# Chapter 2

# Sources of Innovation of Philippine Firms: Production, Logistics and Knowledge Networks

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# 2

# Sources of Innovation of Philippine Firms: Production, Logistics and Knowledge Networks

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**Abstract**

The story of the Philippines in terms of its foray into the S&T system is not unique when compared to other developing countries. It is not impossible for it to catch up with the more advanced, high technology economies but it has to aggressively pursue a national innovation framework that takes advantage of what each stakeholder of knowledge can offer. The difficulties of the S&T system in the country are well documented. Institutional structures exist, the legal and policy frameworks are in place but the process of diffusion, technology transfer and adaptation remains wanting. Propositions have been made that this may be traced to the weak innovative culture prevailing in Filipino society, the low priority accorded to S&T as evidenced by limited resources allotted to it, the dearth in a critical mass of manpower that could build up and sustain an innovative culture, and the inability of the government, the private sector and the academe to collaborate meaningfully. The country's weak performance in S&T lowers its productivity and adversely affects its overall competitiveness. As technological innovation and economic growth are mutually reinforcing, it is imperative that the Philippines continues with its efforts to play catch up in the technological arena.

Perhaps, the lack of appreciation of how the various linkages affecting productivity could affect innovation further aggravates the present condition. The country study aims to find out the present condition of the national innovation system and the types and strengths of linkages prevailing within. With the choice of CALABARZON as the locus of the study, the role of agglomeration economies in diffusing knowledge is featured. Moreover, it is hoped that with increasing integration with other economies in Asia under the web of production networks, a case could be made, based on the

Philippine story, for establishing a regional knowledge network, a possible building block for the creation of an ASEAN economic community.

# 1 INTRODUCTION

The current global economic downturn has cast a pall over the development path of emerging and developing economies in Asia. The closer integration of economies caused by increasing globalization has made certain that the effects of the crisis among developed countries would reach the shores of the developing world. This, in particular, is true for countries in Southeast Asia which have become the production capital of many multinational companies (MNC) based in North America and Europe. But this crisis has also brought to the fore all the more the necessity for Southeast Asian countries and its close neighbors in East and South Asia[ii] for closer intra-regional cooperation.

The presence of industrial clusters in these economies is said to be an important step for stabilizing the industrial structure, encouraging entrepreneurship and the establishment of local firms especially at the small and medium scale, and fostering the culture of innovation. While it is imperative that development gaps across regions within a country is narrowed through the formation of more industrial clusters and stimulating linkages, it would do well for deepening the relationship and closing the development gaps at the Asian regional level if inter-cluster linkages among countries could likewise take effect. Aside from production linkages, collaboration in terms of innovative undertakings would lead to heightened productivity in and competitiveness of the region. The first step in catalyzing this process is knowing the nature and extent of innovation taking place in the countries concerned, including the technological capacities available for absorbing new knowledge and for building up a knowledge-based economy, both at the country and regional level.

This paper attempts to investigate and analyze the channels by which information

flows within and among firms in the Philippines, whether through their production linkages or the existence of knowledge networks. The former points to agglomeration effects while the latter to the known networks of innovation. To manage the analyses, focus is directed towards one of the most important regions in the country, based on its contributions to the national economy. The first section provides a brief review of the literature on agglomeration effects in terms of knowledge spillovers and other sources of knowledge and technology. The national innovation system approach is explained as framework for developing a national science and technology system at the country level. The next section provides a description of the national environment where firms in the country operate under the backdrop of an industrial and technological policy structure in the Philippines. The third section presents the hypotheses for the study and how these were tested through in-depth case study, analysis of survey results and econometric analysis. The section after this presents the situation in CALABARZON and the summary of findings from the survey and in-depth interviews of firms. The fifth section describes the econometrics results of the study as estimated by a Japanese team of collaborators. The last section puts forward propositions for policies at the country-level as well as at the regional level given the fact that the overall study is geared towards providing evidence-based recommendations that would help lead towards the creation of the ASEAN Economic Community in the near future.

## 2 TECHNOLOGY, AGGLOMERATION & INNOVATION: BRIEF REVIEW OF THE LITERATURE

Innovation is the novel application of economically-valuable knowledge (Feldman, 1999). Economic innovation as defined by Schumpeter (1934) could take any of the following forms: introduction of a new good or product; introduction of a new method of production; opening of a new market; engaging a new source of raw materials; and carrying out new organization or management systems. Innovation is synonymous with adding value leading to improved products or processes and yielding benefits to the firm.

It is an acknowledged fact that technological innovation can bring higher

productivity and improves competitiveness of firms. In the aggregate, this increases output and leads to economic growth. The application of new knowledge and technology derived from various sources is what enables firms to reduce costs of production, be flexible in producing products that respond to demands, improve quality of products, and upgrade into higher value added production. It is claimed that technological innovation and economic growth are mutually reinforcing (Hirono, 1985 as cited in Cororaton, 2002). Higher growth enables the generation of further productivity enhancements through innovation derived from research and development (R&D) and this virtuous cycle can continue in a sustained manner as long as the appropriate policy environment remains conducive. The case of Japan and South Korea has been often cited in the literature for their success in catching up in terms of technological progress with highly advanced industrial countries. Cororaton (2002) cited the so-called convergence school that claimed that technologically backward countries can benefit from the technology already created by advanced countries. However, massive technology transfer should take place catalyzed by an appropriate technology policy and investments on education for building up human capital, infrastructure, management capability, and R&D efforts.

In recent years, a body of ideas has emerged pointing to the importance of locations as hubs of economic activities influencing regional economic development and contributing to national growth. The so-called new economic geography highlighted industrial agglomerations as clusters of growth and industrial development. Industrial clusters are formed due to a myriad of factors and the spatial configuration set by the balance between centripetal and centrifugal forces or the push and pull of various forces. To be sure, these clusters emerge due to the presence of Marshallian externalities, i.e. economies of scale; availability of specialized input services; highly specialized labor force; production of new ideas, indeed knowledge, arising from the accumulation of human capital and face-to-face communications; and presence of necessary physical infrastructure. As cited by Fujita and Thisse (2002), industrial agglomeration is an outcome of a “snowball effect” in which increasingly, firms would want to congregate in order to benefit from these externalities. The interest of this paper on industrial agglomeration is the acknowledged existence of knowledge spillovers in

this spatial location. To quote from Alfred Marshall himself, *"the mysteries of trade become no mysteries; but as it were in the air….good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas."*

Though even Krugman (1991, as cited in Feldman, 2000) himself mentioned that *"knowledge flows are invisible,"* and therefore difficult to quantify, this did not prevent researchers from measuring knowledge spillovers[iii]. Feldman (2000) in her review claims that the consensus arising from the body of empirical work done on this is that, knowledge spillovers are geographically bounded within a limited space over which interaction and communication takes place. One path is via the pool of skilled labor available within a cluster, presumed to be able to move freely from one firm to another or have constant and frequent face to face interaction with one another. Also highlighted was the importance of localized knowledge within the spatial configuration. This body of work, as summarized by Feldman (2000), presupposes that proximity matters in innovation and that there is actual interaction and cooperation taking place within an industrial cluster. But is proximity enough for knowledge to be exchanged? What if the firms in a cluster have limited interactions and do not fulfill the conditions for clustering oft-cited in the literature? What types of dynamics are in play within so called, technologically-backward countries? How knowledge is exchanged among firms within and how does this lead to innovation?

There is indeed, a technological divide in the global economy, with the existence of highly advanced economies and technologically-backward countries. Choi (1983 as cited in Cororaton, 2002) enumerated factors that have been causing this technology gap between developing countries and more advanced economies. The former are said to be weak in policy formulation related to S&T, with even the so called S&T culture among the public being low. Viable institutional structures are absent as well as adequate R&D systems. With fiscal constraints and competing priorities, capital outlay for research and budget in general are insufficient. Scientific manpower are also said to be limited in these countries that could have served as the critical mass for initiating scientific and

technological pursuits, individually or collectively. Lastly, the participation of vital sectors in society are sorely lacking for the development of science and technology. The industrial sector, to which the adoption of technology for domestic application is most directed to, is singled out as lacking in its involvement.

The national innovation system framework is anchored on the position that the flows of technology and information among people, enterprises and institutions lead to the innovative process (OECD, 1997). Highlighting the complex relationships and interactions among these actors, the OECD (1997) identifies four types of knowledge or information flows: (a) interactions among enterprises themselves; (b) interactions among enterprises, universities and research institutions; (c) technology diffusion to enterprises; and, (d) personnel mobility or the movement of highly capable personnel within and between institutions. The study done by OECD, linking these channels to performance of firms, has found evidence that high levels of interactions in these different types of flows could indeed, lead to improved capacity of firms, whether in terms of products, number of patents and productivity.

This leads credence to the argument that industrial development necessitates technological capability in industry and that the use of technology is most critical at the firm level (Patalinghug, 2003). Other experts, as cited in Patalinghug (2003) and as would be enumerated here, provide clearer delineation of roles among stakeholders of the system. List (1959) mentioned the role of government in the provision of education and training as an important element as well as the infrastructure for supporting industrial development. Meanwhile, Freeman (1987) points to the organization of R&D and of production within firms, the role of government, the interfirm relationships, and the interaction between them. Nelson (1987, 1988) analyzes the combined public and private nature of technology and the role of firms, government and universities in the generation of new technology. This highlights the fact that new knowledge and technology can be derived from various sources that can be lumped into two channels. One, refers to the structure of the firm itself and its production linkages, both upstream and downstream, domestic or international, and with firms in the same location, whether cooperator or competitor. The other channel pertains to a knowledge network or a web of service providers that enables firms to access, generate, adopt, and utilize knowledge,

whether geographically proximate or not. These are universities, research development institutions – both public and private, technology resource centers, manpower skills development institutions, industry associations, and even national S&T structures and the local government.

How these dynamics come into play in the case of the Philippines would be the subject of the succeeding sections of this paper.

# 3 THE PHILIPPINE INDUSTRIAL AND TECHNOLOGICAL LANDSCAPE

In the last eight years, the Philippine economy has posted positive growth. After posting a high 7.8 percent in its Gross National Product (GNP) in 2007, the economy went down to 6.1 percent and with the global downturn in effect, it is forecasted to further go down to 5.0 percent in 2009 (Yap, 2009).

Among the three sectors comprising its economic structure, services remains to be the main contributor at nearly half of the total, followed by the industry sector, which appears to have stagnated at the 32.3 to 32.7 percentage share level since 2005. A similar trend has been posted by the agriculture sector at a much lower 18 percent share (Yap, 2009). Since the Philippine economy could not get by with the services sector alone, efforts to revitalize the industry sector should continue as it remains to have a substantial share of total employment, the lion's share of which is traditionally taken by the manufacturing sector. Industrial development can be pursued with the appropriate industrial policy and as earlier cited, strengthening technological capability.

## 3.1. Industrial Policy

The Philippine industrial structure used to be characterized by a highly protectionist regime that lasted for three decades. In the 1980s, industrial reforms and structural adjustments were instituted aimed at pursuing a more efficient and internationally competitive economy. Such reforms ranged from trade liberalization to

privatization and the aggressive promotion of foreign direct investments (FDIs), an export promotion strategy and the offering of a flurry of investment incentives to domestic firms. Add to this what started out as a regional dispersal strategy of industrial development through the establishment of export processing zones to what are now existing as well developed industrial parks and economic zones. The industrial clustering strategy was a recent addition as can be gleaned from various policy frameworks starting in 2001, highlighted by the creation of a National Cluster Management Team and the One-Town, One-Product initiative. The latter is aimed to be a collaborative undertaking among various sectors including small and medium enterprises, national government agencies with regional/local presence, and local government units[iv].

### *3.1.1. Trade liberalization*

The Tariff Reform Program (TRP) was the lynchpin of the trade liberalization reforms that started in the 1980s. Since 1981, four TRPs were implemented, each one staged on a five-year period, except one. The TRPs were aimed at not only liberalizing the trade environment but also improving access to essential inputs, making available more choices of goods for the consumers, enhancing competitiveness of local industries in the domestic and export markets, and simplifying the tariff structure for ease of customs administration, among others.

### *3.1.2. Privatization*

In the 1990s, the three-pronged policy of privatization, liberalization and deregulation commenced at the domestic level in line with the goals of engendering economic openness, divestment of state owned and operated enterprises, removal of monopolies in vital utilities in the country such as water, electricity and telecommunications, and promotion of competition. Specifically, the Foreign Bank Liberalization Act was signed into law in 1994 and triggered the entry of foreign banks, gradual at first, and signaled the start of the more efficient implementation of the banking system in the country. In 1995, the passage of the Public Telecommunications

Policy Act started the deregulation reforms, followed by the National Water Crisis Act on the same year and by the Electric Power Industry Reform Act in 2001.

### *3.1.3. Foreign direct investment policies*

The Foreign Investments Act of 1991 was a landmark legislation that allowed foreign equity participation of up to 100 percent in all sectors in the country, except those included in the Foreign Investment Negative List. Four years hence, the List was significantly reduced to allow for greater foreign participation in the domestic economy.

### *3.1.4. Investments promotion*

The primary legal basis for the current investment incentives program in the country is the Omnibus Investments Code of 1987. It provides access to fiscal and non-fiscal incentives to preferred areas of investments, whether pioneer or non-pioneer, and to export production and the rehabilitation or expansion of existing operations. Each year, the Philippine Board of Investments (BOI) come up with an Investment Priorities Plan that defines the investment thrusts of the country as grouped into four categories, Preferred Activities, Mandatory Inclusions, Export Activities, and ARMM List[v]. The investments promotions initiative in the country is being implemented by a host of agencies in the government in addition to the BOI namely, the Philippine Economic Zone Authority, Subic Bay Metropolitan Authority and Clark Development Corporation.

### *3.1.5. Export-oriented strategy*

The national strategy for sustainable agro-industrial development is embodied in the legal policy framework, Export Development Act of 1994. The law calls upon the private sector to lead the effort in increasing the country's share in the export market and promotes leading industries or export champions determined every three years.

### *3.1.6. Industrial clustering strategy*

The industrial clustering strategy being pursued in the country can be considered two-pronged. On the one hand, it relates to the establishment and formation of special economic zones in its various forms among locator firms, both local and foreign-owned. On the other, the promotion of industry clusters in different spatial levels, from national to town level. The industrial zones is likewise a mechanism to disperse industrial development to other parts of the country thereby stimulating local economic development, while industry clustering is intended to spur the entrepreneurial spirit among Filipinos through the operation of small and medium enterprises.

## 3.2. Technology Policy

Sections 10 to 14 of Article 14 of the Philippine Constitution contain specific provisions for the promotion of science and technology (S&T) in the country. The fundamental law of the land recognizes that S&T are essential for national development and progress and essentially dictates the components that should become part of the Philippine technology policy. Patalinghug (2003) defines technology policy as the management and generation of scientific and technological knowledge intended to address specific problems related to the production and delivery of economic, health and social goods and services. Ideally and in close relation to industrial policy, the legal and policy framework, organizational structure, and programs and projects should enable firms to continue producing their products, launch and market new ones, increase their capacities to innovate, raise their productivity, and enhance competitiveness.

### *3.2.1. S&T system*

The Philippine S&T system can be traced as far back as the American colonial period when the Bureau of Science was created. Coverage was limited as it mainly focused on agriculture, health and food processing. Right after the proclamation of independence, the Bureau was reorganized into the Institute of Science in 1946 and was placed under the Office of the President of the Philippines. In 1958, the National Science and Development Board (NSDB) was created in place of the Institute to

formulate and implement S&T policies and coordinate S&T agencies. Almost three decades later, the NSDB was reorganized into the National Science & Technology Authority (NSTA) before becoming in 1987 what is now the Department of Science & Technology (DOST). Specifically, the DOST is mandated to provide central direction, leadership and coordination of all scientific and technological efforts in the country, and formulate S&T policies, programs and projects in support of national development priorities. In its current configuration, the DOST is comprised of a national office and fifteen regional offices, five sectoral councils (agriculture and forestry, health, aquatic and marine resources, industry and energy, and advanced science and technology), two collegial bodies, seven R&D institutes (industrial technology, nuclear research, forest products, food and nutrition, textile metals, and advanced science and technology), and seven S&T service institutes (delving on science education and training, information database and networks, adoption and commercialization of technology, weather forecasting, and volcanology and seismology).

