.). 'Privatization of Business Incubation: Initiatives to Achieve Sustainability and Success' Retrieved from: http://www.dlsu.edu.ph/research/centers/aki/_pdf/_publications/Hui_Fernandez_Sio.pdf

4.7. A new framework for industry–academe collaboration

In a presentation for the 2017 Inclusive Innovation Conference, Dr Ricardo E. Rotoras, the first president of the University of Science and Technology of Southern Philippines (USTP) and the incumbent President of the Philippine Association of State Universities and Colleges, described the current situation of (state) university–industry collaborations. In a survey of 63 state universities and colleges, Dr Rotoras found that one-fifth (13) of them have no academe–industry collaborations. Most (57%) of the institutions have between two and six collaborative projects, corroborating the results of the 2015 PSIA about the lack of network links of firms and industry on innovation. Rotoras pointed to three major reasons why universities and colleges score so poorly on industry research collaboration: (i) faculty rewards and incentives for collaboration with industry are insufficient, (ii) leadership fails to appreciate the value of collaborating with industries, and (iii) existing government policies do not encourage academe–industry collaboration. On the other hand, demand-side issues must also be raised, including the relevance of the R&D work being done by the academic community to the market and business opportunities as perceived by firms, issues on potential commercialisation of products or processes, and the cost of accessing university talent and expertise.

The formation of the USTP through Republic Act 10919 provided a concrete policy framework on which academe–industry collaboration can be pursued. The law has a number of provisions pertaining to collaboration with industries. The legislation allowed the USTP's board of trustees to enter into public–private partnerships in the areas of research, instruction, and extension. These can be in the form of joint curriculum, research, or business ventures.

Box 6: Legal Foundation for University–Industry Linkage: The Case of the University of Science and Technology of Southern Philippines

Republic Act No. 10919 was passed to provide a legal basis for the amalgamation of the Mindanao University of Science and Technology and the Misamis Oriental State College of Agriculture and Technology. This legislation established the University of Science and Technology of Southern Philippines. The law, however, anticipated the need to also establish partnerships with the private sector and industries and thus, provisions related to collaboration with private sector were included.

Section 17 of the act enumerated the powers and duties of the Board of Regents, the governing body of the university. Section 17(s) gives the Board of Regents the power 'to develop mechanisms for the efficient adoption of public–private partnerships in the areas of research, instruction, extension, and in the acquisition of facilities and structures of the University, such as:

(1) Join curriculum ventures: sandwich programmes for students in specialised science and technology courses, faculty development curriculum in collaboration with partner industries, staff development of the industries to be run by the University and other such similar projects; and

(2) Joint research ventures: outsourcing of the research components of the industries to the academe's graduate programmes; product/service research and similar research endeavours.'

Succeeding sections also mentioned the powers of the board related to industry collaboration. Section 17 discusses the powers to '(t) To enter into joint ventures with business and industry for the profitable development and management of the economic assets of the University, the proceeds of which shall be used for the development and strengthening of the University; (u) To develop consortia and other economic forms of linkages with local government units *KGUs), institutions, and agencies, both public and private, local and foreign, in the furtherance of the purposes and objectives of the University; (x) To setup the adoption of modem and innovative modes of transmitting knowledge such as the use of information technology, the dual training system, open distance learning and community laboratory for the promotion of greater access to education….'

Other legal provisions are aimed at providing an enabling environment for university–industry links to develop. Section 28 designated the Alubijid and the Clavera Campuses as science and technology parks for the long-term development of the academic and research facilities of the university in strong partnership with industries. Section 29 identifies the incentives that industries can enjoy should they locate their operations in the university science and technology parks. Section 31 identifies the university as a research partner of partner industries providing the possibility of the university allocating funds to support joint collaborative research with partner industries.

Source: Government of the Philippines, Republic Act 10919.

