Chapter 4

Innovation in the Automotive Sector of the Philippines

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CHAPTER 4

Innovation in the Automotive Sector of the Philippines

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The performance of the Philippine automotive industry has steadily improved after the Asian Crisis. However, relative to the performance of the automotive industry in other countries, the automotive sector in the country has languished. To understand the challenges being faced by the automotive assemblers, as well as parts and components manufacturers, the innovation capability and activities of selected establishments are analyzed following the framework developed by Bessant. This paper finds that despite having an awareness of the importance of technology and upgrading, some of the automotive firms are not able to translate this awareness into other technology activities.

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1. Introduction

The Philippine automotive sector is relatively small, in terms of share in value added in manufacturing, size (number of players), and production especially if compared to its ASEAN neighbors such as Thailand, Malaysia and Indonesia. But recognizing the backward and forward linkages of the sector, the government continues to promote its expansion and improve its competitiveness.

A major policy on the sector is the Motor Vehicle Development Program which aims to provide the automotive sector with comprehensive industrial policy and development direction. This law is adequate on promoting competitiveness and taking advantage of the tariff reduction schemes but seems to lack in supporting innovation in the automotive industry. And it does not help that, in the Philippine industries in general, the low R&D expenditure and the failing R&D indicators indicate how innovation is not getting enough attention in the country.

Nonetheless, a recent case of innovation in the Philippines is the electric jeepney. [Jeepney is a uniquely Filipino public transport]. This can be considered an innovation for local public utility vehicles in view of improving the fuel economy and reducing environmental impact. But other than this, innovation particularly in the automotive sector is not very active.

Innovation can be defined in terms of improvement or development of product, process, operations or systems, as well as formulation of technology strategies, to name a few. Innovation can be sourced within a company (internal), such as from its pool of engineers to R&D activities; or be acquired through linkages outside the company (external), through expertise coming from research institutes, universities or

other networks. It would be interesting to look closely into the innovation situation in automotive firms and to assess how these firms fare in terms of innovation capability.

This case study aims to provide a background of the automotive sector of the Philippines and to understand the challenges being faced by the automotive firms (assemblers and parts manufacturers) in terms of innovation. The paper uses the framework by Bessant, which classifies firms into different types depending on their innovation capability level. Specifically, a simple survey tool and an interview tool are used as audit tool for measuring innovation capability. Nine (9) firms from the automotive sector are selected and interviewed for the case study. Innovation activities and capabilities are analyzed in terms of patterns, similarities and differences among the 9 firms.

The paper is organized as follows: Section 2 gives a background on the Philippine automotive sector, including policies implemented by the government. It is followed by a section that presents the Philippine technology and innovation policy. The methodology and specific tools used in the analysis is explained next followed by Section 5 which presents the results of the audit tool. Section 6 discusses the analysis and findings while Section 7 presents implications for policy.

2. Background on the Automotive Industry of The Philippines

Before the 1950s, all motor vehicles in the Philippines were imported mainly from the US. It was in the early 1950s when importation of completely-built-up (CBU) vehicles in commercial scale was prohibited and importation of completely-knocked-

down (CKD) components was allowed. This paved the way for parts manufacturing and car assembly in the Philippine automotive industry.

Programs to develop the industry were implemented starting in early 1970s. Examples of this program include: increasing local content requirement to promote the domestic manufacture of automotive components, and promoting manufacturing activities with small and medium enterprises. From 12 vehicle assemblers in 1960, there are now 52 of them in this subsector, and there are 256 parts and components manufacturers. From an annual demand of about 10,000 units in 1960, the automotive industry was able to produce more than 160,000 vehicles in 1996 (an all time high).

From an economy's perspective, the transport sector - on average - accounts for only about 1 percent of total manufacturing gross value added.[1] Despite this small share to manufacturing GVA, the machinery and transport equipment industry has - on the average - accounted for 4 percent of total Philippine exports from 2000 to 2009. In 2008, the total value of exports by the machinery and transport sector has amounted to US$2.1 billion (F.O.B) beating out the garments sector as the second largest value of manufacturing export (Table 1).

[1] Food manufactures, Products of petroleum and coal and Manufacture of electrical machinery have the largest share to total manufacturing gross value added with 37 percent, 16 and 6 percent respectively.

Table 1:Philippine Exports by Major Commodity Group (Million US Dollars FOB)

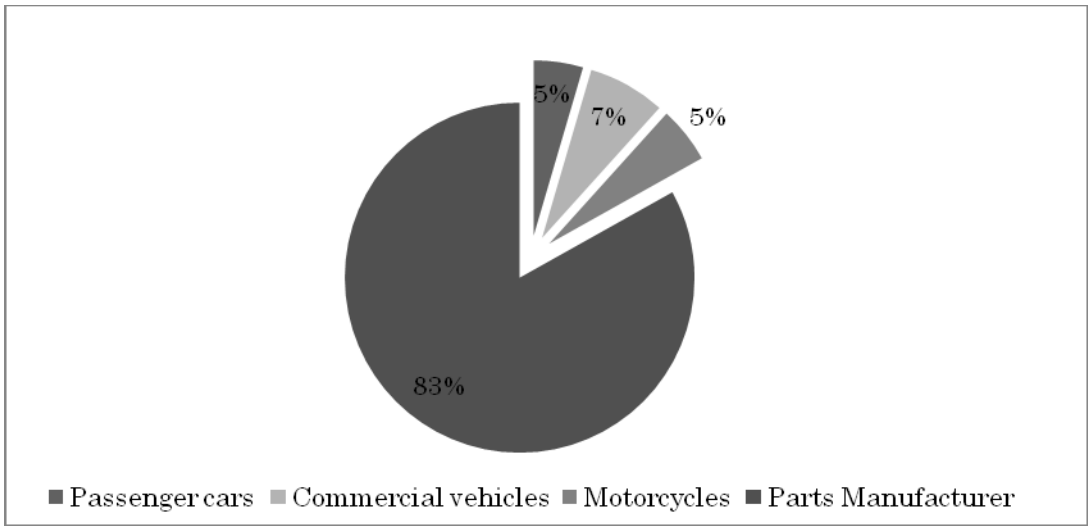
Commodity Group	2004	2005	2006	2007	2008
Agro-based Products	1,235	1,562	1,574	1,781	2,162
Other Agro-based Products	206	442	458	521	612
Forest Products	34	33	28	34	34
Mineral Products	757	819	2,103	2,605	2,498
Petroleum Products	381	586	918	1,109	1,240
Manufactures	33,604	36,955	39,722	41,769	40,999
Of which machinery and transport	1,603	1,835	1,715	1,854	2,113
Of which garments	217	2,309	2,646	2,300	1,949
Of which electronics	27,871	28,499	29,683	31,085	29,927
Total Exports	37,326	41,255	47,410	50,433	49,078

Source: *Philippine Statistical Yearbook.*

Still, in terms of number of players, the sector is considered small. Currently, there are only about 308 industry players in the automotive sector (excluding authorized dealers). Figure 1 presents the distribution of the industry players according to sub-industries. As can be gleaned in figure 1, the automotive industry in the Philippines is composed of two sub-sectors: 1. the vehicle assemblers (passenger cars, commercial vehicles[2] and motorcycles) accounting for about 17 percent of the total industry players; and 2. the parts and components manufacturers which accounts for more than 80 percent of the firms in the automotive sector. Aldaba (2007) recognizes this dichotomy of the industry in terms of access to technology. Aldaba mentions that a small number of assemblers have access to the best industry practices and state-of-the-art equipment and technology, while a large group of parts manufacturers are mostly small and medium enterprises that have low technology levels and face problems of limited capital, low productivity and lack of skilled workers.