In terms of policy framework setting the S&T objectives and detailed guidelines for attaining them, the country has had four major ones so far since 1986. It is apparent that there is one strategic framework every time the presidency changes hands. During the time of President Corazon Aquino, the 10-year S&T Master Plan (STMP) was formulated spanning 1991-2000. Then, with President Fidel Ramos at the helm, the S&T Agenda for National Development or STAND Philippines, 1993 to 1998 came into being. Meanwhile, the less comprehensive but more specific DOST Medium Term Plan, 1999 to 2004 came out during the short-lived administration of President Joseph Estrada. The current President meanwhile, can boast of having the long-term National S&T Plan, 2002 to 2020.

The STMP is said to have correctly diagnosed the problems faced by the S&T system such as low investment in R&D, poor quality of S&T education, lack of private sector participation in R&D, inadequate attention to the needs of the market as basis for R&D and innovation, and lack of technology transfer and commercialization. Though basically sound, the STMP did not receive the resources required to turn its objectives into fruition. Ironically, the same problems that the STMP tried to address are generally the same challenges cited to still being faced by the Philippine S&T system. In fact, the

NSTP targets for 2004 were not met, while the attainment of the 2010 goals does not seem to be optimistic. It remains to be seen whether adjustments for more realistic targets for 2020 will be made.

In his paper tracing public and private expenditures in R&D in the Philippines in agriculture, fishery, manufacturing, education, and health, Cororaton (2002) cited that the technology-related problems are generally common across sectors and could be summarized into four: underinvestment in R&D; lack of adequate R&D manpower; institutional weaknesses; and, policy failures. Patalinghug (2000) meanwhile, declares that there has been a general failure to use technology in the country to gain competitive advantage. According to him, resource-based exports were basically still in their raw, unprocessed form, while traditional exports were likewise exported without infusing much technology-based processing. Even the shift to manufactured exports like garments and electronics merely reflected the changing factor composition, that is, from resource-intensive to labor-intensive. In another study, Patalinghug (2003) further mentions that R&D is not an attractive endeavor in the country, mainly for two reasons: one, capability is lacking and two; incentives meant to induce R&D activities are not attractive enough. Even the recent policy review of the DOST Technical Working Committee on Technology Transfer in 2007 highlighted the flaws of the Philippine innovation system such as: (i) weak public-private collaboration in R&D; (ii) weak technology transfer system; (iii) issues on technology ownership and information sharing; (iv) weak support to S&T and lack of resources for technology transfer; (v) weak intellectual property culture; (vi) declining human capital in R&D; and (vii) policy setbacks.

As previously mentioned, the national innovation system framework also points to the role of universities, particularly research-based universities in promoting innovation. Aside from supplying the educated manpower to industry, Tansinsin (2006) mentions in her paper that universities can collaborate with industry through contractual R&D; support of an industry's R&D activities; licensing and transfer of technology; R&D joint ventures and support for spin-off companies; consultancy by the university faculty; funding graduate or post-graduate students; and the most commonly practiced in the Philippines, apprenticeships or on-the-job training of students in industry. However, in

her assessment of each mode of collaboration, the relationship is either weak or gradually emerging. The challenges can be attributed both ways. Some firms tend to regard R&D as expense rather than investment for higher productivity, while others lack confidence on the capabilities of local laboratories and would rather consult their mother companies or buy or license a particular technology. On the other hand, universities themselves are beset with constraints that prevent them from partnering in a more aggressive and sustained manner with industry. It was found that there is a dearth in involvement of full time researchers, scientists and faculty due to teaching loads and lack of research skills and experience. Also wanting is the administrative and financial support from university (Edralin, 2001 as cited in Tansinsin, 2006). According to Patalinghug (2003), some faculty resort to informal arrangements with firms given the limitations imposed by typically, public universities, to accept funds from private entities. Another important concern is the fact that even major universities in the country do not have policies on intellectual property (IP) rights nor have dedicated offices capable of handling these activities. So far, it is only the University of the Philippines that has an office called Technology Licensing Office created in 2004 but was an offshoot of the Intellectual Property Office established as far back as 1995. Even the chief of the Intellectual Property Office of the Philippines laments this situation saying that a lot of work needs to be done in raising awareness about the IP system in universities, which could actually encourage research and innovation.

Still, there were instances in the past and continuing university-industry partnerships in the country despite the constraints. The Manufacturing Linkage Program in 1985 comes to mind, which brought together engineering graduates of the University of the Philippines and manufacturing firms as brokered by DOST's Philippine Council for Industry and Energy Research and Development. Tansinsin (2006) provides a number of examples of past and current university-industry linkages. However, to reach the extent found in developed countries, the challenges earlier cited have to be hurdled.

One of the recent surveys that looked into the innovation activities in the country by both the public and private sectors was done in 1997-1998 by the Philippine Institute for Development Studies (PIDS) under the auspices of the Department of Budget and Management. The one done for the private sector focused on five industry groups,

namely food processing; textile and garments; metals and metal fabrication; chemicals; and electronics and electrical machineries. Highlights of the survey results include the following: (i) only large firms engage in innovation and considered to be industry leaders; (ii) government standards and regulations and environmental concerns are not important drivers for innovation activities; (iii) a majority employ only college graduates or lower to conduct their innovation activities, implying a very low level of innovation activity; (iv) government research institutions rank very low as a source of innovative ideas and are perceived to be lagging even in monitoring technology developments in their respective fields; (v) financial constraints such as risk and rate of return, lack of financing and taxation are the major hindrances to innovation; and (vi) Philippine schools do not provide the requisite technical and technological skills and knowledge to meet demands. Also validated was the claim that government limits the amount of expenditure on R&D given its budget constraints; that the system only reaches out to the larger firms to the detriment of small and medium scale firms; and that, since government and private sector linkages are very weak, commercialization of developed technologies has not met adequate success.

### *3.2.2. Technological competitiveness: Philippine R&D indicators*

Almost five years ago, in 2004, there was recognition of the need to strengthen the Philippine R&D statistical system. It was also a response to the call for updating the S&T data of the ASEAN S&T Management Information System (ASTMIS) related to the development of technology competitiveness indicators in ASEAN and based on the OECD recommended indicators. Thus, in 2004, the DOST was able to compile a three-year data of R&D indicators, 1992, 1996 and 2002. Based on this database and updated figures for 2005, total R&D personnel in the Philippines was found to have declined sharply in ten years, from almost 16,000 in 1992 to only 9,325 in 2002. Comparing this with the population size during those years, there were 239 R&D personnel per million population in 1992, 220 per million population in 1996, and 116 personnel per million population in 2002. The figure has slightly increased in 2005 to 127 but remains far from the ideal prescription of UNESCO at 380 per million population for developing countries.

**Table 1. Selected Philippine R&D Indicators**

| | 1992 | 1996 | 2002 | 2005 |
|---|---|---|---|---|
| R&D manpower per million population | 239 | 220 | 116 | 127 |
| R&D expenditures as % of GDP | 0.22 | 0.19 | 0.15 | 0.12 |
| % share of the public sector in total R&D expenditures | 71 | 60 | 28 | - |
| % share of the private sector in total R&D expenditures | 29 | 40 | 72 | - |

*Sources*: Department of Science & Technology and the ASEAN Science and Technology Management Indicators System.

Meanwhile, the standard of UNESCO in terms of R&D expenditures is 1 percent of the GDP. This has been an elusive goal for the Philippines for decades with the rate posted at 0.22 percent of the GDP in 1992, to 0.19 in 1996, 0.15 in 2002, and 0.12 in 2005. Notice the steady decline in the resources being allocated to R&D. A silver lining in the horizon though, is the increasing participation of the private sector in the conduct of R&D activities, perhaps coming in the heels of the need to gain a foothold in the competitiveness race globally. In 1992 and 1996, the distribution of total expenditures was 71 and 60 percent, respectively from the public sector and 29 and 40 percent, respectively from the private sector. In 2002, public R&D expenditure only reached 28 percent, while those attributed to the private sector was 72 percent (DOST, 2004, 2009). Expenditures on R&D may also come from both public and private higher education institutions with the major spenders coming from the biggest universities in the country. Private, non-profit institutions likewise expend on R&D activities, the bulk of which are spent for agricultural production and technology, social structures and relationships, and control and care of the environment. In a similar manner, higher educational institutions direct their resources to agriculture, health, social structures and relationships, the environment, and then, industrial production and technology. This is another indicator that universities give lesser priority to the needs and concerns of the industrial sector. Government R&D efforts, on the other hand, give much more priority to research on industrial production and technology, which comes in second to agricultural production and technology.

In terms of patents granted to residents, data from ASTMIS show the lamentable low numbers in the case of the Philippines, earning it a ranking of close to the bottom of the ASEAN pile since 2001 (ASTMIS, 2009). Figures from the Intellectual Property Office of the Philippines show that only 15 local patents was granted from a total of 1,653 granted in 2005 and only 28 out of 1, 814 in 2007 (DOST, 2009).

Based on the ASEAN/ASEAN+3 Science & Technology Competitiveness Indicator being maintained by the ASTMIS, in terms of overall ranking, the Philippines is in the middle of the pack from 1996 to 2003. In 2004 however, it was ranked 10$^{th}$ out of 13 economies being evaluated in terms of S&T performance. As expected, Japan is at the top of the heap from when the database was monitored in 1996 up to 2004, followed by Singapore and then Korea. Malaysia and Thailand keep the Philippines company in the middle before the breakaway in 2004 by the latter, effectively improving the rankings of the two. Indonesia was the bottom-ranked economy since 1996, but was ahead only to Lao in 2004, when the membership composition of the sub-regional grouping was completed.

The R&D situation in the country gave the Philippines an overall ranking of 70 out of 134 countries in terms of technological readiness for the period 2008 to 2009 and a rank of 67 out of 134 on innovation and sophistication factors in the latest Global Competitiveness Report of the 2008 World Economic Forum. Along with other indicators, the Philippines was given a rank of 71 out of 134 countries in terms of the global competitiveness index. In terms of stage of development, the country remains at the factor-driven stage and still a bit far from the efficiency-driven level. Much, much farther is the innovation-driven stage. This begs the question, is the Philippines farther from the innovative stage because of its current stage of industrial development or is it in its current stage of development because of dearth in innovation? This is a difficult question to postulate answers for but it seems likely that in terms of innovation, the Philippines is still at a very early stage.

# 4 HYPOTHESIS

The previous discussion should not preclude the fact that Philippine firms do innovate and there are firms that do have R&D departments or units. Macasaquit (2008) states in her paper the results of the survey of firms done in 2007[vi] indicating the top three innovations undertaken by firms in the Greater Manila Area in the last three years. These were the introduction of new products and services; upgrading of machineries and equipment; and opening of a new market. Those that have undergone the most innovations were those engaged in manufacturing, wholesale trade and retail trade. In terms of technology sources, the survey has shown that the firms themselves were the main drivers, followed by technology transfer from MNCs. Highlighted was the finding that there were weak linkages between industry and R&D generating institutions such as higher education institutions, government agencies and private institutions.

With the review of literature and previous primary data collection, there are evidences that the propensity of firms to innovate in the Philippines, no matter how minimal or how low in terms of value added, is not driven by strong linkages with the knowledge networks comprising of government research institutions, universities, technology resource centers, industry associations, and local public and private supporting institutions. It is quite possible to denote, that the primary sources of technological innovation are the firms and their affiliated firms themselves encompassing the production networks where they belong to and by local firms within the proximate location of the firms where they are engaged in production relationships like buying and selling. Production linkages may be considered part and parcel of how firms operate and therefore, a given knowledge channel. Based on earlier empirical findings of experts, proximity matters due to knowledge externalities. This also denotes an internal orientation of the firms in terms of technological development efforts.

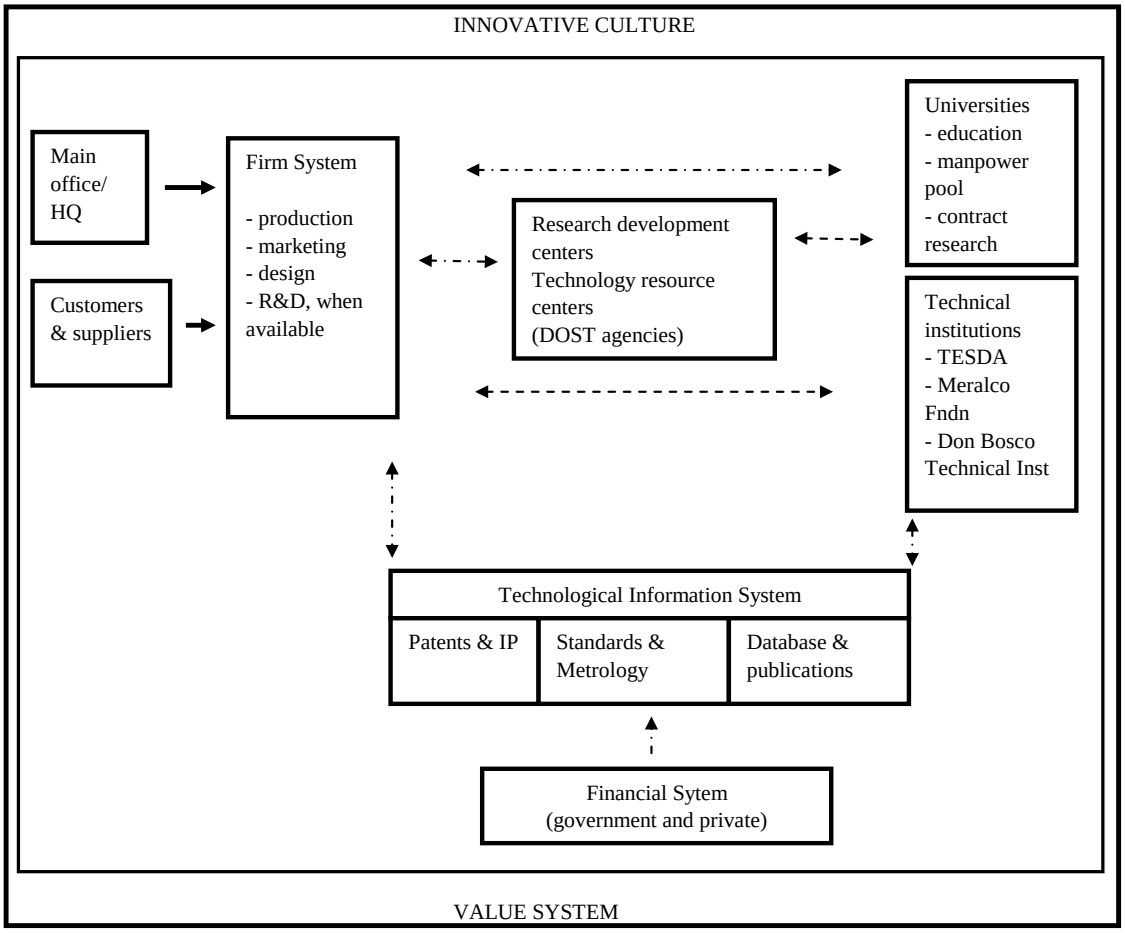
There may be a lack of appreciation of how important intellectual linkages are to innovation. Moreover, the so-called dearth in innovative culture among Filipinos is being perpetuated by an educational system that is not attuned to the demands of local

industries. Meanwhile, incentives for joint research and collaboration in technology commercialization seemed flawed as there are still loopholes in the intellectual property rights (IPR) code, not to mention the fact that not too many are aware of the IPR system nor has it been imbibed as part and parcel of the culture for knowledge generation and diffusion.

Though the programs and projects being implemented largely by the public sector are numerous, the applicable design and mix of interventions seem to have not yet been found. Besides, the level of financial resources being attributed may not be enough to reach the magnitude where significant impact would be more evident. These may be the key reasons why the state of R&D in particular and the Philippine innovation system in general, has remained in its stagnant state over the years.

Figure 1 presents a simple diagram of these postulates derived from the current dynamics of the Philippine innovation system, which is quite straightforward. Note that the arrows representing the linkages or relationships with other knowledge stakeholders are in broken form denoting weakness, while the arrows relating to affiliated firms are solid to indicate strong linkages. The system is operating under the backdrop of a still to be developed (or emerging) innovating culture among the Filipinos and the value systems they believe in. It has been pointed out in the literature that there exists a conflict in terms of the public good nature of research and efforts toward commercializing it to generate income.

**Figure 1. The Philippine Innovation System**




*Source*: Adopted from Patalinghug (2003).