Other provisions of the law opened the USTP to the entry of industries as it designated the Alubijid and Clavera campuses as S&T parks. Incentives are provided to attract industries and businesses to locate in these parks. A number of collaborations have started in USTP, such as the Business Incubation Technology Entrepreneurship and Start-ups and Food Innovation Center. The former is a collaboration of the Philippine Council for Industry, Energy and Emerging Technology Research and Development, Cagayan de Oro ICT Business councils, and the USTP. The services they offer include incubation monitoring and coaching, training, networking events, and other basic services. Examples of start-up companies that are located in the USTP are the Hyperstack, Wela (Bai Web and Mobile Lab), Scribbles, Tome, XGN, Shoplocal, and CarlShift Web

Technologies. The USTP's Food Innovation Center is the product of the collaboration among the DOST, the DTI, and private companies. It offers product development services. Other services that are provided include intellectual property assistance, training, consultancy, research assistance, and assistance on labelling and packaging. The Food Innovation Center has already assisted 200 MSMEs, developed 40 products, and provided consultants to 32 clients.

5. Future Innovation Policy in the Country

This section attempts to provide some guidelines in fostering a better innovation ecosystem in the country, and having innovation mainstreamed in the policy environment. The guidelines do not attempt to be comprehensive, but will focus specifically on addressing the issues identified in the current status of innovation activity in the country and the case studies described in this paper.

A national policy should veer away from the linear innovation model[6] to one that is defined in consultation with all stakeholders. The type of national innovation policy that should be pursued is one that supports various forms of collaboration taking into consideration sector-specific characteristics of the firms. Data from firms' innovation behaviour show that larger firms tend to rely on internal sources for their information and innovation. Case studies of the food processing and automotive sector confirm this. Only a few automotive firms have links with university and government. Similarly, the smaller food processing firm is more open to knowledge transfer than the larger firm. This implies that a policy to support collaboration is important but the strategies should consider specific characteristics of the firm, as behaviour of the firm changes depending on the size and type of industry.

Ensuring that intellectual property in the Philippines is protected is also essential. The importance of intellectual property rights can be seen in the case of the pharmaceutical industry, where the trademark filed by Pascual Laboratories resulted to improved product recognition and increased sales. However, the experience of firms relying on secrecy to protect their innovations is a signal that intellectual property rights in the Philippines should be strengthened by appropriate policies that solidify the intellectual property environment. Similarly, the case of the automotive firms having limited innovation because technology is not transferred by the parent company due to intellectual property concerns should be addressed by a strong intellectual property rights policy. To encourage technology transfer, balancing the restrictions and incentives on foreign direct

[6] A linear innovation model assumes that R&D leads to innovation and commercialisation of mature of R&D outputs, product technologies, and consequently economic growth (Ancog and Aquino, 2007).

investment cannot be emphasised enough. It needs to strike the right balance between protecting domestic industries but at the same time appeasing the mindset fearful of foreign companies.

HEIs should be encouraged to pursue R&D without being encumbered by myopic internal policies that fail to see the long-term benefits of research. Similarly, they should be incentivised to pursue partnerships with private firms to pursue product development and commercialisation.

The start-up environment should be enabling with appropriate incentives and support for start-ups to thrive, but at the same time allowing businesses to learn from real-world experiences. TBIs bring together the resources of the three major stakeholders related to innovation: the government, the start-ups and private firms, and academe. Because these three would be directly affected by policies on start-ups, any national policy should be made in coordination with, and with inputs from, all three groups of stakeholders.

Policies should be explicit about the inputs needed to elevate the country's innovation ecosystem to international standards. This is a lesson that can be inferred from the review of development plans undertaken in this paper. While the strategies and even indicators of STI are monitored in these plans, the plans are often silent on budget required to support STI. R&D expenditures need to be scaled up in both the public and private sectors. Innovation indicators, including traditional R&D indicators, should also be produced more regularly for the country to be able to assess its progress in developing the innovation ecosystem. Related to this, it is important to conduct a review of the effectiveness of the STI plans and an assessment of the impact of these programmes.

6. Summary and Conclusion

This paper presents the patterns of STI policy in the Philippines over time. While innovation is recognised as an important driver of competitiveness and a means of expanding employment opportunities, innovation policy needs to be substantially mainstreamed. The results of the 2015 PSIA showed that in 2015, only less than half of firms have engaged in innovation activities. Given the public good character of R&D, these innovative firms prefer to conduct R&D by themselves or only in cooperation with those in their value chain. The government should foster the innovation ecosystem, but specific actions and time-bound plans must be formulated in close collaboration with other innovation actors while ensuring that complementary factors for innovation are present. The selected case studies highlight some successful innovation policies and strategies that the country can pursue to scale up innovative programmes and projects.

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