[2] Refer to utility vehicles; sports utility vehicles; Asian utility vehicles; Philippine utility vehicles; pick-ups; commuter vans; light, medium and heavy trucks and buses; and special purpose vehicles.

Figure 1:Distribution of Industry Players, 2007



Source: Philauto, *The Philippine Automotive Industry Profile*.

Despite the relatively small size and lackluster performance of the automotive industry, the Philippine government has consistently issued policies aimed at improving the performance and increasing the size of the sector.[3] The most recent of these policies would be the New Motor Vehicle Development Plan which provides incentives like tax breaks offered in free trade zone areas, income tax holidays, duty drawback arrangements and other benefits in order to encourage them to continue business in the Philippines.

The Philippine government has recognized the importance of the sector because of its deep forward and backward linkages. The backward linkages are composed of the first tier industries that directly supply the needs of the local automotive industry, and the second and third tier industries that are the subcontractors of the first tier as well as providers of the raw materials that are needed by the first tier. The forward linkages include shippers, forwarders, dealers and other upstream services.

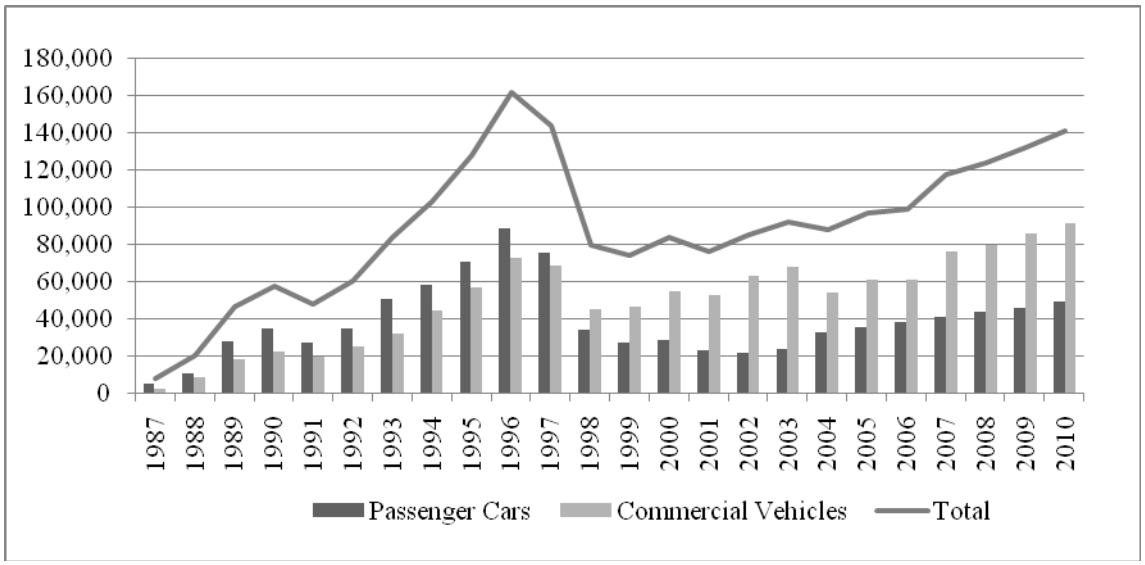
[3] Aldaba (2008) has listed a number of policies dating back from 1970s all focusing on improving the sector.

2.1. Automotive Assemblers

There are 52 manufacturers of passenger cars, commercial vehicles and motorcycles in the industry, 14 of which are car assemblers. Major vehicle assemblers are composed of five Japanese companies – Toyota, Mitsubishi, Honda, Isuzu, and Nissan; one American company – Ford Motors; and one Korean company – Hyundai, which has been increasing its market share in recent years.

The Philippine automotive industry experienced its highest vehicle sales in 1996, with over 160,000 units sold, 55 percent of which were passenger cars while the remaining 45 percent were commercial vehicles. Sales declined during the 1997 Asian crisis, but have been showing gradual improvement in recent years. From 1998 to 2010, sales increased by 76 percent. Units sold reached over 100,000 in 2007 and has since been increasing annually by 6 percent on average. Sales increased by 7 percent from 132,444 units in 2009 to 141,218 units in October 2010. In addition, sales in 2010 (October) is 20,000 units shy of the 162,087 high sales in 1996. Statistics also indicate that commercial vehicle sales dominated over passenger car sales starting 1998. Aldaba (2007) recounts that preference for commercial vehicles, such as AUVs, is due to their affordability, sturdy built and capacity to accommodate members of large Filipino households. Moreover, with its make, utility vehicles can withstand the poor condition of some road networks in the Philippines.

Figure 2: Vehicle Sales in the Philippines



Source: CAMPI Website.

Looking closely at the production side, domestically assembled vehicles (CKD) decreased since after 1997. Production picked up towards 2003 with 92 percent of total sales, but again declined to 49 percent towards 2009. Meanwhile, importation by domestic firms increased from 4 percent to 51 percent of total sales in the recent decade. This importation was facilitated by the implementation of tariff schemes in the ASEAN, such as the Common Effective Preferential Treatment (CEPT) under the ASEAN Free Trade Agreements (AFTA).