Validating this scenario would entail the use of primary data collected through a survey of firms located in a specific region of the country. The claim that knowledge flows are geographically-mediated would also be proven to some degree in this case given the limited spatial focus of the case study. The descriptive results of the survey will be derived from the Survey on Production and Logistic Networks (SPLN) of Philippine Manufacturing Industries in CALABARZON conducted in late 2008 by the National Statistics Office, which was commissioned by the PIDS under the auspices of ERIA. This will be supplemented by the learnings from the in-depth interviews of fourteen firms all over the region and selected from the survey respondents. Lastly, an econometrics exercise that was undertaken through the assistance of the Japanese study

team involved in the same project would serve to show how and to what extent innovative activities are driven by both production and intellectual linkages; the probability that each of these linkages could lead to innovation; and how better business performance is affected by innovation driven by the intensity of R&D activities and the knowledge linkages.

# 5 PRODUCTION, LOGISTICS AND KNOWLEDGE NETWORKS IN CALABARZON

## 5.1. Profile of CALABARZON

CALABARZON, which stands for the iterations from the provinces of Cavite, Laguna, Batangas, Rizal, and Quezon, is considered as one of the fastest-growing region in the Philippines. Partially owed to the region's close proximity to the National Capital Region or Metro Manila, the provinces of CALABARZON have individual and collective attributes that make the region vital to the development of the nation's economy. In terms of population size, CALABARZON has already overtaken Metro Manila as of the latest 2007 Census. The region is home to some 11.74 million people, which is roughly equivalent to 13.3 percent of the country's population or 0.3 percentage points higher than that of Metro Manila. Owing perhaps to the proliferation of housing projects in the area and their proximity to Metro Manila, Cavite has the largest population among the CALABARZON provinces with 2.86 million, followed by Rizal with 2.84 million. But in terms of land area, Quezon province is the biggest with 9,069 square kilometers. All in all, the region has a total land area of 16,289 square kilometers and an estimated population density of 600 persons per kilometer.

**Table 2. Proximity to Metro Manila**

| Province | Distance | Location |
|---|---|---|
| CAVITE | 30 kilometers | south of Manila |
| LAGUNA | 30 kilometers | southeast of Manila |
| BATANGAS | 60 kilometers | south of Manila |
| RIZAL | 20 kilometers | east of Manila |
| QUEZON | 89 kilometers | south of Manila |

The region is vital to the economic fabric of the nation as it contributes around 13 percent to the national domestic output (second only to Metro Manila), and has the largest concentration of manufacturing or industrial activities. Of the 5,024 manufacturing establishments in the country in 2006, 27 percent or 1,397 are located in CALABARZON[vii].

In terms of industrial typology, the region is dotted with industrial parks in various categories. Out of 179 PEZA registered economic zones in the country today, 44 can be found in the CALABARZON provinces, except Quezon, with Laguna hosting 17 of these economic zones. Most of these were created through joint ventures between local and foreign partners.

**Table 3. PEZA Registered Economic Zones in CALABARZON**

| Province | Number | Nature/orientation |
|---|---|---|
| CAVITE | 13 | High tech; electronics/semi-conductor eqpt manufacturers; ship building |
| LAGUNA | 17 | High tech; electronics/semi-conductor eqpt manufacturers; auto assembly plants; food processing/manufacturing |
| BATANGAS | 12 | agro-industrial processing; shipbuilding; eco-tourism |
| RIZAL | 2 | agro-industrial processing; eco-tourism |
| QUEZON | 0 | |
| **CALABARZON** | **44** | |

It is noteworthy that each of the five provinces caters to different types of industrial and manufacturing activities. The province of Laguna for instance, being the home of 17 industrial parks, is host to a number of prestigious motor vehicle manufacturers, food giants and high tech electronics manufacturers like Toyota Motors, Universal Robina, San Miguel Corporation, Amkor, Fujitsu, and many others. Similarly, Cavite finds

electronics, automotive parts manufacturing as well as ship building activities as good investment priorities due to the presence of such firms across the 13 economic zones located in the province.

Batangas on the other hand, is excellent for ship-building business activities and agro-industrial processing zones. It can be considered as the logistics hub in the region due to the accessibility provided by Batangas International Port and other smaller jetties utilized by businesses in the area, and its close proximity to the agricultural provinces of Quezon, Mindoro and Palawan. Though Rizal may have the smallest land area among the five provinces, its closeness to Metro Manila makes it the next best alternative site for manufacturing and agro-industrial activities. And as the catchment area for both Metro Manila and Cavite, its growing urban population size may be seen as a favorable market condition by some astute investors. In contrast, the province of Quezon is still largely agricultural. And while there is still, as of the moment, no economic or industrial zone operating in the area, the 1995 Special Economic Act has already identified some areas in the province as potential special economic zones. As the country's leading producer of coconut products like coconut oil and copra, the province's strong points and key areas for development would have to be in the area of ecotourism and agribusiness.

To sustain the region's development path and to maximize its growth potential, production facilities, logistics and infrastructure system are continuously being upgraded and developed. Aside from existing power facilities, several other power projects are underway. These include the 700 megawatt Pagbilao Coal-Fired Thermal Power Plant, Makban Modular Geothermal Power Plant, the Batangas Coal-Fired Power plant, among others. Water is mostly supplied by local water districts but there are also some areas that are serviced by franchise operators of Manila Waterworks and Sewerage System. Industrial zones have their respective water supply system.

In addition to the nearby Ninoy Aquino International Airport and the port of Manila, the region has well functioning ports in Batangas and in Quezon, the Dalahican Port. And with the conversion of the Batangas Seaport into an international container and passenger port, the region is expected not only to double its carrying inbound and outbound cargo capacities but also to ease or share in the load traffic in the Port of

Manila.

In terms of transport and road network, the region is deeply committed to improving its major artilleries like the South Luzon Expressway (which connects the international port of Batangas to Metro Manila and the rest of Luzon), the Infanta-Maharlika Highway and the Maharlika Highway, linking CALABARZON with the Bicol region. The expansion of the LRT Line 1 is also being prioritized to ease and facilitate access and mobility in the Cavite area.

With respect to telecommunication facilities, CALABARZON is at par with Metro Manila. The improvements undertaken by PLDT, which serviced most of the country's telecommunication needs, enabled direct dialing in the area and made telecommunications less costly. Cellular or mobile telephone carriers, broadband and internet providers are all powered by fiber optic cable network infrastructure. Courier services also abound in the area.

In terms of manpower support, CALABARZON has a number of prestigious learning institutions where they can be drawn from, foremost of which is the University of the Philippines in Los Banos, Laguna. It has the best agriculture program in the country and is in close contact with the International Rice Research Institute (IRRI)—the world's premiere rice research center. There is also the APEC Center for Technology Exchange and Training for Small and Medium Enterprises (ACTETSME) in Los Banos—a joint venture of APEC member countries that promotes and offers trainings to small and medium enterprises. And perhaps as pro-active response to the ongoing industry demands, the local governments took it upon themselves to initiate manpower training and skills upgrading programs in their respective jurisdictions. A good example would be the Dual Training Center in Canlubang which offers hands-on factory training in addition to school work, in close coordination with the Laguna Employment and Manpower Development Center (LEMDC). The Batangas State University has similar undertakings like vocational-technollogy programs infused with subjects or trainings that will improve the students' employability in nearby ecozone firms like Babcock-Hitachi Philippines—manufacturer of bonding wires for shipping firms in Japan. The Network of CALABARZON Educational Institutions or NOCEI was recently established to promote collaboration among said institutions and promote

knowledge sharing.

Each of the provincial local government units in CALABARZON is actively instituting ways to sustain the economic growth momentum in the region. The Cavite provincial government has business-friendly practices, including the promotion of industrial peace through dialogues and regular meetings between labor and management thru the Cavite Tripartite Industrial Council and the Cavite Industrial Peace Advisory Group. It also implemented local tax incentives programs for locators inside business parks to attract more of them in the numerous industrial parks located in Cavite. On the other hand, Laguna was able to set-up its own version of National Economic Research and Business Assistance Center, a one-stop shop that assist investors interested in investing in the province. The Laguna Investment Promotions Bureau is equipped to guide and assist investors through the province's business application processes, which is a joint project of the Laguna Chamber of Commerce and Industry, the Provincial Office of the Department of Trade and Industry, the German Confederation of Small Business and Skilled Crafts (ZDH) and Ayala Land, Inc.

Boosting the tourism potential of Rizal, is the main thrust of the provincial government as of the moment, as reflected in its 12 Point Development Agenda. On the other hand, Quezon is being touted to be the new economic and investment zone in the region that would be known for being investment- and business-friendly. The approval of its Provincial Investment and Incentives Code, the holding of the summits on agriculture and fishery, business and investment, and tourism are geared toward the realization of the three key areas of development (i.e. agriculture, tourism and economic enterprise) for the province. Marketing Quezon as a viable investment option is the goal of the Quezon-Lucena Chamber of Commerce Inc., the Provincial Government and the Department of Trade and Industry which prompted them to stage the 1st Quezon Business Conference recently. The Batangas provincial government, meanwhile, has preference for promoting further the tourism potential of the area. Given the natural attributes of the province and its accessibility to all sorts of economic pursuits, the rapid pace of industrialization in Batangas is expected to only continue.

Still, it remains to be seen if all these structures and concerted efforts are able to impact on fostering technology generation, adaptation and utilization in the region.

Learnings from close interactions with a sample of firms would prove to be instructive.

## 5.2. Summary of Findings from the Survey

### *5.2.1. Profile of respondents*

The survey results are derived from the responses of 205 respondent firms where 30 percent is located in Cavite, 29 percent in Rizal, almost 20 percent in Batangas, around 16 percent in Laguna, and 5 percent in Quezon. Table 4 below provides the numbers.

**Table 4. Surveyed firms by province**

| | Freq. | Percent |
|---|---|---|
| Batangas | 40 | 19.5 |
| Cavite | 62 | 30.2 |
| Laguna | 32 | 15.6 |
| Quezon | 11 | 5.4 |
| Rizal | 60 | 29.3 |
| **Total** | **205** | **100.0** |

More than half of the firms were established in the 1990s, which coincides with the decade of reforms in the country's industrial structure. Fifteen percent were formed in the 1980s, while 20 percent followed suit in the present decade. A similar pattern can be observed in terms of the tabulation of years when the firms were established in CALABARZON. This implies that most of the firms that were established in the country were originally formed in the region as well.

**Table 5. Surveyed firms, by year first started operation in RP**

| | Freq. | Percent |
|---|---|---|
| 1930s | 1 | 0.5 |
| 1950s | 2 | 1.0 |
| 1960s | 7 | 3.4 |
| 1970s | 9 | 4.4 |
| 1980s | 31 | 15.1 |
| 1990s | 114 | 55.6 |
| 2000s | 41 | 20.0 |
| **Total** | **205** | **100.0** |

Of the total firms, 33 percent are firm-locators in special economic zones all over the region being managed by the PEZA. The rest are scattered outside of these designated industrial parks.

**Table 6. Surveyed firms in PEZA and Non-PEZA areas, by province**

| | Non-PEZA | | PEZA | | Total | |
|---|---|---|---|---|---|---|
| | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** |
| Batangas | 26 | 19.1 | 14 | 20.3 | 40 | 19.5 |
| Cavite | 27 | 19.9 | 35 | 50.7 | 62 | 30.2 |
| Laguna | 12 | 8.8 | 20 | 29.0 | 32 | 15.6 |
| Quezon | 11 | 8.1 | - | - | 11 | 5.4 |
| Rizal | 60 | 44.1 | - | - | 60 | 29.3 |
| **Total** | **136** | **100.0** | **69** | **100.0** | **205** | **100.0** |

*5.2.2. Distribution of industries: business activity, capital structure, size*

At the regional level, it is clear from the survey that there exists industrial clusters of textiles, apparel and leather; food, beverages and tobacco; electronics other than computers; and, chemicals in the region based on the number of firms operating in each category. The rest of the firms are fairly spread out among the other types of industries. However, among those inside the special economic zones, there are more firms engaged in electronics followed by chemicals manufacturing.

**Table 7. Surveyed firms in PEZA and Non-PEZA areas, by main business activity**

| | Non-PEZA | | PEZA | | Total | |
|---|---|---|---|---|---|---|
| | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** |
| Food, beverages, tobacc | 31 | 22.8 | 4 | 5.8 | 35 | 17.1 |
| Textiles, apparel,leat | 37 | 27.2 | 6 | 8.7 | 43 | 21.0 |
| Wood, wood products | 6 | 4.4 | 1 | 1.4 | 7 | 3.4 |
| Paper, paper products, | 3 | 2.2 | 2 | 2.9 | 5 | 2.4 |
| Chemicals, chemical & | 12 | 8.8 | 10 | 14.5 | 22 | 10.7 |
| Other non-metallic mi | 7 | 5.1 | 1 | 1.4 | 8 | 3.9 |
| Iron, steel | 5 | 3.7 | - | - | 5 | 2.4 |
| Non-ferrous metals | 1 | 0.7 | - | - | 1 | 0.5 |
| Metal products | 12 | 8.8 | 4 | 5.8 | 16 | 7.8 |
| Machinery, eqpt, tools | 4 | 2.9 | 4 | 5.8 | 8 | 3.9 |
| Computers, computer pa | - | - | 1 | 1.4 | 1 | 0.5 |
| Other electronics, ele | 5 | 3.7 | 25 | 36.2 | 30 | 14.6 |
| Precision instruments | - | - | 1 | 1.4 | 1 | 0.5 |
| Automobile, auto parts | 5 | 3.7 | 7 | 10.1 | 12 | 5.9 |
| Other transportatn eq | - | - | 1 | 1.4 | 1 | 0.5 |
| Others | 7 | 5.1 | 2 | 2.9 | 9 | 4.4 |
| NA/NR | 1 | 0.7 | - | - | 1 | 0.5 |
| **Total** | **136** | **100.0** | **69** | **100.0** | **205** | **100.0** |

In terms of distribution by capital structure, half of the firms are locally owned, 29 percent are foreign-owned and the rest were formed through joint venture arrangements. Locally-owned firms are engaged more in the food sector as well as in textiles and located mostly in non-economic zones. Meanwhile, foreign owned firms are mainly located in special economic zones engaged in the manufacture of electronics. Among the non-Filipino investors, the top three are Japanese (20%), South Korean (10%) and Taiwanese (8%).

**Table 8. Surveyed firms by capital structure**

| | **Freq.** | **Percent** |
|---|---|---|
| 100% Locally-owned | 104 | 50.7 |
| 100% Foreign-owned | 59 | 28.8 |
| Joint Venture | 42 | 20.5 |
| **Total** | **205** | **100.0** |

**Table 9. Surveyed firms, nationality of Non-Filipino investors**

| | Freq. | Percent |
|---|---|---|
| Singaporean | 3 | 1.5 |
| Other ASEAN | 2 | 1.0 |
| Chinese | 3 | 1.5 |
| Japanese | 40 | 19.5 |
| South Korean | 20 | 9.8 |
| Taiwanese | 16 | 7.8 |
| Other Asian | 2 | 1.0 |
| American | 8 | 3.9 |
| European | 5 | 2.4 |
| Others (Canadian, Indian) | 2 | 1.0 |
| **Total** | **101** | **100.0** |

Of the total respondents, 58 percent are comprised of firms with employees below 200, while the rest can be considered large firms.

**Table 10. Surveyed firms by number of fulltime employees, as of date of visit**

| | Freq. | Percent |
|---|---|---|
| 1-19 | 17 | 8.3 |
| 20-49 | 36 | 17.6 |
| 50-99 | 34 | 16.6 |
| 100-199 | 32 | 15.6 |
| 200-299 | 21 | 10.2 |
| 300-399 | 11 | 5.4 |
| 400-499 | 9 | 4.4 |
| 500-999 | 31 | 15.1 |
| 1,000-1,499 | 7 | 3.4 |
| 1,500-1,999 | 4 | 2.0 |
| 2,000 & above | 3 | 1.5 |
| **Total** | **205** | **100.0** |

*5.2.3. Main target markets and suppliers*

For 57 percent of the firms, the most important target market is the Philippines, with 48 percent geared towards the National Capital Region and close to 45 percent catering to the regional market. Based on the total firms surveyed, the most important market to almost 20 percent of firms is the U.S., followed by Japan at 13 percent. Meanwhile, about 5 percent of firms cater to the European market, with the remaining considering other countries in ASEAN and Asia as target markets.

**Table 11. Surveyed firms' 1st most important target markets**

| | Freq. | Percent |
|---|---|---|
| RP (NCR) | 56 | 27.3 |
| RP (CALABARZON) | 52 | 25.4 |
| RP (other regns) | 8 | 3.9 |
| Thailand (greater BKK) | 1 | 0.5 |
| Malaysia | 1 | 0.5 |
| China | 1 | 0.5 |
| Japan | 27 | 13.2 |
| S. Korea | 3 | 1.5 |
| Taiwan | 3 | 1.5 |
| U.S. | 39 | 19.0 |
| Europe | 10 | 4.9 |
| Others | 4 | 2.0 |
| **Total** | **205** | **100.0** |

For almost half of the firms, their most important suppliers are located in the country and of these, 50 percent go to suppliers from NCR while a substantial 34 percent get raw materials from within the region. After the local suppliers, the next most important providers of raw materials is Japan (16%), China (11%), South Korea (6%), and Taiwan (5%).

**Table 12. Surveyed firms' 1st most important source of raw materials**

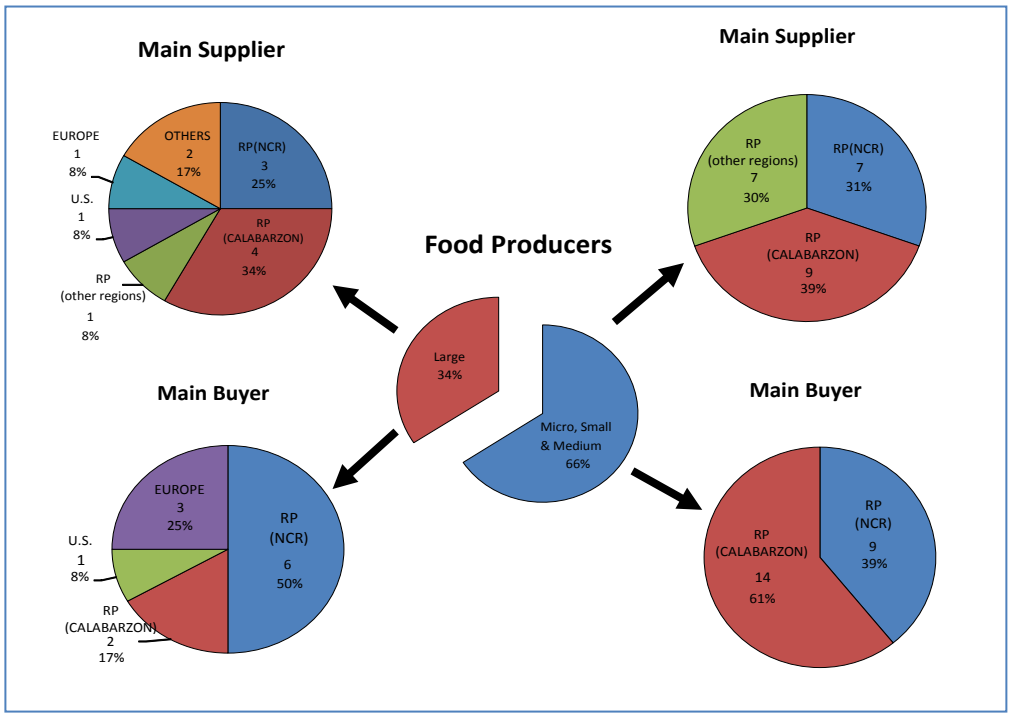
| | Freq. | Percent |
|---|---|---|
| INDO(other regns) | 1 | 0.5 |
| RP(NCR) | 50 | 24.4 |
| RP(CALABARZON) | 34 | 16.6 |
| RP(other regns) | 16 | 7.8 |
| Singapore | 3 | 1.5 |
| Malaysia | 2 | 1.0 |
| Other ASEAN | 2 | 1.0 |
| China | 22 | 10.7 |
| Japan | 33 | 16.1 |
| S. Korea | 13 | 6.3 |
| Taiwan | 10 | 4.9 |
| Other Asia | 2 | 1.0 |
| U.S. | 6 | 2.9 |
| Europe | 6 | 2.9 |
| Others | 5 | 2.4 |
| **Total** | **205** | **100.0** |

These results imply that the manufacturing firms in CALABARZON are closely integrated within the region considering it as a most important market and source of supplies. Logistics-wise, these firms are able to take advantage of proximity and an indication of seamless transport of goods to and from the firms. Outside of the country, while the U.S. remains the most important market for Philippine-made goods, Japan is the main source of raw materials. It is noted that Philippine manufacturing firms as represented by those located in CALABARZON, depend more on the countries in East Asia like China, South Korea and Taiwan for their supplies needs than the countries in ASEAN.

### *5.2.4. Production networks*

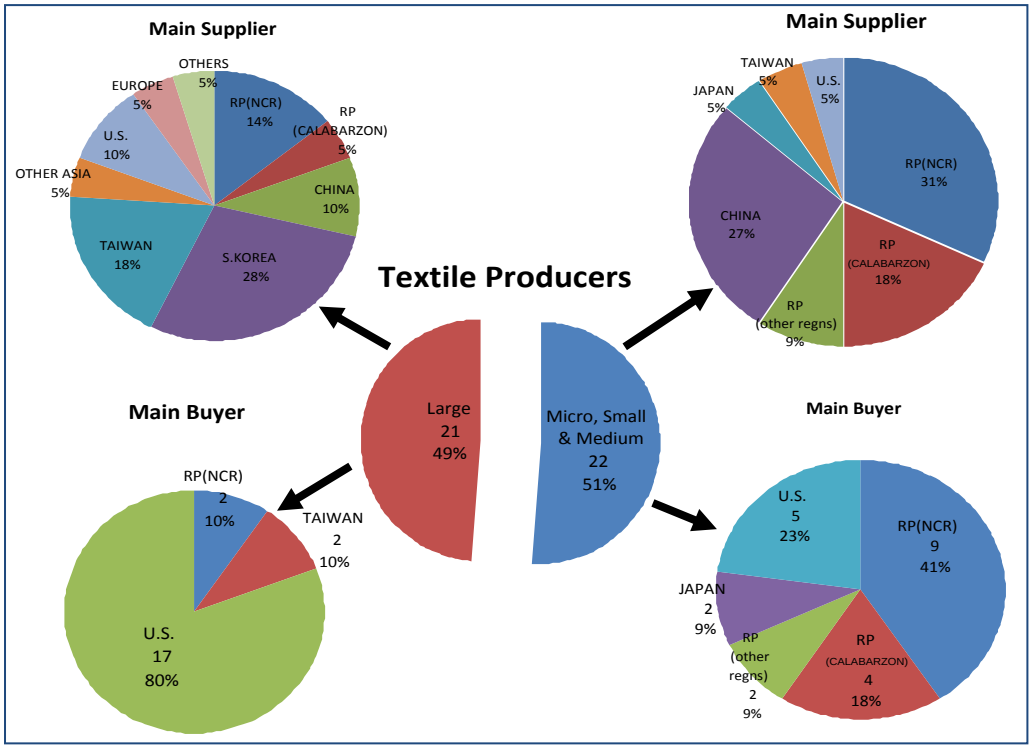
On an industry basis, it is interesting to trace the production route of the firms surveyed in the region albeit on general categories of customers and suppliers only. Among food producers, two-thirds are smaller firms catering only to the domestic market, 60 percent within the same region and 30 percent to NCR. Suppliers likewise entirely come from the country particularly from within CALABARZON, NCR and other regions. Of the large food producers, more than half gets their supplies from within the country, a few from other countries, from Europe and the U.S. Meanwhile, there are few firms catering to Europe and the U.S. but almost three-fourths of the firms cater to domestic needs. This inward orientation of food producers in CALABARZON may have something to do with the high transportation cost of the product owing to its perishability or for the reason that they are catered more to domestic tastes and consumption.

**Figure 2. Production Network of Food Producers**



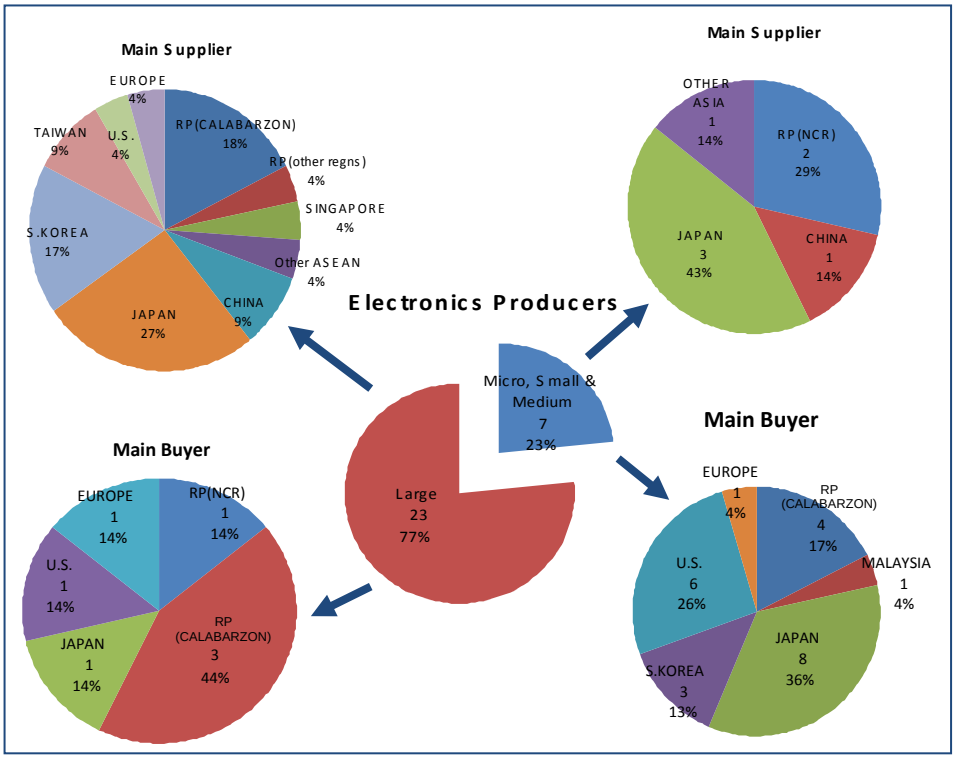

Of the total firms surveyed, those engaged in textiles comprise 21 percent and they are almost equally divided in terms of size with smaller firms edging the larger ones by one firm. The smaller textile firms are again, more domestically oriented comprising more than half of their buyers. The rest are taken up by customers in the U.S. and Japan. Majority of suppliers of these smaller firms is composed of other domestic firms mainly from NCR. Supplies from outside the country substantially come from China, then to a lesser degree from the U.S., Taiwan and Japan. As expected, the larger textile firms are more entrenched outside of the country and considerably latched on to the U.S. market for its sales. A few firms have customers from Taiwan and from within the country. As for sources of raw materials, large firms are more diversified with supplies coming from South Korea, Taiwan, China, the U.S., Europe, and other Asia. Supplies are also sourced domestically. Compared to the food sector, the textiles group appears to be more entrenched to the external production value chain, which may have something to do with the relatively low cost of labor in the country, ability to produce quality outputs and in order to maintain traditional business relationships.

**Figure 3. Production Network of Textile Producers**




Another sector that is more integrated into the regional and global production network is electronics. Among the total firms surveyed, 30 come from the electronics industry and are mostly large firms and located in special economic zones. The smaller firms are mainly outside the industrial parks. Large electronics firms are being supplied by quite a number of sources and appear to be more diverse. Main supplier is Japan, followed by South Korea, China, Taiwan, Singapore and other countries in ASEAN, while those from outside Asia come from the U.S. and Europe. There are also suppliers from within the country and interestingly, mainly from within the same region which could be pointing to agglomeration effects. Among their customers, large electronics producers cater mainly to the Japanese and the U.S. markets, then to the domestic market within CALABARZON, to the Asian market as represented by South Korea and Malaysia, and then Europe. Customers from within CALABARZON could be buyers of intermediate electronics inputs, which characterize the composition of the industry.

**Figure 4. Production Network of Electronics Producers**




### *5.2.5. Business performance of firms*

Firms were likewise asked to indicate their current business performance, in comparison with that of 2007. Based on the tabulation, the three most common indicators of improved business performance experienced by firms in the last year are: improvement in the quality of products, reduction in product defects, and increase in the productivity of operations. Since this question entails multiple answers, the responses culled were more than the total of surveyed firms. It could not be said that based on the survey results alone that these improved performances can be directly attributed to the innovative activities undertaken by the firms, yet it can be assumed considering that product quality, flushing out defects and increasing productivity could also take place due to the technology factor.

**Table 13. Current Business Performance of Firms**

| | 100% Foreign-owned | | 100% Locally-owned | | Joint Venture | | Grand Total | |
|---|---|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| Sales amount increased | 26 | 7.76 | 50 | 11.04 | 23 | 10.13 | 99 | 9.75 |
| Profit increased | 17 | 5.07 | 42 | 9.27 | 14 | 6.17 | 73 | 7.19 |
| No. of employees increased | 21 | 6.27 | 23 | 5.08 | 16 | 7.05 | 60 | 5.91 |
| Value of exports increased | 27 | 8.06 | 17 | 3.75 | 17 | 7.49 | 61 | 6.01 |
| Value of exports to developed countries increased | 22 | 6.57 | 15 | 3.31 | 13 | 5.73 | 50 | 4.93 |
| No. of exports destination increased | 14 | 4.18 | 12 | 2.65 | 12 | 5.29 | 38 | 3.74 |
| Productivity of operation increased | 44 | 13.13 | 67 | 14.79 | 32 | 14.10 | 143 | 14.09 |
| Quality of products improved substantially | 51 | 15.22 | 76 | 16.78 | 39 | 17.18 | 166 | 16.35 |
| Product defects were reduced substantially | 50 | 14.93 | 70 | 15.45 | 31 | 13.66 | 151 | 14.88 |
| Production cost decreased substantially | 28 | 8.36 | 27 | 5.96 | 11 | 4.85 | 66 | 6.50 |
| Lead time was reduced | 35 | 10.45 | 54 | 11.92 | 19 | 8.37 | 108 | 10.64 |
| **Total** | **335** | **100.00** | **453** | **100.00** | **227** | **100.00** | **1015** | **100.00** |

### *5.2.6. Functions*

When it comes to functions, the one with the most number of responses is production of final products, followed by procurement of raw materials, parts and supplies and production of raw materials.

**Table 14. Three major functions carried out by surveyed firms in 2008**

| | Freq | Percent |
|---|---|---|
| Production (raw materials processing) | 76 | 16.7 |
| Production (components & parts) | 60 | 13.2 |
| Production (final products) | 159 | 34.9 |
| Procurement of raw matls., parts, or supplies | 103 | 22.6 |
| IT systems development, maintenance | 6 | 1.3 |
| After sales services | 10 | 2.2 |
| Marketing, sales promotion | 39 | 8.6 |
| Others | 2 | 0.4 |
| Total | 455 | 100.0 |

### *5.2.7. Business linkages with most important customer and supplier*

Among the surveyed firms, six have identified that their most important customer

is located within the same industrial park where they are locators, while this is also true for the most important supplier of seven firms. Meanwhile, 51 firms indicated that their most important customer is in CALABARZON and 37 stated the same for their most important supplier. For 84 firms, their most important customer is actually located in another country, which is the same situation for 94 firms when it comes to their most vital supplier. These results show that the location of most important market and suppliers is varied with about a quarter of the total firms surveyed reliant on those in their immediate proximity and almost half looking outwards to other countries.

### *5.2.8. Technological capacity of firms*

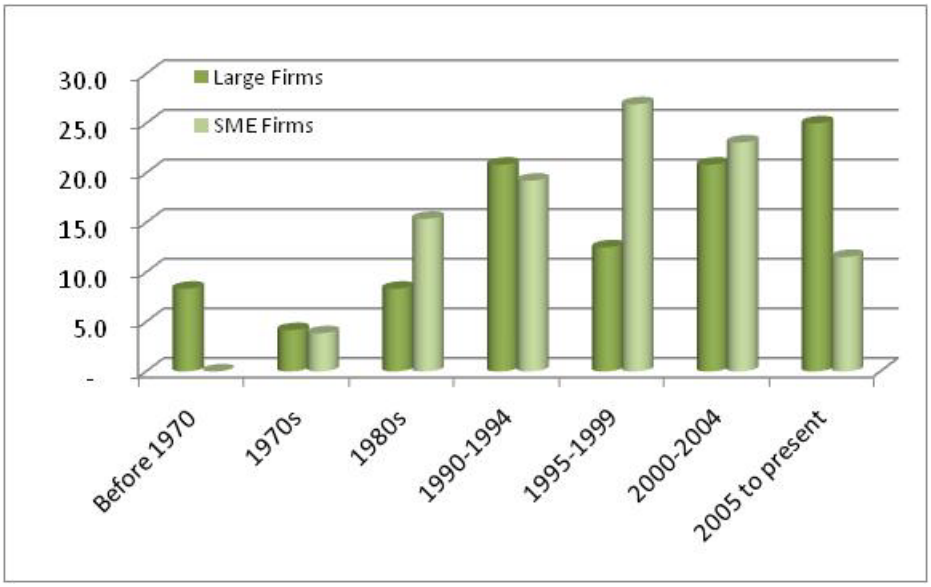
Fifty of the total 205 firms surveyed undertake R&D activities. Among them, 52 percent are small and medium firms and the rest of the 48 percent are large firms. In the previous surveys, the results point to the larger firms as those with more propensities to undertake R&D. This can be explained by the result that more firms engaged in food manufacturing are the ones doing the most R&D at 36 percent of the total firms conducting R&D. There are more of the smaller firms in the food sector than larger ones.