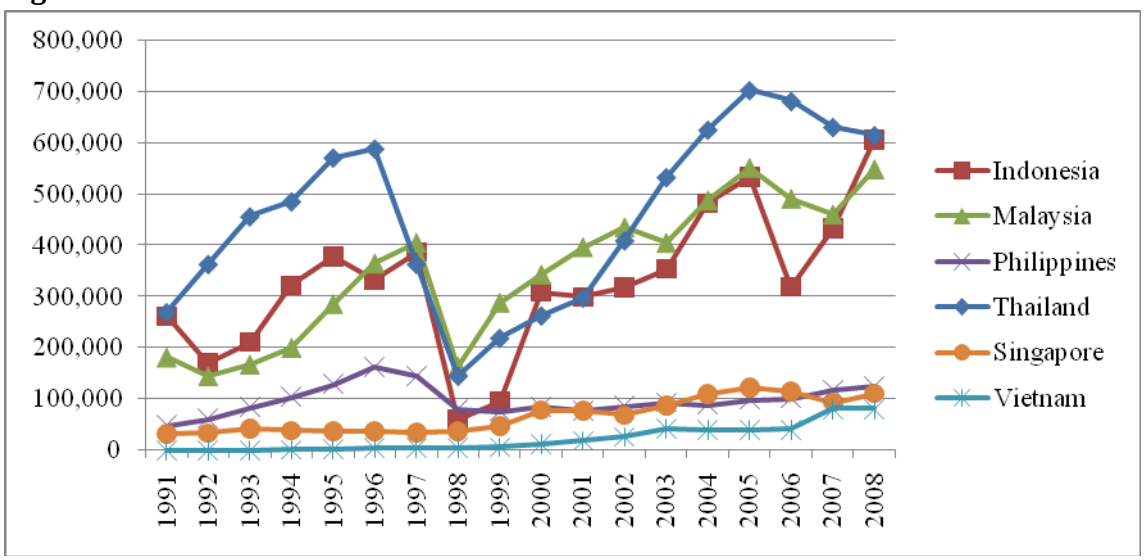
Table 2: Production and Importation of Vehicles

Year	Sales	Production/CKD Sales	New CBU Imports	CBU Imports as % of total Sales	CKD Sales as% of total Sales
1991	47,949	47,008	941	2	98
1992	60,360	58,899	1,461	2	98
1993	83,811	82,202	1,609	2	98
1994	103,471	99,346	4,125	4	96
1995	128,162	127,016	1,146	1	99
1996	162,095	137,365	24,730	15	85
1997	144,435	120,488	23,947	17	83
1998	80,231	67,903	12,328	15	85
1999	74,414	64,635	9,779	13	87
2000	74,000	70,851	3,149	4	96
2001	76,670	65,202	11,468	15	85
2002	85,587	74,734	10,853	13	87
2003	92,336	85,388	6,948	8	92
2004	88,068	58,822	29,246	33	67
2005	97,063	58,566	38,497	40	60
2006	99,541	56,050	43,491	44	56
2007	117,903	61,128	56,775	48	52
2008	124,449	61,513	62,936	51	49
2009	132,444	64,498	67,946	51	49

Source: Table 1 in Aldaba (2008) update by the same author.

From a regional view, vehicle sales in the Philippines have been lagging behind its neighbors in ASEAN. Even if sales around the region declined sharply during the 1997 Asian financial crisis, Indonesia, Malaysia and Thailand showed strong recovery, with Singapore catching up in recent years. Sales in the Philippines, however, have been slow to recover. While in Viet Nam, sales increased by 92 percent from 2006 to 2007. It was assessed that after the Asian financial crisis in 1997, the Philippine automotive industry operated below its total capacity and suffered from a weakened demand.

Figure 3: Vehicle Sales in Selected ASEAN Countries



Source: Various country websites.

The Philippines exports passenger cars – mostly those with spark ignition combustion engine exceeding 1500 cc but not more than 3000 cc – sent to Thailand and Indonesia, under the ASEAN Industrial Cooperation Scheme or AICO.[4] Aldaba (2008) reports that the sector experienced an increase in exports from 12,367 units in 2003 to 14,417 units in 2005, then a drop to 6,730 units in 2006. There is one firm, Ford Motors, which exports volume CBU. Major automotive players have expressed that, even with incentives, it is difficult for them to export locally-assembled CBUs. Apparently, the exports market has become difficult to enter because of AFTA as well as JPEPA. This suggests that at this point, improving competitiveness needs further attention than provision of incentives.[5]

2.2. Auto Parts and Components

[4] The AICO scheme is an industrial cooperation program of ASEAN to promote joint manufacturing industrial activities between ASEAN-based companies. The major privilege of this scheme is that approved AICO products, output of an AICO arrangement, shall enjoy preferential tariff rates of 0-5%. (www.aseansec.org)

[5] Cahiles-Magkilat, B.(2011) "PH assemblers find exporting CBUs hard," Manila Bulletin Newspaper Online, January 1, 2011. <http://www.mb.com.ph/articles/295936/ph-assemblers-find-exporting-CBUs-hard>, accessed January 5, 2011.

The Philippine automotive industry is composed of 256 firms that manufacture auto parts and components. Among this number, 124 are first-tier suppliers (of the domestic automotive assemblers), while 132 are second- and third-tier suppliers (of the first-tier manufacturers), mostly small and medium enterprises (Aldaba 2008). These firms are engaged in metalworking, rubber, seats and trims, plastics, electrical systems for automotives. The products they manufacture include:[6]

- suspension: tires, steel rims, aluminum wheels, leaf and coil springs
- interior: carpets and seats
- electrical system: wiring harnesses, batteries, lamps and relays
- pressed components: mufflers, radiators, seats, frames, seat adjusters, oil and air filters, pedals
- rubber and plastic components: fan belts, rubber hoses and small plastic parts
- mechanical parts: transmission, engine parts, etc.
- cast and forged components: gear blanks, brake disks, brake drums.

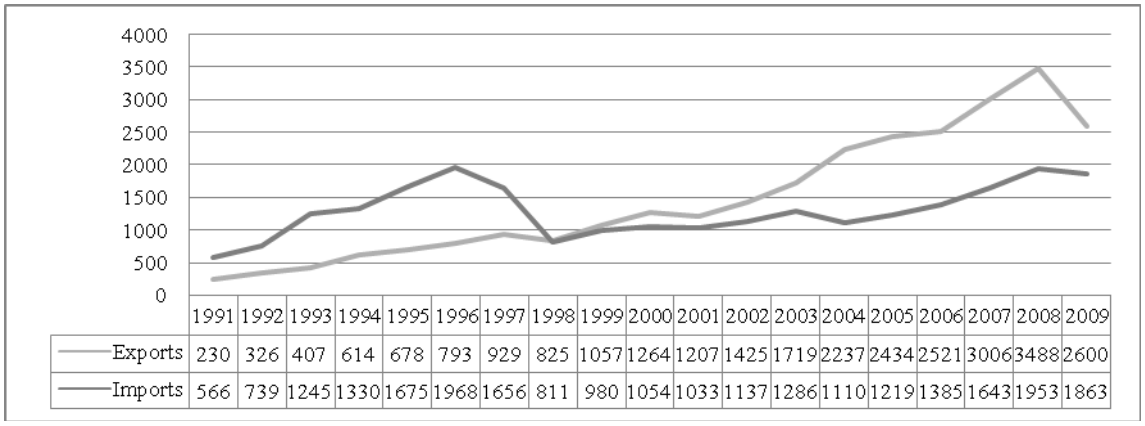
These firms can be further subdivided in terms of ownership. Some of them are 100 percent Filipino owned firms - such as the SMEs, and there are firms that are affiliated with multinational companies - for instance, firms from Japan that were brought in to supply parts and components to the mother firm (e.g. car assembler) in the country or abroad, as part of vertical integration. Major auto parts and components manufacturers include: Yazaki-Torres Manufacturing Corp. (wiring harness), United Technologies Automotive Phils. (wiring harness), Temic Automotive (Phils.) Inc. (anti-brake lock system), Honda Engine Manufacturing Phils., Inc. (engines), Asian Transmission Corp. (automotive transmissions), Toyota AutopartsPhils. (automotive

[6] Aldaba (2007); Raymundo (2004).

transmission), Fujitsu Ten Corp. of the Phils. (car stereos) and Aichi Forging Co., Inc. (forged parts) (Aldaba 2007).