**Table 15. Firms that carry out R&D activities, by size**

| | Yes | | No | | Grand Total | |
|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| Large Firms | 24 | 48.0 | 56 | 36.1 | 80 | 39.0 |
| SME Firms | 26 | 52.0 | 99 | 63.9 | 125 | 61.0 |
| **Grand Total** | **50** | **100.0** | **155** | **100.0** | **205** | **100.0** |

On the period when these firms started R&D activities, 62 percent commenced in the 1990s towards the middle of 2000 and with almost the same pattern between large and small firms, except in 1995 to 1999, when more small and medium-sized firms started doing R&D than large firms. Refer to figure 5 to observe the pattern.

**Figure 5. Year Started R&D Operations**




When it comes to R&D manpower, survey results show that the majority, at 58 percent, maintain 1 to 5 employees dedicated to such specialized activities. Among the large firms, 38 percent has 6 to 10 employees doing R&D, while among the small firms, 81 percent can only afford to have 1 to 5 employees in their R&D roster. Meanwhile, 16 percent of the large firms have more than 20 R&D personnel but not higher than 50.

**Table 16. Number of R&D Employees**

| | Large Firms | | SME Firms | | Grand Total | |
|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| 1-5 employees | 8 | 33.3 | 21 | 80.8 | 29 | 58.0 |
| 6-10 employees | 9 | 37.5 | 2 | 7.7 | 11 | 22.0 |
| 11-15 employees | 3 | 12.5 | 2 | 7.7 | 5 | 10.0 |
| 21-25 employees | 2 | 8.3 | 1 | 3.8 | 3 | 6.0 |
| 26-50 employees | 2 | 8.3 | | - | 2 | 4.0 |
| **Grand Total** | **24** | **100.0** | **26** | **100.0** | **50** | **100.0** |

In terms of R&D intensity, measured by getting the ratio of R&D expenditure over total sales, 53 percent of the firms with R&D devote between 0.01 to 0.5 percent of total sales to this. The pattern is not so different between large and small firms.

**Table 17. Share of R&D to Total Sales**

| | Large Firms | | SME Firms | | Grand Total | |
|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| 0.01 - 0.50% | 13 | 54.2 | 13 | 52.0 | 26 | 53.1 |
| 0.51 - 1.0% | 4 | 16.7 | 2 | 8.0 | 6 | 12.2 |
| 1.01 - 1.5% | 3 | 12.5 | 4 | 16.0 | 7 | 14.3 |
| 1.51 - 2.0% | 1 | 4.2 | 2 | 8.0 | 3 | 6.1 |
| 2.01 - 2.5% | | - | 1 | 4.0 | 1 | 2.0 |
| 4.01 - 5.0% | 1 | 4.2 | 1 | 4.0 | 2 | 4.1 |
| 5.01% - above | 1 | 4.2 | 2 | 8.0 | 3 | 6.1 |
| No expenditure | 1 | 4.2 | | - | 1 | 2.0 |
| **Grand Total** | **24** | **100.0** | **25** | **100.0** | **49** | **100.0** |

*5.2.9. Innovation*

Majority of the firms surveyed has undergone product innovation or in other words, has introduced new products to the market in the last three years. Among these firms, 54 are large, while the remaining 51 are small and medium. However, though new products were introduced, these are mostly for existing markets and produced through existing technologies. In terms of industries undertaking this innovation, 21 percent were found to be firms in electronics, 20 percent engaged in food manufacturing and 13 percent into textiles and apparel production. Meanwhile, 66 percent of total firms that have undergone product innovation were able to increase total sales with the introduction of new products.

**Table 18. Product Innovation**

| | Total | | Large Firms | | SME Firms | |
|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| Introduced new products to the market in the recent 3 years | 105 | 100.0 | 54 | 51.4 | 51 | 48.6 |
| *Are these products introduced in new or existing market?* | | | | | | |
| Existing market | 85 | 81.0 | 46 | 85.2 | 39 | 76.5 |
| New market | 20 | 19.0 | 8 | 14.8 | 12 | 23.5 |
| *Are these products based on new or existing technologies?* | | | | | | |
| Existing technology | 75 | 71.4 | 43 | 79.6 | 32 | 62.7 |
| New technology | 30 | 28.6 | 11 | 20.4 | 19 | 37.3 |
| Intro.of new products increased total sales | 69 | 65.7 | 38 | 70.4 | 31 | 60.8 |

In terms of process innovation or improvements undertaken in operations, production procedures and/or management systems, majority of respondent-firms bought new machines, 72 percent improved existing machines and 65 percent introduced new know-how. The differences between large and small firms in terms of these three types of process innovation are not too wide. Moreover, nearly half of the respondent-firms adopted an ISO, while more than 60 percent instituted other internal improvements. However, only 29 percent introduced ICT in their operations, which could also mean that many of the firms are already ICT-based.

**Table 19. Process Innovation**

| | Total | | Large Firms | | SME Firms | |
|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| *Improved production/operations* | | | | | | |
| Bought new machines | 118 | 57.6 | 59 | 50.0 | 59 | 50.0 |
| Improved existing machine | 148 | 72.2 | 69 | 46.6 | 79 | 53.4 |
| Intro new know-how | 134 | 65.4 | 66 | 49.3 | 68 | 50.7 |
| *Improved operations/management systems* | | | | | | |
| Adopted an ISO | 99 | 48.3 | 54 | 54.5 | 45 | 45.5 |
| Intro ICT | 59 | 28.8 | 35 | 59.3 | 24 | 40.7 |
| Intro other internal activities | 125 | 61.0 | 61 | 48.8 | 64 | 51.2 |

*5.2.10. Sources of information and new technologies*

Firms have a number of sources of new information and technologies, which could only be tapped through establishing linkages with them. These channels can be categorized into three: own efforts, production linkages (denoting a relationship with other firms, whether as buyer or seller or as competitors) and intellectual linkages (universities, public and private research institutions). In total, 42 firms indicated that they get information and new technologies from their own R&D departments; 51 from their sales departments; and 61 from the production units. There are 35 firms that have technical agreements with their mother companies or headquarters.

**Table 20. Sources of New Technologies: Internal Sources**

| | 100% Foreign-owned | | 100% Locally-owned | | Joint Venture | | Grand Total | |
|---|---|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| *Internal sources of info and own R&D efforts* | 51 | 100.0 | 92 | 100.0 | 46 | 100.0 | 189 | 100.0 |
| 1. Own R&D | 11 | 21.6 | 20 | 21.7 | 11 | 23.9 | 42 | 22.2 |
| 2. Own sales dept | 12 | 23.5 | 28 | 30.4 | 11 | 23.9 | 51 | 27.0 |
| 3. Own production | 15 | 29.4 | 33 | 35.9 | 13 | 28.3 | 61 | 32.3 |
| 4. Technical agreement w/ Headquarters | 13 | 25.5 | 11 | 12.0 | 11 | 23.9 | 35 | 18.5 |

A total of 92 types of linkages have been denoted by respondent-firms with other local firms, out of which, 22 percent were with local suppliers or customers and another 22 percent with local consultants hired. More than 18 percent referred to licensing technology from other firms. Meanwhile, a total of 97 types of linkages were forged with foreign firms and/or multinational corporations. Of these, 27 percent were with foreign owned suppliers or customers, about 18 percent via joint ventures with other foreign owned firms and 14 percent each with foreign competitors in the same business, foreign competitors in the same business but neither customer nor supplier, and with international consultants.

**Table 21. Sources of New Technologies: Production Linkages**

| | 100% Foreign-owned | | 100% Locally-owned | | Joint Venture | | Grand Total | |
|---|---|---|---|---|---|---|---|---|
| | Freq | % Share | Freq | % Share | Freq | % Share | Freq | % Share |
| *Technology Transfer from Local firms* | 20 | 100.0 | 36 | 100.0 | 36 | 100.0 | 92 | 100.0 |
| 1. Joint Venture with other local firms | 3 | 15.0 | 2 | 5.6 | 6 | 16.7 | 11 | 12.0 |
| 2. Local supplier or customer | 3 | 15.0 | 10 | 27.8 | 7 | 19.4 | 20 | 21.7 |
| 3. Local competitor | 3 | 15.0 | 8 | 22.2 | 3 | 8.3 | 14 | 15.2 |
| 4. Local firm in different business with neither supplier nor customer | 3 | 15.0 | 4 | 11.1 | 3 | 8.3 | 10 | 10.9 |
| 5. Licensing technology from other local firms | 3 | 15.0 | 5 | 13.9 | 9 | 25.0 | 17 | 18.5 |
| 6. Local consultant hired | 5 | 25.0 | 7 | 19.4 | 8 | 22.2 | 20 | 21.7 |
| *Technology Transfer from Firms or Cooperation w/ MNCs* | 34 | 100.0 | 21 | 100.0 | 42 | 100.0 | 97 | 100.0 |
| 1. Joint Venture with other Foreign firms | 6 | 17.6 | 3 | 14.3 | 8 | 19.0 | 17 | 17.5 |
| 2. Foreign supplier or customer | 7 | 20.6 | 9 | 42.9 | 10 | 23.8 | 26 | 26.8 |
| 3. Foreign competitor | 5 | 14.7 | 3 | 14.3 | 6 | 14.3 | 14 | 14.4 |
| 4. Foreign competitor in the same business (neither supplier or customer) | 5 | 14.7 | 3 | 14.3 | 6 | 14.3 | 14 | 14.4 |
| 5. Licensing technology from other MNCs | 5 | 14.7 | 2 | 9.5 | 5 | 11.9 | 12 | 12.4 |
| 6. International consultant | 6 | 17.6 | 1 | 4.8 | 7 | 16.7 | 14 | 14.4 |

Local organizations were the sources of technologies based on 80 responses by the surveyed firms. These were through the assistance of government, local business organizations and via participation in business consortium with support of local business organizations. There were however, only 28 types of linkages identified by the respondent firms under the category of university-industry linkages. Of these, 46 percent were with local universities or R&D institutes, 32 percent via membership in academic societies or subscription in academic journals and the remaining 21 percent were with foreign universities or R&D institutes.

**Table 22. Sources of New Technologies: Intellectual Linkages**

| | 100% Foreign-owned | | 100% Locally-owned | | Joint Venture | | Grand Total | |
|---|---|---|---|---|---|---|---|---|
| | Freq | % Share | Freq | % Share | Freq | % Share | Freq | % Share |
| *Technical assistance by local organizations* | 27 | 100.0 | 28 | 100.0 | 25 | 100.0 | 80 | 100.0 |
| 1. Technical Assistance by government | 7 | 25.9 | 7 | 25.0 | 5 | 20.0 | 19 | 23.8 |
| 2. Technical Assistance by local business organizations | 5 | 18.5 | 5 | 17.9 | 5 | 20.0 | 15 | 18.8 |
| 3. Research consortium w/ government support | 3 | 11.1 | 3 | 10.7 | 5 | 20.0 | 11 | 13.8 |
| 4. Research consortium w/ local business organization support | 4 | 14.8 | 3 | 10.7 | 3 | 12.0 | 10 | 12.5 |
| 5. Business consortium w/ government support | 4 | 14.8 | 4 | 14.3 | 3 | 12.0 | 11 | 13.8 |
| 6. Business consortium w/ local business organization support | 4 | 14.8 | 6 | 21.4 | 4 | 16.0 | 14 | 17.5 |
| *Linkages w/ universities, R&D institutes and academic society* | 10 | 100.0 | 3 | 100.0 | 15 | 100.0 | 28 | 100.0 |
| 1. Technical cooperation with local university or R&D institute | 3 | 30.0 | 2 | 66.7 | 8 | 53.3 | 13 | 46.4 |
| 2. Technical cooperation with foreign university or R&D institute | 3 | 30.0 | | - | 3 | 20.0 | 6 | 21.4 |
| 3. Academic Society and academic journal | 4 | 40.0 | 1 | 33.3 | 4 | 26.7 | 9 | 32.1 |

There are other sources of information and new technologies aside from the three general categories mentioned above, and these pertain to personnel mobility such as mid-class personnel and those retired from MNCs and large firms, and from technical information derived from patents, foreign made equipment and software, and via reverse engineering. There were 44 responses culled for human resources and 43 for other sources.

**Table 23. Sources of New Technologies: Others**

| | 100% Foreign-owned | | 100% Locally-owned | | Joint Venture | | Grand Total | |
|---|---|---|---|---|---|---|---|---|
| | Freq | % Share | Freq | % Share | Freq | % Share | Freq | % Share |
| *Human Resources* | 14 | 100.0 | 11 | 100.0 | 19 | 100.0 | 44 | 100.0 |
| 1. Recruitment of mid-class personnel | 9 | 64.3 | 5 | 45.5 | 13 | 68.4 | 27 | 61.4 |
| 2. Recruitment of personnel retired from MNCs | 5 | 35.7 | 6 | 54.5 | 6 | 31.6 | 17 | 38.6 |
| *Other sources* | 19 | 100.0 | 10 | 100.0 | 14 | 100.0 | 43 | 100.0 |
| 1. Technical information obtainable from patents | 6 | 31.6 | 4 | 40.0 | 3 | 21.4 | 13 | 30.2 |
| 2. Introduction of "foreign-made" equipment and software | 8 | 42.1 | 4 | 40.0 | 7 | 50.0 | 19 | 44.2 |
| 3. Reverse engineering | 5 | 26.3 | 2 | 20.0 | 4 | 28.6 | 11 | 25.6 |

*5.2.11. Important partners for innovation*

The survey likewise asked the firms to indicate their most and second most important partners for innovation and whether they are actual or potential partners at the moment. Of the total firms surveyed, majority (60%) of those who responded consider their respective departments, headquarters and affiliates as their most first important partners, and second will be their local customers and/or suppliers (21.2%). This trend is true across provinces and sectors. This tendency to rely on own departments becomes even more pronounced in large firms engaged in joint ventures (100%) that claim to rely on their own offices and affiliates for their innovative activities. The same can be said of foreign firms, with 55 out of the 59 surveyed firms admitting to depend more on their own departments and affiliates when it comes to innovative undertaking. In terms of proximity, 30% of those that responded are less than 11 kilometers away from their actual partners, while the other 30% are more than 200 kilometers away from their network partners. The latter could refer to their local customers/suppliers in other regions and/or foreign affiliates abroad. When it comes to the duration of the relationship, most of the firms that respondent indicated the longest tenor in the questionnaire options, which is, more than three years. These results denote that among the firms that have actual partners for innovation, other than their own or referring to local firms (customers and/or suppliers), duration of the relationship also matters.

In terms of potential partners for innovation, these are mostly confined or limited to identified local customers and/suppliers.

*5.2.12. Obstacles to innovation*

The respondents were likewise asked about the hindrances to innovation that they have been experiencing. This question directly pinpoints the obstacles that should be removed by policy interventions or overcome through the efforts and cooperation of the various stakeholders in the innovation system. Based on the survey, the most serious obstacles to innovation as indicated by surveyed firms in CALABARZON are: lack of R&D supporting industry; high price of R&D support services; high tariffs on equipment and materials necessary for innovation; no business organization or chamber of commerce which can provide training courses, seminar or testing facilities in the neighborhood; and, no tax break or accelerated depreciation system.