Auto parts and components are exported to ASEAN countries such as Thailand, Singapore, Viet Nam, and to Taiwan, the US, Japan and Europe. Figure 4 illustrates that the values of exports have been steadily increasing from 1991 to 2009, with an average annual increase of 17 percent. The bulk of exports are wiring harnesses and brakes, registering 26 percent and 21 percent of total exports in 2008, respectively (details on the products exported are in Appendix A1). Value of total exports of automotive parts and components in 2008 was US$3.5 billion.

Figure 4: Value of Exports and Imports of Automotive Parts and Components (in million USD)



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Exports	230	326	407	614	678	793	929	825	1057	1264	1207	1425	1719	2237	2434	2521	3006	3488	2600
Imports	566	739	1245	1330	1675	1968	1656	811	980	1054	1033	1137	1286	1110	1219	1385	1643	1953	1863

Source: CAMPI.

In terms of imports, the sector saw a drop in level of importation in 1997 (by 16%), which continued until 1998 (by 51%). Clearly, the Asian financial crisis in 1997 impacted on the importation of motor parts and components. But importation levels are slowly picking up with an average annual increase of about 12 percent (except for a 14% decrease in 2003-2004). In 2008, almost US$2 billion value of imports of auto

parts and components was recorded. Passenger motor vehicle parts and components, and other motor vehicle parts form bulk of imports (both almost 63% of total value) in 2008 (details on the products exported are in Appendix A2).

2.3. Policies in the Philippine Automotive Industry[7]

From 1916 to 1950, automobiles in the Philippines were imported mainly from the US. There was no production activity in the sector, and distributors and dealers of imported CBU units existed. However, the government had to eventually prohibit the commercial scale importation of CBU vehicles due to the depletion of foreign reserves. The Import Control Law of 1950 was then amended to prioritize the allocation of foreign currency for imports. For the automotive sctor in particular, importation of CKD car components was only allowed for automotive assemblers that were given foreign currency allocation.

Subsequently, formal policies and legislations that helped shape the Philippine automotive industry were implemented (Table 3). The first formal programs were implemented in 1973: the Progressive Car Manufacturing Program (PCMP), Progressing Truck Manufacturing Program (PTMP), and the Progressive Motorcycle Manufacturing Program (PMMP). These programs prohibited the importation of CBU vehicles and allowed the government to address the need to rationalize the industry by limiting the number of car assemblers (to 5 firms) by way of requiring local content for domestically assembled cars.

[7] This section draws heavily from Aldaba (2007) and Raymundo (2004).

Table 3: Policies in the Philippine Automotive Industry

Year	Program/ Policy	Objectives
1973	• Progressive Car Manufacturing Program (PCMP) • Progressive Truck Manufacturing Program (PTMP)	- increase local assemblers domestic content from 10 percent in1973 to 60 percent in 1976 - promote horizontal integration in the industry by the creation of new manufacturing activities among small and medium scale enterprises through subcontracting and transfer of technology - build up exports of manufactured products in a regional (ASEAN) automotive complementation program
1987	• Car Development Program (CDP) • Commercial Vehicle Development Program (CVDP)	- increase local assemblers domestic content from 32.26 percent in 1988 to 40 percent in 1990 - develop a viable automotive parts manufacturing industry - facilitate technology transfer and development - generate employment, make available reasonably priced passenger cars, and earn and save foreign exchange for the country
1990	• People's Car Program (PCP)	- include the assembly of smaller cars, named as people's car, or passenger cars with gasoline engine displacement of not more than 1200 cc - meet the minimum local content usage from 35% in 1991 to 51% in 1993
1992	• Luxury Car Program	- allow the entry of high end passenger cars defined as passenger cars with engine displacement greater than 2800 cc
1994	• ASEAN Industrial Joint Venture (AIJV) Scheme	- allow the entry of new assemblers under the ASEAN Industrial Joint Venture (AIJV) Scheme
1996	• Memorandum Order Number 346 • Car Development Program • Commercial Vehicle Development Program	- open up the closed vehicle categories to new participants and removed restrictions on the number of models and variants - terminate the foreign exchange and local content requirements under the CDP and CVDP in the year 2003
2002	• New Motor Vehicle Development Program (EO 156)	- ban the importation of all types of used motor vehicles and parts and components, except those that may be allowed under certain conditions - restructure the Most Favored Nation (MFN) tariff rates for motor vehicles and their raw materials and parts and components at such rates that will encourage the development of the Philippine motor vehicle industry. - restructure the current excise tax system for motor vehicles with the end view of creating a simple, fair and stable tax structure - continue the application of AICO scheme as maybe adopted by the Association of Southeast Asian Nations (ASEAN) - give incentives to assemblers and parts and components makers for the export of CBUs and parts and components
2003	• EO 262 • EO 244	- modify the tariff rates on motor vehicle parts and components - provide special incentives to certain CBU exports
2004	• EO 312	- modify EO 244 to expand coverage of CBU exports and provide special incentives for the export of certain CBUs

The country consequently saw an expansion in the automotive manufacturing industry with the implementation of these programs, and the government recognized the industry's potential to stimulate growth. However, in the mid 1980s, political crisis hit the country and eventually affected the economy. To revitalize the industry, the government replaced the PCMP program with the Car Development Program (CDP)

and the PTMP with the Commercial Vehicle Development Program (CVDP) in 1987. The government had more pronouncedly aimed to increase local content of assembled vehicles, earn and save foreign exchange, generate employment, and develop a viable automotive parts manufacturing industry. The programs that followed were basically amendments that provided for inclusion of new car categories, as well entry of new assemblers which allowed Malaysia's Proton to come in with a joint-venture with a Filipino firm (Autocorp Group), under the ASEAN Industrial Joint Venture (AIJV) Scheme.

In 1996, MO 346 was issued and this liberated the motor vehicle development programs. This memorandum order removed restrictions on the number of models and variants. In addition, with the Philippines' commitment to the Trade-related Investment Measures (TRIMs) in the WTO, the government terminated the foreign exchange and local content requirement in 2003.