**Table 24. Most Serious Obstacles for Innovation**

| | Large Firms | | SME Firms | | Grand Total | |
|---|---|---|---|---|---|---|
| | **Freq** | **% Share** | **Freq** | **% Share** | **Freq** | **% Share** |
| No R&D supporting Industry | 10 | 19.6 | 23 | 23.5 | 33 | 22.1 |
| Price of R&D support services is high | 14 | 27.5 | 19 | 19.4 | 33 | 22.1 |
| No university or public institute in the neighborhood | 1 | 2.0 | 0 | - | 1 | 0.7 |
| Tech. capabilities of universities or public institutes located in the neighborhood too weak to collaborate | 2 | 3.9 | 1 | 1.0 | 3 | 2.0 |
| No business organization or chamber of commerce which can provide training courses, seminar or testing facilities in the neighborhood | 6 | 11.8 | 10 | 10.2 | 16 | 10.7 |
| Protection of IPR not sufficient | 1 | 2.0 | 2 | 2.0 | 3 | 2.0 |
| High tariffs on eqpt & materials necessary for innovation | 9 | 17.6 | 23 | 23.5 | 32 | 21.5 |
| No tax break or accelerated depreciation system | 4 | 7.8 | 12 | 12.2 | 16 | 10.7 |
| Establishment not familiar with public support programs & procedures to apply for support measures | 1 | 2.0 | 2 | 2.0 | 3 | 2.0 |
| Public support programs are not designed appropriately for innovation | 0 | - | 2 | 2.0 | 2 | 1.3 |
| Labor mobility is too rigid for workers to bring with them technologies acquired from previous employer or from previous training | 3 | 5.9 | 4 | 4.1 | 7 | 4.7 |
| **Grand Total** | **51** | **100.0** | **98** | **100.0** | **149** | **100.0** |

## 5.3. In-depth Interviews of Firms

### *5.3.1. Profile of interviewed firms*

In order to get more insights on the linkages dynamics occurring among firms in the Philippines, in-depth interviews were undertaken successfully covering fourteen firms located all over the region. Their location and sectoral distributions are as follows: four firms come from Cavite comprising of three electronics firms and one engaged in apparel; two from Laguna, both undertaking food production; two from Batangas, each engaged in the oleochemicals industry and electronics; four firms from Rizal with one each representing the food and electronics sector and two engaged in apparel production; and, two firms in Quezon, both of which are into food manufacturing. Of the fourteen, half are locators in special economic zones, eight are locally-owned, and all except two are large firms. Six of these firms have R&D departments, three are reliant on their parent companies and the rest do not have R&D capabilities.

### *5.3.2. Relationships with Customers and Suppliers*

At least eight of these firms mentioned that their relationships with customers and suppliers are important for them to come up with differentiated products whether slightly improved or entirely new. Customers provide the specifications and/or changes to details and it is up to the firms to determine and find ways if they could meet these demands. This is especially true for firms without R&D departments. This textile company that was interviewed specializing on dyeing yarns mentioned that the customers specify the colors and combinations, which they try to comply with. The company engaged in processing desiccated coconut follows the signal of their customers, all from Europe, that typically just give them information as to the cut of the product and chemical content. Meanwhile, given that the machinery being used is almost always imported, the suppliers of these machines provide the training to the firms to enable them to operate said machines.

### *5.3.3. Owners/management as key*

While customers are major sources of information and new technologies, there are firms among the roster interviewed that has a pro-active stance in coming up with new ways of utilizing their products in a producer-driven manner, that is, even without receiving requests for firms to do so. According to respondents from this firm engaged in coconut oil production for residential and commercial use, the overall drive of the firm to innovate is inspired by the owner who established the R&D department, sends R&D personnel to training and subscribes to an international industry-related journal. The firm is also more receptive to cooperate with the programs and technical assistance provided by the government-run Philippine Coconut Authority, which has offices in the region. This same drive can be found as one of the traits of the operations manager of a company making biscuits for domestic consumption. This particular firm does not have an R&D department though its sister company has. Nevertheless, the operations manager still goes on his own to search for new product lines that the company can introduce to the market.

The same innovative mind-set was mentioned to be possessed by the owner of the shoe company interviewed in Rizal. Said shoe company is 100 percent locally owned and came from the tradition of shoe manufacturers in the area. With the designs in shoes good only for three months, the owner is said to frequent different countries to undertake scanning of latest and upcoming trends, particularly in Italy and China. The company does its own designs and undertakes market research afterwards via focus group discussions. The company also has exclusive designs for clients and for its own line. When asked if they have plans to secure ISO certification, the representative of the company said that it is very expensive to be certified by them and more than that, the requirements are numerous.

### *5.3.4. Other stimulants of innovation*

Meanwhile, securing an ISO certification was the turning point for a tool and die company (considered electronics) to improve their overall operations and management systems. This was first demanded by their customers which are ISO certified

themselves. So as not to lose these clients and be competitive, the company sought the certification and in the process improved the company itself. The company also has a good quality control system that is able to catch defects at the outset. The engineering department, which is also integrated with the R&D activities, designs their own template enabling them to send proposals to prospective clients.

Among food manufacturers, it was found that product upgrade or introduction of new products is imperative, at least every two years. By the nature of their products, in the case of the interviewed firms – breads, cookies, biscuits, candies – and the very competitive environment by which they operate, keeping up with rivals and coming out with new and improved products are necessary. This could also be the reason why they maintain R&D departments or units. In one of the three firms interviewed engaged in manufacturing such products, it was found that they benchmark their competitors so they would know what they are up against. They are also aware of the need to patent their products. On the other hand, the biggest baking company in the country has been able to patent a process in the preparation of one of their best-selling products. Though wholly foreign owned, the company is not dependent on the head office for R&D activities and are able to conduct their own research. This is because the local affiliate knows better the tastes and preferences of the population they are trying to serve.

### *5.3.5. University-industry linkages*

The most common joint undertakings between the interviewed firms and universities within and outside the region are in terms of apprenticeships or on-the-job (OJT) training and hiring of graduates. The biggest baking company in the country has had some experience collaborating with the University of the Philippines in Los Banos and in the University of the Philippines in Diliman. The firm sought consultancy services from the Colleges of Food Technology and Nutrition for product and vitamin development. The firm approached the university and the arrangement, informal. In fact, there have been some other instances in the past where product testing and partial research were initiated with individuals in the University, like faculty and students. Meanwhile, the arrangement with UP Diliman is on environmental concerns rather than

technology oriented. The firm also has Dual Tech arrangements with Don Bosco Technical Institute. The same is true for the tool and die manufacturer in Rizal, which has OJT agreements with Meralco Foundation, which incidentally, also has a course offering on tool and die. Some of the firms subscribe to the Dual Training System of the government-run Technical Education and Skills Development Authority (TESDA), with one firm preferring to hire those with TESDA certificates.

Firms in the region source their manpower from graduates and residents within the region, which gives them ample supply. Some have, however, expressed fears that engineers would soon run-out if they are not given enough incentives as they would just opt to get pecuniary income from abroad instead where they are also in-demand.

### *5.3.6. Other linkages*

Electronics firms interviewed are all members of the Semiconductors and Electronics Industries in the Philippines, Inc. (SEIPI) and get benefits from their services. Food firms are members of either the Philippine Baking Industry Group or the Philippine Food Processors and Exporters Organization, Inc., while the coconut desiccators are members of the Desiccators Association and the umbrella organization, United Coconut Associations of the Philippines, Inc. However, not much knowledge exchange is happening in these associations as they are mainly geared towards advocating for the advancement of their sectors or to fix prices as with the desiccators. One interviewee did mention that being a member of the Philippine Association of Food Technologists enabled her to attend seminars and learn about updates on new technologies.

As for the interactions with government agencies other than TESDA, limited technological linkages were found even with instrumentalities of the DOST. Those engaged in electronics go to them for calibration only. When asked if they knew of any programs being offered by them, most of the interviewees were not aware. Meanwhile, one of the food firms mentioned that they go to the Bureau of Food and Drugs and the Food Nutrition Research Institute for technical assistance, but it comes with a fee. Another food firm worked with the DOST for the development of a drier equipment but

was not successful. Local government units, despite having their own investment promotional drives and incentives offerings to firms and industries in their jurisdiction, are not yet a channel for the exchange of information and new technologies. Interactions with firms are still limited though an isolated case of support was cited by one firm.

In sum, the more in-depth interviews of select firms has succeeded in clarifying and specifying the information asked through the questionnaire, particularly in terms of the linkages they actually have with various sources of new information and technologies. For all firms, with or without R&D, their customers are the primary sources. Meanwhile, for firms whose owners, management in general, have imbibed an innovative mindset, they themselves source out information and new trends in their industry. These firms are also more prone to having R&D departments and in continuous improvements and industrial upgrading, with or without encouragement by their customers. Linkages with the universities and public research institutions were confirmed to be weak and limited at best. Still, OJT arrangements and Dual Training Systems are concrete steps toward matching needs and manpower supply to industries. So far, despite their pronouncements and programs, the local government units are not yet a factor in the local innovation system.

# 6 ECONOMETRICS RESULTS

Using dataset collated from the 2008 SPLN survey, the econometrics analysis will try to trace out the correlation between innovation and sources of information and new technology. Innovation in this regard will be measured by the number innovative activities undertaken by manufacturing firms in CALABARZON in the last three years, while sources of technology will be determined by the number of linkages that has taken effect between the firms and the various sources. Such linkages can be grouped into two categories, the production and intellectual linkages. In this model, the dependent variable is the number of innovation while the independent variables are the total number of linkages and by type of linkages. Control variables are the firms' capital

structure, age, size in terms of count of full-time employees, and selected industries which were found to be agglomerated in the region (food, apparel and electronics).

### 6.1. Innovation and Linkages

This relationship was tested using three models: all firms, firms with R&D units and firms without R&D units. Number of linkages was found to be positively correlated to the number of innovations both among all firms and among those without R&D units at the 5 percent and 1 percent significance levels, respectively. The results indicate that an additional linkage taking effect likely leads to an increment in the number of innovative activities for all firms and for those firms without R&D departments. Having more sources of technology makes it conducive for the conduct of more innovation, while firms without R&D capabilities would most likely rely on other sources of information and new technology. The result for the model pertaining to firms with R&D was positive but not significant.

Among the control variables, the coefficient for local firms was found to be negative and significant at the 5 percent level denoting that local firms are less likely to innovate than foreign firms. Larger firms are positively correlated to the number of innovations in all the models indicating that they are more likely to conduct innovative activities. Among the three sectors, the coefficient for food is significant only among firms without R&D (at 10% level) and was found to be negative. This denotes that food producers without R&D departments are less likely to contribute to innovative activities. Firms engaged in producing apparel likewise show negative coefficients in all three models and significant at the 1 percent level. Apparel firms are less likely to conduct innovative activities, which are reflected in actual scenarios since many of them are engaged in low value added activities and rely much on the specifications of the mother companies. The coefficients for electronics are found to be insignificant.

**Table 25. Number of Linkages and Number of Innovations by R&D**

| OLS | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variables: Number of Innovations | All | With R&D | Without R&D |
| Number of Linkages | 0.154* | 0.019 | 0.217** |
| | [0.072] | [0.086] | [0.079] |
| Local | -1.605* | -0.885 | -1.429+ |
| | [0.720] | [1.673] | [0.793] |
| Age | 0.046 | 0.073 | -0.014 |
| | [0.034] | [0.054] | [0.057] |
| Full-time Employees | 0.003** | 0.006** | 0.002* |
| | [0.001] | [0.002] | [0.001] |
| Food | -0.329 | -0.316 | -2.071+ |
| | [0.889] | [1.442] | [1.135] |
| Apparel | -4.160** | -5.368** | -3.944** |
| | [0.704] | [1.905] | [0.731] |
| Electronics | -0.603 | -1.85 | 0.044 |
| | [1.097] | [3.781] | [1.042] |
| Constant | 7.593** | 8.507** | 8.124** |
| | [0.754] | [1.860] | [0.902] |
| Observations | 204 | 50 | 154 |
| R-squared | 0.29633 | 0.40051 | 0.2869 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

### 6.2. Innovation and Types of Linkages

Using the same model above but focusing only on production linkages, results show that the coefficients, both among all firms and among firms without R&D, are positive and significant at the 5 percent level. The results imply that firms having production linkages add to the instances of innovative activities. In the same manner, firms that do have intellectual linkages are more likely to contribute to innovation based on the positive signs of coefficients attributed to all firms and those without R&D, which are significant at 5 percent and 1 percent levels, respectively. However, it cannot be claimed that having intellectual linkages has more or stronger effect on innovation than production linkages or vice versa due to the issues of endogeneity. It can only be stated in certain terms that linkages in all forms, among the stakeholders of knowledge, are positive and significant drivers of technological upgrading among firms.

**Table 26. Number of Production Linkages and Number of Innovations by R&D**

| OLS | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variables: Number of Innovations | All | With R&D | Without R&D |
| Number of Production Linkages | 0.207* | -0.003 | 0.300* |
| | [0.101] | [0.128] | [0.119] |
| Local | -1.613* | -1.026 | -1.405+ |
| | [0.723] | [1.670] | [0.789] |
| Age | 0.048 | 0.074 | -0.015 |
| | [0.034] | [0.054] | [0.057] |
| Full-time Employees | 0.003** | 0.006** | 0.002* |
| | [0.001] | [0.002] | [0.001] |
| Food | -0.316 | -0.258 | -2.057+ |
| | [0.892] | [1.438] | [1.131] |
| Apparel | -4.173** | -5.387** | -3.929** |
| | [0.705] | [1.878] | [0.728] |
| Electronics | -0.554 | -1.65 | 0.081 |
| | [1.108] | [3.773] | [1.055] |
| Constant | 7.577** | 8.662** | 8.112** |
| | [0.755] | [1.889] | [0.901] |
| Observations | 204 | 50 | 154 |
| R-squared | 0.29341 | 0.39982 | 0.28787 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

**Table 27. Number of Intellectual Linkages and Number of Innovations by R&D**

| OLS | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variables: Number of Innovations | All | With R&D | Without R&D |
| Number of Intellectual Linkages | 0.473* | 0.16 | 0.528** |
| | [0.212] | [0.232] | [0.191] |
| Local | -1.630* | -0.705 | -1.416+ |
| | [0.715] | [1.662] | [0.813] |
| Age | 0.044 | 0.071 | -0.012 |
| | [0.034] | [0.055] | [0.057] |
| Full-time Employees | 0.003** | 0.006** | 0.002* |
| | [0.001] | [0.002] | [0.001] |
| Food | -0.315 | -0.38 | -2.115+ |
| | [0.888] | [1.446] | [1.145] |
| Apparel | -4.163** | -5.273** | -4.004** |
| | [0.701] | [1.898] | [0.740] |
| Electronics | -0.653 | -2.21 | 0.043 |
| | [1.073] | [3.831] | [1.017] |
| Constant | 7.668** | 8.344** | 8.136** |
| | [0.760] | [1.793] | [0.905] |
| Observations | 204 | 50 | 154 |
| R-squared | 0.29804 | 0.40603 | 0.27881 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

### 6.3. Innovation and Internal Sources

The more recent surveys of firms have indicated that Philippine firms have tendency to rely more on their in-house capacities for technological development. Results of the econometrics give validity to these efforts as coefficients denoting correlation between number of internal sources and number of innovations is positive both among all firms and those without R&D departments at 1 percent and 5 percent levels of significance, respectively. Said coefficients have high values, suggesting that the more internal capabilities firms have, the more innovation they are able to generate.

**Table 28. Number of Internal Sources and Number of Innovations by R&D**

| OLS | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variables: Number of Innovations | All | With R&D | Without R&D |
| Number of Internal Sources | 0.969** | 0.218 | 0.822* |
| | [0.208] | [0.394] | [0.353] |
| Local | -1.820** | -0.982 | -1.506+ |
| | [0.679] | [1.641] | [0.778] |
| Age | 0.038 | 0.072 | -0.011 |
| | [0.034] | [0.055] | [0.056] |
| Full-time Employees | 0.003** | 0.006** | 0.002* |
| | [0.001] | [0.002] | [0.001] |
| Food | -0.791 | -0.371 | -2.064+ |
| | [0.842] | [1.434] | [1.152] |
| Apparel | -4.202** | -5.301** | -4.073** |
| | [0.697] | [1.918] | [0.734] |
| Electronics | -0.878 | -1.997 | -0.204 |
| | [1.054] | [3.960] | [1.043] |
| Constant | 7.420** | 8.238** | 7.940** |
| | [0.727] | [2.090] | [0.874] |
| Observations | 204 | 50 | 154 |
| R-squared | 0.34687 | 0.40428 | 0.29867 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

### 6.4. Innovation and Linkages by Functions of the Firms

Another indicator of R&D capacity of firms is the so called intensity of R&D derived from computing actual R&D expenditures over total sales. Said variable was plugged in into the model, this time by functions of the firms whether raw materials processing, parts and components production, final assembly, procurement, and marketing. Interestingly, the R&D sales ratio is found to have significant coefficients

only in procurement and marketing, both with negative signs. This denotes that procurement functions of firms are less likely to drive innovation than those performing other functions. Likewise, the same connotation can be made among firms doing marketing. The results could find validation in actuality considering that firms are more likely to direct R&D efforts towards production than procurement and marketing functions.

In terms of total number of linkages vis-à-vis number of innovation, all coefficients show positive results but only those among all firms, as well as those engaged in parts assembly and procurement are found to be significant. This can be interpreted to mean that the number of linkages that parts assemblers and those having procurement functions have adds to the likelihood of undertaking innovative activities. Similar results are obtained when linkages are specified into production but slightly different when intellectual linkages are used. Results show that having intellectual linkages are positively correlated to the number of innovations taking place among all firms, those engaged in raw materials processing, parts assembly, procurement, and marketing. This could denote that intellectual linkages are able to bring in more diverse knowledge that can be applied into various functional levels. On the other hand, in terms of the number of internal sources that firms have, which is a proxy for technological capabilities, all the signs are positive in various levels of significance among all firms and in all functions. This brings to mind the argument under the national innovation system framework that industrial development requires technological capability in industry and the use of technology is most crucial at the firm level. Econometrics results indeed show that when firms have the technological capacities, innovation takes place and their capacities could be built up more with the promotion of stronger intellectual linkages.

## Table 29. Number of Linkages and Number of Innovations by Functions

| OLS | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variables: Number of Innovations Last 3 years | All | Raw materials | Parts | Final Assembling | Procurement | Marketing |
| R&D Sales ratio | -1.321 | 26.197 | -5.603 | -1.626 | -2.598+ | -4.616* |
| | [1.421] | [19.719] | [29.830] | [1.371] | [1.491] | [2.167] |
| Number of Linkages | 0.154* | 0.111 | 0.299** | 0.149 | 0.246** | 0.124 |
| | [0.072] | [0.067] | [0.087] | [0.097] | [0.074] | [0.077] |
| Local | -1.623* | -3.072* | -0.182 | -1.508+ | -2.653* | -1.848 |
| | [0.727] | [1.260] | [1.659] | [0.796] | [1.190] | [1.420] |
| Age | 0.046 | 0.037 | -0.043 | 0.069+ | 0.026 | 0.047 |
| | [0.034] | [0.078] | [0.074] | [0.035] | [0.045] | [0.042] |
| Full-time Employees | 0.003** | 0.004+ | 0.002 | 0.004** | 0.003* | 0.007** |
| | [0.001] | [0.002] | [0.001] | [0.001] | [0.001] | [0.002] |
| Food | -0.284 | 0.175 | -7.244** | -0.399 | -0.598 | -1.905 |
| | [0.913] | [1.300] | [1.589] | [1.040] | [1.259] | [1.788] |
| Apparel | -4.162** | -5.284** | -3.846+ | -3.966** | -4.052** | -4.196** |
| | [0.705] | [1.227] | [1.962] | [0.793] | [1.222] | [1.469] |
| Electronics | -0.620 | -2.686 | -0.845 | -2.188 | -1.471 | 3.243 |
| | [1.104] | [2.586] | [1.171] | [1.538] | [1.656] | [2.021] |
| Constant | 7.616** | 9.018** | 9.249** | 7.103** | 8.767** | 8.898** |
| | [0.761] | [1.756] | [1.386] | [0.864] | [1.125] | [1.130] |
| Observations | 204 | 75 | 59 | 159 | 103 | 39 |
| R-squared | 0.297 | 0.405 | 0.385 | 0.285 | 0.330 | 0.573 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

## Table 30. Number of Production Linkages and Number of Innovations by Functions

| OLS | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variables: Number of Innovations Last 3 years | All | Raw materials | Parts | Final Assembling | Procurement | Marketing |
| R&D Sales ratio | -1.319 | 26.768 | -6.371 | -1.597 | -2.548+ | -4.627* |
| | [1.438] | [19.751] | [29.270] | [1.389] | [1.492] | [2.200] |
| Number of Production Linkages | 0.206* | 0.137 | 0.422** | 0.214 | 0.352** | 0.178 |
| | [0.101] | [0.093] | [0.130] | [0.136] | [0.104] | [0.115] |
| Local | -1.631* | -3.062* | -0.078 | -1.508+ | -2.666* | -1.836 |
| | [0.730] | [1.256] | [1.652] | [0.797] | [1.186] | [1.413] |
| Age | 0.047 | 0.041 | -0.043 | 0.070* | 0.028 | 0.049 |
| | [0.034] | [0.077] | [0.074] | [0.035] | [0.045] | [0.042] |
| Full-time Employees | 0.003** | 0.004+ | 0.002 | 0.004** | 0.003* | 0.007** |
| | [0.001] | [0.002] | [0.001] | [0.001] | [0.001] | [0.002] |
| Food | -0.270 | 0.167 | -7.270** | -0.390 | -0.624 | -1.865 |
| | [0.916] | [1.305] | [1.572] | [1.041] | [1.255] | [1.786] |
| Apparel | -4.175** | -5.329** | -3.884+ | -3.969** | -4.032** | -4.184** |
| | [0.707] | [1.228] | [1.946] | [0.796] | [1.219] | [1.486] |
| Electronics | -0.572 | -2.627 | -0.727 | -2.147 | -1.432 | 3.512+ |
| | [1.114] | [2.621] | [1.168] | [1.538] | [1.682] | [1.898] |
| Constant | 7.600** | 8.948** | 9.167** | 7.066** | 8.682** | 8.813** |
| | [0.762] | [1.751] | [1.386] | [0.862] | [1.123] | [1.161] |
| Observations | 204 | 75 | 59 | 159 | 103 | 39 |
| R-squared | 0.294 | 0.401 | 0.384 | 0.285 | 0.332 | 0.572 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

## Table 31. Number of Intellectual Linkages and Number of Innovations by Functions

| OLS | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variables: Number of Innovations Last 3 years | All | Raw materials | Parts | Final Assembling | Procurement | Marketing |
| R&D Sales ratio | -1.429 | 24.691 | -3.444 | -1.749 | -2.805+ | -4.845* |
| | [1.397] | [19.772] | [31.070] | [1.343] | [1.499] | [2.039] |
| Number of Intellectual Linkages | 0.471* | 0.386+ | 0.816** | 0.397 | 0.679** | 0.335+ |
| | [0.213] | [0.213] | [0.274] | [0.285] | [0.237] | [0.192] |
| Local | -1.649* | -3.068* | -0.404 | -1.553+ | -2.637* | -1.934 |
| | [0.721] | [1.266] | [1.708] | [0.790] | [1.196] | [1.424] |
| Age | 0.043 | 0.028 | -0.038 | 0.068+ | 0.024 | 0.041 |
| | [0.034] | [0.082] | [0.075] | [0.035] | [0.045] | [0.041] |
| Full-time Employees | 0.003** | 0.004 | 0.002+ | 0.004** | 0.003* | 0.007** |
| | [0.001] | [0.002] | [0.001] | [0.001] | [0.001] | [0.002] |
| Food | -0.266 | 0.168 | -7.252** | -0.378 | -0.540 | -1.867 |
| | [0.911] | [1.292] | [1.666] | [1.038] | [1.279] | [1.762] |
| Apparel | -4.165** | -5.251** | -3.805+ | -3.979** | -4.176** | -4.337** |
| | [0.702] | [1.216] | [2.026] | [0.789] | [1.231] | [1.475] |
| Electronics | -0.672 | -2.775 | -0.988 | -2.231 | -1.476 | 2.906 |
| | [1.080] | [2.501] | [1.185] | [1.512] | [1.611] | [2.170] |
| Constant | 7.692** | 9.168** | 9.348** | 7.210** | 8.943** | 9.112** |
| | [0.766] | [1.788] | [1.402] | [0.876] | [1.135] | [1.099] |
| Observations | 204 | 75 | 59 | 159 | 103 | 39 |
| R-squared | 0.298 | 0.410 | 0.366 | 0.281 | 0.317 | 0.571 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

## Table 32. Number of Internal Sources and Number of Innovations by Functions

| OLS | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variables: Number of Innovations Last 3 years | All | Raw materials | Parts | Final Assembling | Procurement | Marketing |
| R&D Sales ratio | -1.031 | 12.189 | -23.651 | -1.113 | -1.355 | -3.940+ |
| | [1.007] | [15.837] | [22.984] | [1.094] | [1.427] | [1.987] |
| Number of Internal Sources | 0.967** | 0.626+ | 1.495** | 0.987** | 1.438** | 0.717+ |
| | [0.209] | [0.360] | [0.393] | [0.237] | [0.307] | [0.364] |
| Local | -1.833** | -2.855* | -1.958 | -1.729* | -2.635* | -2.054 |
| | [0.685] | [1.267] | [1.468] | [0.762] | [1.138] | [1.351] |
| Age | 0.038 | 0.032 | -0.062 | 0.061+ | 0.015 | 0.056 |
| | [0.034] | [0.079] | [0.062] | [0.035] | [0.045] | [0.044] |
| Full-time Employees | 0.003** | 0.004+ | 0.002 | 0.004** | 0.003* | 0.007** |
| | [0.001] | [0.002] | [0.001] | [0.001] | [0.001] | [0.002] |
| Food | -0.754 | -0.286 | -5.282** | -1.056 | -1.308 | -2.281 |
| | [0.864] | [1.271] | [1.593] | [0.993] | [1.253] | [1.598] |
| Apparel | -4.203** | -5.177** | -2.216 | -3.988** | -4.174** | -4.592** |
| | [0.698] | [1.288] | [1.960] | [0.776] | [1.144] | [1.669] |
| Electronics | -0.892 | -2.842 | -1.468 | -2.455 | -1.614 | 2.615 |
| | [1.060] | [2.400] | [1.131] | [1.509] | [1.433] | [1.827] |
| Constant | 7.437** | 8.729** | 9.466** | 6.862** | 8.533** | 8.584** |
| | [0.734] | [1.749] | [1.250] | [0.841] | [1.092] | [1.192] |
| Observations | 204 | 75 | 59 | 159 | 103 | 39 |
| R-squared | 0.347 | 0.417 | 0.469 | 0.341 | 0.395 | 0.588 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

### 6.5. Linkages and Probability of Innovation

Econometric results demonstrated the effect of linkages on the probability of firms to innovate, i.e. introduce new products, using three models: all firms, those with R&D and those without R&D. The resulting coefficients are positive both for all firms and those with R&D but negative among those without R&D. However, they are not significant. The same is true even with only the number of production linkages was used. However, when the number of intellectual linkages is used, the coefficients become positive and significant among all firms and among those with R&D. Simply put, the number of intellectual linkages has positive and significant effect on the probability that all firms will introduce new goods in the market. Among firms with R&D units and having intellectual linkages, the effects are likewise positive and significant for the likelihood of this type of innovation to take place.

In terms of the number of internal sources alone, the coefficient is positive among all firms and among those with R&D but only the former is significant. Thus, firms with internal technological capacities in terms of the number of sources of new knowledge it has from within positively affects the probability that said firms would introduce new products.

**Table 33. Number of Linkages and Introduction of New Product by R&D**

| Probit, Marginal Effects<br>Dependent variables: Introduction of New Good (Yes/No) | (1)<br>All | (2)<br>With R&D | (3)<br>Without R&D |
|---|---|---|---|
| Number of Linkages | 0.011 | 0.01 | -0.012 |
| | [0.007] | [0.008] | [0.012] |
| Local | -0.123 | 0.022 | -0.153 |
| | [0.084] | [0.145] | [0.095] |
| Age | -0.001 | -0.007 | 0.002 |
| | [0.004] | [0.004] | [0.005] |
| Full-time Employees | 0.000+ | 0 | 0 |
| | [0.000] | [0.000] | [0.000] |
| Food | 0.134 | 0.17 | -0.105 |
| | [0.101] | [0.123] | [0.137] |
| Apparel | -0.194* | -0.018 | -0.232* |
| | [0.095] | [0.189] | [0.094] |
| Electronics | 0.088 | | 0.118 |
| | [0.122] | | [0.134] |
| Observations | 204 | 45 | 154 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

**Table 34. Number of Production Linkages and Introduction of New Product by R&D**

| Probit, Marginal Effects | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variables: Introduction of New Good (Yes/No) | All | With R&D | Without R&D |
| Number of Production Linkages | 0.011 | 0.007 | -0.016 |
| | [0.010] | [0.011] | [0.017] |
| Local | -0.125 | 0.006 | -0.154 |
| | [0.083] | [0.147] | [0.095] |
| Age | 0 | -0.007 | 0.002 |
| | [0.004] | [0.004] | [0.005] |
| Full-time Employees | 0.000+ | 0 | 0 |
| | [0.000] | [0.000] | [0.000] |
| Food | 0.136 | 0.174 | -0.105 |
| | [0.101] | [0.124] | [0.138] |
| Apparel | -0.196* | -0.028 | -0.232* |
| | [0.094] | [0.192] | [0.094] |
| Electronics | 0.093 | | 0.116 |
| | [0.122] | | [0.133] |
| Observations | 204 | 45 | 154 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

**Table 35. Number of Intellectual Linkages and Introduction of New Product by R&D**

| Probit, Marginal Effects | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variables: Introduction of New Good (Yes/No) | All | With R&D | Without R&D |
| Number of Intellectual Linkages | 0.048* | 0.080* | -0.024 |
| | [0.023] | [0.040] | [0.036] |
| Local | -0.122 | 0.027 | -0.154 |
| | [0.083] | [0.125] | [0.095] |
| Age | -0.001 | -0.007+ | 0.002 |
| | [0.004] | [0.004] | [0.005] |
| Full-time Employees | 0.000+ | 0 | 0 |
| | [0.000] | [0.000] | [0.000] |
| Food | 0.132 | 0.154 | -0.104 |
| | [0.102] | [0.115] | [0.136] |
| Apparel | -0.191* | 0.024 | -0.229* |
| | [0.095] | [0.139] | [0.094] |
| Electronics | 0.079 | | 0.115 |
| | [0.123] | | [0.135] |
| Observations | 204 | 45 | 154 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

**Table 36. Number of Internal Sources and Introduction of New Product by R&D**

| Probit, Marginal Effects | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variables: Introduction of New Good (Yes/No) | All | With R&D | Without R&D |
| Number of Internal Sources | 0.063* | 0.006 | -0.003 |
| | [0.027] | [0.034] | [0.040] |
| Local | -0.140+ | -0.016 | -0.159+ |
| | [0.083] | [0.145] | [0.095] |
| Age | -0.001 | -0.007+ | 0.002 |
| | [0.004] | [0.004] | [0.005] |
| Full-time Employees | 0 | 0 | 0 |
| | [0.000] | [0.000] | [0.000] |
| Food | 0.111 | 0.177 | -0.103 |
| | [0.103] | [0.124] | [0.137] |
| Apparel | -0.201* | -0.027 | -0.228* |
| | [0.095] | [0.189] | [0.094] |
| Electronics | 0.069 | | 0.107 |
| | [0.124] | | [0.135] |
| Observations | 204 | 45 | 154 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

### 6.6. Technological Linkages and Business Performance

Innovation affects the business performance of firms in a number of ways. It could lead to increases in sales amount, profit and value of exports, increased ability to employ more and tap into more markets, improve productivity and the quality of products, reduce product defects and lead time, and decrease production costs. Looking at the empirical relationship among them and the number of innovations undertaken yields the following results: (i) the number of innovations has positive and significant correlation with the probability of improved business performance among those that reported increases in sales amount, value of exports, value of exports to developed countries, and number of export destinations; (ii) the number of innovations affects the probability of heightened business performance positively among those firms whose productivity of operations improved, with better quality of products, and with reductions in product defects and lead time. This outcome validates exactly the results from the survey cited in previous sections, which enumerated the three most common business performance improvements experienced by firms in CALABARZON.