In 2002, the government legislated EO 156 or the Motor Vehicle Development Program (MVDP) to provide the automotive industry with a comprehensive industrial policy and development direction. Under this executive order, the production and/or assembly of motor vehicles and other vehicle assemblies covered under the MVDP shall be in knocked down condition only. And, only brand-new Original Equipment Manufacturer (OEM) of knocked down parts and components for assembly purposes shall be eligible for importation under the program. The EO likewise expounded on requirements for new participants and declared relaxing of limitations on the number of models and variants. And, recognizing the continuing trade liberalization and intensifying competitive environment, the government enhanced EO 156 with the issuance of EO 877-A of 2010 or the Comprehensive Motor Vehicle Development

Program. This Program aims to address the need to strengthen the used vehicle importation prohibition under EO 156; to take advantage of tariff reduction schemes in ASEAN; to promote maximum scale integration of the production of motor vehicles, parts and components; and enhance privileges and benefits for the industry, among others.

Moreover, with the country's trade building up, the motor vehicle development programs that started under EO 156 incorporated provisions related to tariff rates (Table 3). The government initially imposed very high tariffs combined with import restrictions[8] in order to promote manufacturing of parts and components, and to protect local assemblers. Since then, with the country's trade commitments in WTO and AFTA-CEPT, tariff rates have gone down.

For instance, MFN tariff rate for motor vehicles was reduced from 50 percent in 1990 to 40 percent at present, while the AFTA-CEPT rate is 5 percent. Meanwhile, CKD parts for motor vehicles had a big drop in MFN rate from 30 percent to 3 percent in 1996-1997. However, this meant that imported parts became cheaper than locally-procured parts, thereby alarming domestic parts manufacturers, especially the SMEs. The government then increased the tariff rate to 7 percent in 1998, then 10 percent in 2000-2003, but later on had to be reduced to 3 percent in 2004 (the AFTA-CEPT rate is also 3%). This shows that at some point, the government had to postpone or reschedule reduction in tariffs for reasons such as clamor from the affected industry or changes in industrial policies.

As for other vehicles, such as CKD buses and trucks, tariffs were likewise reduced

[8] There are currently no existing import quotas on CBU and CKD vehicles. There is, however, prohibition on the importation of used cars, except if for returning residents or diplomats. Importation of used trucks, buses and special purpose vehicles is also allowed but is subject to approval by the Bureau of Import Services.

to a range of 3-20 percent; while for parts and components, tariffs were reduced from 20 percent in 1990 to 1 percent in 2004. For tariffs on locally manufactured auto parts under EO 262, MFN rates range from 10 percent to 30 percent. Wiring harness, seat belts, air conditioning machines, radiator and transmission assembly are some of the products with 30 percent MFN tariff rate and 5 percent AFTA-CEPT rate. This puts the AFTA-CEPT rate of locally manufactured parts from 3-5 percent in general.

At home, taxes imposed on motor vehicles increased from 10 percent to 12 percent in 2006. Excise taxes[9] are levied on imported and domestically assembles vehicles. In 2003, another law to rationalize the excise tax scheme was enacted. This law imposed an ad valorem tax on automobiles based on the manufacturer's/importer's selling price, net of excise and value-added taxes.

3. The Philippine Technology and Innovation Policy

Innovation has been receiving increasing attention in many developing countries as it has been recognized as an important factor in the process of modernization and industrialization. The experience of many developing countries like China and India has shown that the process of industrialization could be achieved faster through the paradigm shift from technology adoption to one of domestic knowledge production. Aside from the goal of rapid economic development through decentralization, there is the challenge of increasing globalization and competition. This challenge is more critical for firms which not only have more opportunities brought about by the access

[9] Internal tax imposed on the manufacture, sale or consumption of a commodity within the country.

to wider regional and global markets, but also face stiffer competitions from these same markets.

In order for local industries to survive and maximize the opportunities brought about by these broader markets, they must be able to adopt measures to modify production processes, introduce new products, initiate improved organizational systems and apply new marketing methods. These would entail a level of awareness in the firm of the need to improve their current capacities. Such awareness should then translate to an ability to identify external threats and opportunities, further strengthening of the firms potential to develop, acquire, effectively use and learn from technologies. Sources of technologies like network of suppliers, the academe and other research institutions should also be maximized.

In the Philippines, the status of innovation has been depressing. Table 4 presents some indicators of Research and Development in the country. From 1992, the trend for the number of research and development (R&D) personnel per million population has been decreasing. It has decreased sharply from 1996 to 2002 but has improved slightly in 2003 and 2005. This improvement, however, has been unable to restore the level of R&D personnel per million population to the 1990s level. The similar trend can be observed for the number of scientists and engineers per million population. In 1992, there were about 152 scientists and engineers per million population. This figure has decreased sharply to 90 scientists and engineers per million population in the span of 10 years. The most recent available estimate reflects some improvement to the 2002 figure, but it still far from the 1990s figure.

A report by the World Economic Forum compared the performance of the Philippine with those of its neighbors in Asia in terms of innovation as a component of

competitiveness. Their findings are in accord with the sad picture presented in the preceding paragraphs. The Global Competitiveness report of the World Economic Forum conducts a perception survey of industry organizations of different countries to evaluate the status of competitiveness within the country. Innovation is one element of their measure of competitiveness and has a number of dimensions. Table 5 presents a comparative ranking of the Philippines relative to other ASEAN and East Asian countries across all these dimensions. Among the 7 dimensions for innovation, the Philippines has been the farthest from number 1 in 6 dimensions, and one notch below the farthest in the remaining dimension.

Table 4: R&D Indicators

	1992	1996	2002	2003	2005
Total R&D Personnel (headcount)	15,610	15,837	9,325	14,388	14,087
No. of Scientists and Engineers (headcount)	9,960	11,215	7,203	8,866	10,690
Population Size (in million people)	65	72	80	82	85
No. of R&D Personnel per million population	239	220	116	176	165
No. of Scientists and Engineers per million population	152	156	90	108	125
GDP (current prices/ in million pesos)	1,351,559	2,171,922	3,963,873	4,316,402	5,444,039
GNP (current prices/ in million pesos)	1,375,838	2,261,339	4,218,883	4,631,479	5,248,064
Total R&D Expenditures (current prices/ in million pesos)	2,940.5	4,144.9	5,769.8	5,909.7	6,326.7
R&D Expenditures as % of GDP	0.22	0.19	0.15	0.14	0.12
R&D Expenditures as % of GNP	0.21	0.18	0.14	0.13	0.12

Source: *Philippine Statistical Yearbook.*

Table 5:Ranking of Selected Asian Countries (out of 139 countries) on Innovation Capability, 2010-2011

	Capacity for Innovation	Quality of Scientific Research Institutions	Company spending on R&D	University-industry collaboration in R&D	Government procurement of advanced technology products	Availability of scientists and engineers	Utility patents per million population
China	21	39	22	25	12	35	51
Japan	2	15	3	19	41	2	2
Korea	18	25	12	23	39	23	5
Taiwan, China	14	17	9	12	7	8	1
Indonesia	30	44	26	38	30	31	89
Malaysia	25	32	16	22	8	33	29
Philippines	**80**	**108**	**85**	**85**	**129**	**96**	**71**
Singapore	17	11	8	6	2	10	11
Thailand	56	59	48	42	59	40	65
Vietnam	32	63	33	62	18	66	87

Source: *The Global Competitiveness Report* Section XII Innovation, 2010-2011.