## Table 37. Number of Linkages and Current Business Performance

| **Probit, Marginal effects** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** | **(10)** | **(11)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dependent variables: Current Business Performance Compared to FY2007 (Q6.1-Q6.11)** | **Sales amount increased** | **Profit increased** | **Number of employees increased** | **Value of exports increased** | **Value of exports to developed countries increased** | **Number of export destination increased** | **Productivity of operation improved** | **Quality of products improved** | **Product defects were reduced** | **Production cost decreased** | **Lead-time was reduced** |
| Number of Innovations | 0.020* | 0.002 | 0.002 | 0.026** | 0.017* | 0.025** | 0.023** | 0.016** | 0.021** | 0.009 | 0.018* |
| | [0.009] | [0.008] | [0.007] | [0.008] | [0.007] | [0.007] | [0.008] | [0.006] | [0.008] | [0.008] | [0.009] |
| R&D Sales Ratio | 2.914 | 1.001* | 1.039 | 1.869 | 2.556 | 2.317 | 0.335 | 0.145 | 0.237 | -4.104 | -2.599 |
| | [2.706] | [0.486] | [1.694] | [2.482] | [2.332] | [1.729] | [0.291] | [0.213] | [0.266] | [2.721] | [3.043] |
| Number of Production Linkages | 0.031 | 0.006 | -0.003 | 0.023 | 0.017 | 0.017 | 0.031 | 0.006 | -0.014 | 0.017 | 0.005 |
| | [0.020] | [0.019] | [0.017] | [0.017] | [0.015] | [0.012] | [0.024] | [0.016] | [0.017] | [0.019] | [0.021] |
| Number of Intellectual Linkages | -0.039 | 0.018 | 0.044 | -0.052 | -0.027 | -0.022 | -0.067 | 0.019 | 0.050+ | -0.004 | 0.008 |
| | [0.038] | [0.039] | [0.037] | [0.038] | [0.032] | [0.026] | [0.041] | [0.027] | [0.030] | [0.039] | [0.042] |
| Local | 0.084 | 0.165* | -0.054 | -0.114 | -0.087 | -0.042 | 0.038 | -0.109+ | -0.013 | -0.032 | 0.104 |
| | [0.090] | [0.081] | [0.076] | [0.075] | [0.072] | [0.064] | [0.077] | [0.063] | [0.075] | [0.076] | [0.083] |
| Age | -0.003 | -0.001 | -0.010* | 0.000 | -0.001 | -0.005+ | -0.003 | -0.002 | -0.004 | -0.005 | -0.005 |
| | [0.004] | [0.004] | [0.004] | [0.004] | [0.003] | [0.003] | [0.003] | [0.002] | [0.003] | [0.004] | [0.004] |
| Full-time Employees | 0.000 | 0.000 | 0.000* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| Food | 0.101 | -0.001 | 0.021 | -0.219** | -0.043 | -0.035 | 0.039 | -0.065 | 0.018 | -0.147+ | -0.146 |
| | [0.110] | [0.097] | [0.099] | [0.064] | [0.084] | [0.074] | [0.092] | [0.092] | [0.089] | [0.083] | [0.105] |
| Apparel | -0.347** | -0.274** | -0.215** | 0.019 | 0.022 | 0.032 | -0.148 | -0.042 | -0.018 | 0.063 | -0.111 |
| | [0.090] | [0.076] | [0.071] | [0.096] | [0.098] | [0.085] | [0.094] | [0.071] | [0.083] | [0.096] | [0.101] |
| Electronics | -0.042 | -0.074 | -0.130 | 0.143 | 0.290* | 0.062 | 0.137 | -0.217+ | -0.041 | -0.090 | 0.117 |
| | [0.118] | [0.105] | [0.085] | [0.117] | [0.118] | [0.096] | [0.100] | [0.123] | [0.115] | [0.094] | [0.119] |
| Observations | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 |

*Note*: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

# 7 KEY FINDINGS

The results of this paper's methodology, such as secondary data, literature review, survey results, in-depth interviews of firms, and econometrics, confirm the hypotheses earlier postulated. Indeed, for firms in the Philippines as represented by manufacturing firms located in CALABARZON, production linkages or interactions with buyers and sellers and other local firms do matter for innovation to transpire. While there are evidences of weak linkages with the intellectual community, i.e., universities and public and private research institutes, econometrics results show that intellectual linkages do have positive and significant effects on innovation and should be acknowledged as evidence-based information for aggressively promoting these types of knowledge flows. It was also clearly highlighted that internal resources or the technological capacities of the firms affect innovation positively and efforts toward building up capabilities of firms to do so should be undertaken. Evidences were also provided, based on the survey results and the econometrics analysis, that innovation does affect business performance positively. At this moment, these characterize the national innovation system in the country. The following provide more details on the key findings.

**7.1.** The Philippines' technology policy is drawn from the mandates enshrined in the constitution on S&T. The national innovation system consists of the government through the cabinet-level Department of Science and Technology and its instrumentalities; the private sector through their R&D efforts; the higher education system; non-profit private institutions; and, other supporting institutions.

**7.2.** The diffusion of technology via adoption, utilization and commercialization is not widespread, despite the numerous programs that aim to achieve these objectives. Lack of resources, dearth in a critical mass of R&D human resources and the private sector's cautious regard of the capacities of research development institutions to diffuse the technology are possible culprits for this condition.

**7.3.** University-industry linkages are occurring but weak, characterized by informal arrangements rather than more formal agreements due to the absence of internal IPR

policies in universities. The main role of universities is to produce the manpower that would comprise the workforce of the industry. A common type of collaboration between universities and industry is apprenticeship/on-the-job training.

**7.4.** Due to lack of appropriate IPR policy within the universities, scientists and researchers fear that their novel body of works would only get "pirated" or ripped off when publicly disseminated. Ironically, their adherence to the "publish or perish" belief systems forces them to publicize their findings in scientific or academic journals.

**7.5.** Policy frameworks and priorities change every time a new administration is sworn into office, casting doubts on the continuity and sustainability of strategies, plans and programs. Though it cannot be said that the contents of these policy pronouncements are invalid, thrusts and priorities do change in the political succession. The long term National S&T Plan is no guarantee that strategies and plans would not change when the new administration is sworn into office in 2010.

**7.6.** Based on the survey, manufacturing firms in CALABARZON are well integrated into the regional economy as far as production goes. Customers and suppliers are in close proximity and many of them get new ideas from them. Some firms in the region also have production links with other countries, particularly the U.S., Europe, Japan, Korea, China, and Taiwan. Almost 3 out of 10 firms have foreign parent companies and derive new technological knowledge from them.

**7.7.** However, these firms on the average have stronger technological linkages within their internal organizational structure and with their local customers and suppliers. Linkages with knowledge networks are weaker whether in terms of accessing technical assistance from the government or participating in research consortium organized with support from government or from local business organizations. Also found to be low is the cooperation between the firms and local universities or R&D institutes.

**7.8.** The most important actual partners for innovation and upgrading are own departments, headquarters and affiliates, and local customers and suppliers. They are also considered as most important potential partners. Logistics-wise, these important partners are very accessible and duration of the relationship, long-term.

**7.9.** The five most serious obstacles faced by the firms in CALABARZON are: lack of R&D supporting industry; high price of R&D support services; high tariffs on equipment and materials necessary for innovation; no business organization or chamber of commerce which can provide training courses, seminar or testing facilities in the neighborhood; and, no tax break or accelerated depreciation system. However, in the Investment Priorities Plan for 2008 (and presumably, in previous years), R&D activities are one of the so-called preferred activities where incentives can be tapped. It is not clear if such incentives offered include importation of equipment for innovation. Meanwhile, experts claim that there are very few-takers of these incentives for R&D activities. On the second obstacle, it is found that while national business/industry associations are actively cooperating with government and academe on R&D related activities, there are no such active associations at the regional level though there may be chapters. There are provincial chambers or business associations but membership may not be that widespread as of yet or has not really been active in terms of knowledge exchange. The consortium of educational institutions in CALABARZON has more academe-related pursuits than R&D related.

**7.10.** The in-depth interviews of firms confirmed many of the above findings, while adding insights on what drives innovation among them. A key finding is that the innovative mind-set of the firms' leadership (management or owner) is a strong driver or facilitator for innovative pursuits.

**7.11.** Econometrics results indicate that the firms' own technological capacities and number of intellectual linkages have positive and significant impact on the occurrence and number of innovations. Number of production linkages was also proven to be positive and significant. The number of innovations was also found positive and significant predictor of improved business performance particularly those related to sales, value of exports, productivity, quality of products, reduction of product defects and lead time. Intellectual linkages were also found to be particularly important for reducing product defects. Thus, it can be concluded that indeed, linkages are essential to firms' innovation in the region and efforts should be extended towards tracing out and strengthening the ties that bind leading to innovation as this in turn, affect positive performance of firms.

# 8 RECOMMENDATIONS FOR POLICY AND PRACTICAL STRATEGIES

The overall goal of the proposed interventions is to emphasize less the differences on how each stakeholder of the innovation system performs but more on how they can work together, strengthening their linkages, given the resources that each can offer.

## 8.1. At the national level

### *8.1.1. On intellectual property rights and the need to provide incentives for researchers to conduct R&D and disseminate their findings*

The Intellectual Property Code of the Philippines does not have an explicit provision on how to assign ownership or copyright to government funded research activities. In fact, the Code has conflicting provisions: Section 30 states that the "person who commissions the work shall own the patent, unless otherwise stipulated in the contract," while Section 176 mandates, "No copyright shall subsist in any work of the Government of the Philippines. However, prior approval of the government agency or office wherein the work is created shall be necessary for exploitation of such work for profit. Such agency or office may, among other things, impose as a condition the payment of royalties."

To address this concern, the recently filed legislation aimed at clarifying the assignment of IP on commissioned work of the government should be supported. Said proposed legislation refers to House Bill 5208 titled, "An Act Promoting the Transfer of Technologies and Knowledge from R&D Funded by Government." This is also hoped to facilitate further technology transfer, particularly of public funded R&D outputs.

In terms of the lack of familiarity with IPR protection in general, and the IPR Code in particular, it is suggested that a more aggressive information campaign on IPR be conducted. Strengthen the capacities of universities and private research development institutes to protect their R&D outputs by helping them formulate internal policies on

IPR. Example: University of the Philippines has a Technology Licensing Office, which can serve as model for the others. The Intellectual Property Office of the Philippines should endeavor to have a registry of patented inventions that can easily be accessible in order to disseminate the information and inspire the conduct of R&D.

### *8.1.2. On policy frameworks for S&T*

The ever-changing national S&T framework for plan, policy formulation and program development should be strategically fixed to enable better monitoring of progress and to plug in problems in the process. It would also be best to acknowledge and aggressively pursue the national innovation strategy recently launched and branded as FilipINNOVATION. This notion developed multi-sectorally, serves as a battle cry that Filipinos could support and aspire for and an updated version of the National S&T Plan, 2002-2020. Conducting the National Conference on Innovation regularly could help sustain awareness and interest. Also, formal agreements fostered in the last conference should be tracked and monitored, like the open technology and business incubation partnership between DOST and the Philippine Economic Zone Authority for start-up companies in the ICT industry and the works of the Engineering Research and Development for Technology Consortium comprised of 7 engineering schools in the country and includes policy research and scholarship offerings as major activities. In fact, many of the actions recommended in this paper are also part of the action agenda that came out from the first national conference on innovation.

### *8.1.3. On fostering heightened UILs*

Create a forum where the academe and industry can share ideas for possible collaboration. Universities can pool their studies and make them available online or send to firms they could include in their mailing list. This is also one way of marketing their outputs! On the other hand, firms can disseminate their R&D requirements through their websites or directly to universities and even, private R&D institutions (RDIs). In CALABARZON, tap the consortium of educational institutions to publicize information.

Government, national or subnational or both, could offer tax or non-tax incentives to firms for partnering with universities and/or RDIs.

### *8.1.4. On the high cost of R&D equipment and supporting services*

This has been explicitly identified in the survey as most serious obstacles, together with high tariffs on equipment and materials necessary. With the high cost of R&D related capital equipment and supporting services a given and while the public sector could not afford to allocate funds for this, alternative scenarios can be pursued. (a) Foster bilateral cooperative agreements with nations or industries in other countries that supply R&D equipment in order to lower tariffs and/or other transaction costs (requirements and procedures). (b) Establish common R&D related facilities that are prohibitive and impractical to purchase by firms on their own. Examples are testing facilities and laboratories. Industry clusters in industrial parks may be able to pull this through more than those outside since space can be made available and basis for joint action and sharing of facilities already in place, i.e. common utilities, common services, and typically, a locators' association is established in each industrial park that can manage collective action.

### *8.1.5. Lack of local business organization or chamber of commerce in the area*

There are business organizations that are active in the country such as the Philippine Chamber of Commerce and Industry (PCCI), Semi-conductors and Electronics Industry Philippines, Inc. (SEIPI), Philippine Baking Industry Group, Desiccators' Association of the Philippines, PhilFoodex, Philippine Footwear Federation, Inc., among others. Regional, provincial and other local chapters should be established in order to cater to the needs of member firms in these areas. There are provincial based associations like the Cavite Tripartite Industrial Council, Laguna Chamber of Commerce and Industry and the Quezon-Lucena Chamber of Commerce Inc. However, the fact that they were not mentioned by any of the firms interviewed suggests that they have not penetrated the collective consciousness of most of the firms in their respective areas and their activities are not yet inclusive. It is laudable that in

Laguna, the provincial government is promoting a "Culture of Excellence" in the province with the private sector as active partners. Data show that representatives from the private sector participate in the Laguna Area and Productivity Council (LAPC) and have co-founded the Laguna Employment and Manpower Development Council (LEMDC). The former seeks to improve the productivity of those currently employed in the business sector, government sector, cooperatives and sectoral associations, and academe. Its most recent project is industry clustering and value chain analysis. LEMDC, on the other hand, provides skills training to out-of-school youth so that they can enter the labor force as well as retraining and upgrading to retrenched or laid off workers.

These associations should also be encouraged to pursue R&D activities. For example, the PCCI's commitment to FilipINNOVATION was to pass a resolution promoting the establishment of technology business incubators targeting SMEs. They intend to tap the DOST and universities in implementing a national business incubation program, promote the concept in their chapters and include this as a module in the PCCI Development Institute. Evidences of associations of Chinese businessmen/women and among Korean firms in the region were found, which could be encouraged to pursue R&D related activities. The role of local government units in this process should likewise be promoted as they can provide financial and logistic support.

## 8.2. At the ASEAN+6 Regional Level

### *8.2.1. On production networks*

Production and business linkages are very important for Philippine firms as sources of new ideas and knowledge based on the survey results and was also found to have positive and significant correlation with innovation. A policy suggestion is for the concerned economies in the region to cooperate in pursuing further intra-regional trade among them, with governments facilitating business matching or sourcing out information on regional suppliers and getting information on markets for local products. In the case of the Philippines, these are mandates of the Department of Trade and Industry and other related-instrumentalities of the government and perhaps by the

industry associations, but more focus is proposed to be directed to tapping the opportunities specifically found in the region. Information and disseminating it effectively to firms especially in all parts of the country is important.

### *8.2.2. On costly equipment and supporting services for R&D*

Foster regional cooperation agreements that would facilitate lowering the cost of equipment and supporting services such as lowering tariffs, particularly with those economies that are technologically advanced and supplies these kinds of materials. Another possible area of cooperation wherein these more advanced economies could assist the less advanced is through the transfer of technologies that they already consider obsolete or near-obsolete but can still be used by the latter for more practical purposes like reverse engineering and research.

### *8.2.3. Benchmarking regional centers of excellence in Science education*

Facilitate exchange of knowledge and perhaps, even faculties, between local and regional academic institutions, particularly to those located in technology-advanced neighbors. If possible, benchmarking of curriculum (on S&T and others) can be done to upgrade the quality of education in technology-backward countries. Visiting fellowships or researchers' programs can likewise be pursued among public and private R&D institutions.

### *8.2.4. On Intellectual Property Rights*

Countries in the region with weak IPR culture like the Philippines can learn a lot from neighboring countries that have advanced IPR regimes. Sharing of knowledge and technical assistance in this area should well be undertaken in the spirit of cooperation.

### *8.2.5. On R&D financial resources*

More financially-capable neighboring countries and institutions therein with thrusts

towards S&T development, could establish a fund that can be tapped by government, universities, industry associations (on behalf of member firms), and RDIs for pursuing R&D activities from less technologically capable countries.

## NOTES

[i] The excellent assistance of Ms. Fatima del Prado in the writing of this paper is gratefully acknowledged. A big thank you also goes to Melalyn Cruzado-Mantaring and Michael Cabalfin for their inputs.

[ii] Reference is being made here to the ten country-members of the Association of South East Nations (ASEAN) and its partners, Japan, China, Korea, and India, plus Australia, and New Zealand.

[iii] Feldman (1999) provides an exhaustive review of approaches for measuring knowledge spillovers and proving that it is indeed, geographically mediated.

[iv] The succeeding discussion draws heavily from Macasaquit (2008).

[v] List of priority investment areas determined by the Regional Board of Investments of the Autonomous Region of Muslim Mindanao (ARMM).

[vi] Also done by PIDS in collaboration with the National Statistics Office under the auspices of the Economic Research Institute for ASEAN and East Asia and the Institute of Developing Economies.

[vii] Firms with an average total employment of 20 and over; as of 2006 CPBI.

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