Although all the dimensions are critical and should be given appropriate attention, one should give extra notice to the Quality of Scientific Research Institutions and Government procurement of advanced technology products. Out of 139 countries in the list, the Philippines has ranked 108 and 129 respectively. This means that business leaders and heads of industries perceive the quality of research institutions in the Philippines to be really poor. It is no surprise therefore, that the linkages between research and development institutions and businesses and manufacturing firms are weak and limited. Paderanga (2009) explains that this points to the problem of lack of coordination among various stakeholders.

In terms of government procurement decisions, the business leaders perceive that the procurement decisions of government do not foster technical innovation in the country. This occurred despite the introduction of a number of Science and Technology Master Plans by the Department of Science and Technology.[10]

[10] "In terms of a policy framework that sets the S&T objectives and detailed guidelines for attaining these, the country has had four major ones so far since 1986. Currently, the long-term National

Zeroing on programs and policies promoting innovation in the automotive industry, the 2004-2010 Medium Term Philippine Development Plan (MTPDP) recognized the automotive sector as one of the major industrial sectors where investment should be promoted because of its forward and backward linkages.

The strategy adopted by the Philippines to improve its automotive sector was unlike that of Malaysia and Indonesia which attempted to institute their own car programs. For the Philippines, the strategy would be to attract multinational car companies to invest and set up production in the country. Examples of policies that allowed the entry of new assemblers in the market were The Car Development Program (CDP), CDP Category III, ASEAN Industrial Joint Venture (AIJV). The Car Development Program (CDP) allowed the entry of Honda, Daewoo, Daihatsu, Fiat and Kia. Under the CDP Category III, Mercedez-Benz, BMW and Volvo entered the market while Proton of Malaysia entered the AIJV. The entry of these new assemblers meant the influx of technology. This is because part of the agreement under the CDP was the utilization of an existing assembly facility or establishment of a new assembly facility (Lee U 2005).

Recently, the issue of climate change and sustainable energy has encouraged the automotive industry to innovate. The 2008 Forum of FilipINNOVATION recognized the need to innovate the local public utility vehicles in order to improve fuel economy and reduce environmental impact. A number of cities have initiated the use of Electric Jeeps in their routes as part of this initiative. On the part of the assemblers, one of the major issues for the manufacture of the electric jeep is the electric battery that they have to import. The challenge now for the automotive parts manufacturers is to design

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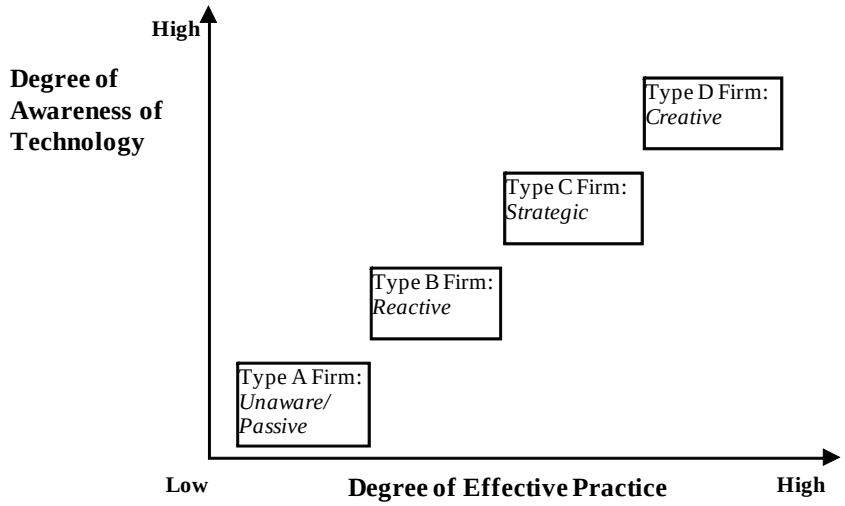
S&T Master Plan, 2002 to 2020 serves as the guiding framework for technology policy in the country." (Macasaquit 2010)

and manufacture a similar or better type of battery for the use of local assemblers. Another issue is also the high cost of manufacturing an electric jeep which is about 500,000 to 630,000.

4. Methodology

The study adopted the instrument for measuring innovation capability developed by Bessant *et al.* (2001) and applied by Hobday, Rush and Bessant (2002) in their analysis of the innovation capability of selected industries in Korea. With the use of three tools: the simple survey tool, interview tool and case study tool, the instrument, which is based on the framework presented in Figure 5, classifies firms into 4 different types depending on their innovation capability level.

Figure 5: Groups of Firms according to Technological Capability



Source: Bessant *et al.* (2001).

Type A firms are identified as Unaware/Passive firms because these firms have low degrees of awareness of technology and of effective practice of technology

development. These firms are less likely to survive against hostile, competitive and technology-driven environments because these firms are unaware of the need for technological development, or because these firms do not realize or recognize the need for technological development which is necessary for them to effectively compete. For Unaware or passive firms, there is an urgent need for a basic improvement program, the goal of which is to enable firms to recognize the need for change. These changes include the development of a strategic framework for manufacturing; and identifying, acquiring and implementing necessary technologies. Long term assistance should be provided in order to improve assembly capabilities and develop engineering skills. An environment where opportunities for progressing to product development should also be provided (Hobday *et al*. 2002).

Unlike Type A firms which are unaware of the need for technology development, Type B firms have a good comprehension of the need for technology development. Unfortunately, their understanding of the need for technology development does not translate into practice because of internal resource limitations. Type B firms are described as Reactive because they would normally face technological threats and possibilities with knee-jerk reactions and slight procedural adjustments without fully understanding the possibility of taking advantage of these events and situations for their own benefit. These firms are characterized by limited resources which include poor human capital (skills), lack of background and experience in technology, and underdeveloped external networks.

Because Reactive firms have limited resources to develop a strategic framework for technology, they should be given assistance in terms of crafting such a framework. This framework would guide them in facing technological threats and possibilities.

More than that, assistance should also be provided to strengthen their resources, technology experience and networks. In the long term, the assistance provided is expected to decrease as these firms will eventually develop an internal capability for technology development and innovation.

Type C firms not only have a deep awareness of the need for technological change but also have the ability to institutionalize the development and implementation of new projects and innovation systems. These firms have a strong ability to search, acquire, implement and improve technology because of their internally developed strategic technological framework. Type C firms are weak in terms of the ability to create new opportunities with the use of technology. Despite having a strategic technological framework, type C firms may have difficulty in finding and acquiring technology that is beyond their traditional line of business. However, they can easily build on their strengths to move beyond their comfort zones and expand into other markets.

Similar to Type B firms, Type C firms also need support in terms of developing internal capabilities, but the focus would be in terms of technical expertise and networks in order to strengthen R&D capabilities. Hobday*et al.* (2002) suggests access to technical and marketing expertise; link up with universities which have innovative ideas; network with specialist research and technology organizations on certain projects, be the kinds of assistance provided to these firms.

Type D firms are at the forefront of technology development, having technological capabilities that have been cultivated and well-developed. Because of this, they have a more pro-active approach in terms of changing the industrial environment through new and modern technology. Their strength lies in strong internal resources, high degree of absorptive capacity and extensive technology and market networks.

For Type D firms, the needed support focuses on strengthening their internal capabilities and ensuring that an enabling environment would sustain their position as market leaders in terms of innovation. These firms can also provide assistance to the government in terms of which strategic areas should be focused on and which policies should be implemented in order to develop the national innovation system. Hobday *et al*. (2002) cites the case of Singapore and UK as examples where the governments discuss programs and policies with leading industrialists from such firms.

The instrument isdesigned to focus on the innovation capability within firms. It is based on the understanding that firms operating in the same economic and political environment may have different levels of innovation due to a number of firm-level factors like firm policies, priorities and resources. By using the three tools, the instrument aims to obtain information on innovation capabilities within firms to generate insights into the development process.

Because of limitations in time and resources, only the simple survey tool and the interview tool were used in the conduct of this study. The simple survey tool is a perception survey administered to middle and top management personnel of the firm in order to gather their perception on a number of innovation related statements pertaining to their firm. Their responses are translated into numerical quantities in order to classify them according to the 4 types.

In order to better understand the dimensions where automotive firms need support and what type of policies are needed to enable them to improve in these dimensions, their degree of technological capability and innovativeness is further analyzed. This is accomplished by looking at the nine activities of technological capability which enable firms to choose and use technology to create competitive advantage. These activities

are categorized as follows:

1. Awareness of the need to improve
2. Search ability in relation to external threats and opportunities
3. The building of distinctive core capabilities
4. The development of a technology strategy to support the business
5. The ability to assess and select the appropriate technological solutions
6. The acquisition and absorption of the technologies in question
7. The implementation and effective use of the technologies
8. The ability to learn from experience in order to improve technological change capabilities
9. The ability to form and exploit linkages with a network of suppliers and collaborating firms.

The first of these activities is awareness. This refers to the importance of technology in maintaining a firm's level of competitiveness. Being aware of the need to improve also recognizes the fast-paced world of technology development and implies that a competitive firm keeps itself informed of important technological developments.

Related to awareness is the second activity, searching for technology trends or events which might challenge the competitiveness of the firm or provide opportunities for the firm to be more competitive. The firm takes a pro-active stance when it comes to technology development by assigning personnel to be responsible for seeking out technology events and trends. Building a core technological competence implies that the firm has identified, protected and maximized its strengths in terms of technology. Through these technological strengths, the firm has developed a comparative

advantage in certain areas of the business process.

Associated with developing a core technological competence is the firm's development of a technology strategy. A firm leading in business and innovation would have a technology strategy incorporated in its business strategy. The technology strategy states the visions, objectives and priorities in terms of technology. It would also include which technology to out-source and which to develop in-house.

A strong capacity to assess and select technology among the range of technological options available is one of the characteristics of a highly innovative firm. They are able to make comparisons among various options, and based on these, it would be able to identify which technology best suits their needs.

The next category of technology activity is about how a firm uses its resources to acquire the technology it has evaluated as best suited for its needs. Various techniques may be adopted: from as simple as purchasing the technology to as complicated as developing the technology through in-house research and development. A highly innovative firm is able to employ the various techniques in order to bring in technology from external resources or develop technology in-house.

Following the acquisition of technology would be implementation and absorption of the acquired technology in the firm. For the firm that has acquired the technology, implementation in the firm may involve different phases like further fine-tuning of the technology to meet the company's needs or various trainings to familiarize the entire organization. This process may be viewed as a big project that requires strong project management capability of the firm.

Apart from searching, acquiring and implementing technology, another important activity for the firm would be to learn from its (and other firms') experiences in

implementing technology-related projects. Highly innovative firms have a recognized and institutionalized system which allows them to further improve their business processes and strategy.

External sources of technology like consultancy companies, government research institutions and the academe may be sources of technology for the firm. A highly innovative firm has a well-developed network of these external sources of technology which it regularly consults. It has achieved a level of openness with these organizations that it shares knowledge in order to contribute to the further development of technology.

The following section presents the results of the application of the instrument to 9 automobile assemblers or parts and components manufacturers.

4.1. The Sample and Its Characteristics

For the purpose of this case study, 9 firms were selected and interviewed using the audit tool for measuring technological capability. The characteristics of these selected firms can be seen in Table 6.

Despite the small number of firms in the sample, the coverage of the selected firms was designed to provide different perspectives on innovation capability. For instance, Firms B and I are assemblers which have different characteristics and levels of innovation capability. The questionnaires were sent to a number of large automobile assemblers in the country. But because of some policy being implemented in their respective firms regarding participating in innovation surveys, the said firms have declined to participate in the study despite assurances that the names and certain details about their establishment shall be withheld in the final report. Thus, the case of

assemblers for this study has been limited to one local assembler and one large automobile assembler.

Also included in the 9 firms are parts and components manufacturers (Firm C, Firm E, Firm F, and Firm G) which supply the needs of the assemblers. Other firms (Firms A, Firm D, and Firm H) could be classified as second or third tier firms or those that the parts and components manufacturers consider as suppliers. Interesting insights can be derived by comparing the different levels of innovation within and across these groupings. Other possible groupings that could provide interesting insight would include ownership (Joint Venture, Filipino, Foreign owned), and employment size (Small, Medium, Large).

Table 6: Characteristics of Interviewed Firms

Key Questions	General products	Products	No. of Employees	Type of Ownership	Tier
Firm A	Molded rubber parts for the automotive and electronic industries	Grommets and covers for automotive wiring and harness, Boots, covers and seals for engine and transmission parts, O-rings and packings for filter systems, O-rings and packings for gas and water meters, Dampers, bush, caps and step rubbers for motorcycles, Packings, o-rings, cap breather, seals, base pad and grommets for power windows and antenna assemblies.	203	Joint-venture	2
Firm B	Electronic version of local public transport	Assmebles E-jeep	50	Filipino-owned	Assembler
Firm C	Automatic wires and parts manufacturing	Brake hose, power steering hose	410	Joint-venture	1
Firm D	Wireharness manufacturing	Wireharness manufacturing	309	Filipino-owned	2
Firm E	Plastic molded parts	Plastic molded parts	260	Joint-venture	1
Firm F	Automotive parts	Fans; motors	112	Foreign-owned	1
Firm G	Automotive parts	Electronic horn and other electronic products	1686	Foreign-owned	1
Firm H	Automotive parts	Manufacturing of wire harness	93	Joint-venture	2
Firm I	Automotive vehicles	Assembler	2164	Joint-venture	Assembler

Admittedly, the limited number of firms would not allow for conclusions about the general automotive industry of the country. However, the contribution of this analysis would be able to provide a snapshot of the automotive industry of the Philippines, and

to raise issues pertaining to innovation and technological capability that have been long over-looked and neglected.

5. Results of the Audit Tool

The selected establishments were asked to complete the Simple survey tool in order to be able to get an initial understanding of the firm's perception on technology and innovation capability. To further elaborate on the answers on the simple survey tool, interviews with the firm were conducted using the questions outlined in the interview tool. The following section summarizes the results of the audit tool. For each firm, diagrams of innovation capability shall be presented based on the simple survey and the interview tools.

5.1. Firm A

Firm A manufactures rubber products for the automotive and electronics industry like boots, covers and seals for engine and transmission parts. The establishment is a joint-venture between Japanese and Filipino stockholders. Based on the number of employees, Firm A can be classified as a large firm (more than 200 employees).

In terms of self-evaluation of innovation capability (as reflected by the results of the simple survey tool), Firm A is a Type C Strategic firm. However, its score (54) is on the lower end of the range (49-72) for a strategic firm. This implies that there may be a number of weaknesses in the different categories of technology activity. Thus, a detailed analysis is necessary. Table 7 presents the 9 different categories of technology activity and the score of Firm A for each of these categories.

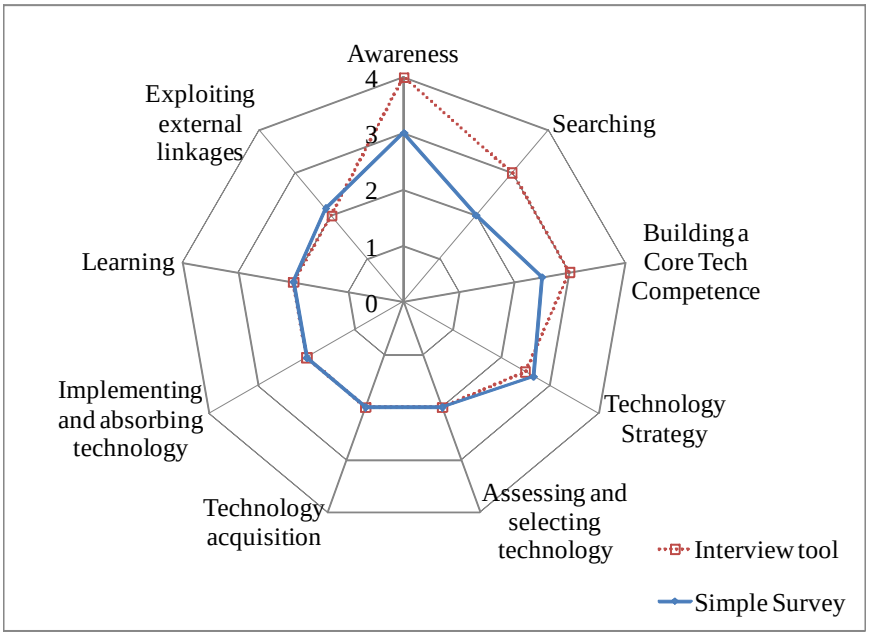
Table 7: Results of Simple Survey Tool for Firm A

	Best Practice	Firm A Score	Percentage
Awareness	8	6	0.75
Search	8	4	0.5
Building a core technological competence	8	5	0.63
Technology strategy	12	8	0.67
Assessing and selecting technology	8	4	0.5
Technology acquisition	8	4	0.5
Implementing and absorbing technology	8	4	0.5
Learning	12	6	0.5
Exploiting external linkages and objectives	24	13	0.54

As can be seen from Table 7, Firm A has performed strongest in terms of awareness (75 percent of best practice score) followed by technology strategy (67 percent) and building a core technological competence (63 percent). Firm A has scored 50 percent for all the remaining five categories of technology activity, except for Exploiting external linkages and objectives which is the activity where Firm A has scored 54 percent.

To probe deeper into the meaning of these scores, the interview tool was used. The interview tool was structured in a way that for each of the category of technology activity, an interviewer's assessment should be provided by the interviewer. Based on the responses to the key questions, the author's evaluation of the innovation capability of Firm A is presented as Figure 6. Figure 6 shows that the strengths of Firm A are on Awareness (rating of 4), Searching (rating of 3), Building a core technological competence (rating of 3) while in all the other areas, the firm was given the rating of 2.

Figure 6: Results of Simple Survey Tool and Interview Tool for Firm A



From figure 6, it can be seen that there is very little discrepancy between the results of the simple survey tool and the interview tool. One interesting point that should be observed is that the interview tool has pointed out the strengths of Firm A.

The firm is aware of the importance of technology and is aware how far it is from the technological frontier. Admittedly, the firm has placed itself below the technological frontier for their type of business conceding the fact that some of their production processes have not been fully automated. This level of awareness gives Firm A an advantage against its competitors. Firm A is cognizant that there is some level of technology that it needs to target or implement in order for them to not be left behind.

The interview tool has allowed Firm A to mention some of the activities it has conducted in order to search for new or existing technologies that may be applicable to their company. The responses of Firm A have also indicated that it is aware of how technology allows the firm to meet the different designs and specifications required for

different products and markets. Apart from the usual sources of technology like forums and exhibits (locally and abroad), Firm A also uses linkages with customers and suppliers as sources of new technology. The limitation, perhaps, that Firm A is experiencing in terms of searching for the appropriate technology is evaluating the technology's applicability. This has been evident in its response on the simple survey tool on the items pertaining to search.

Another dimension of innovation capability where firm A has shown relative strength is in terms of building a core technological competence. The "ideal" firm which rates 4 in this dimension is able to offer something better (more efficient, cheaper, better quality) goods or services which other manufacturers cannot. Firm A has recognized that it is able to offer highly specialized production designs particular to the requirements of its customers because they utilize some technologies that other local firms in the same industry have not yet acquired. They are aware that in time, the other firms would be able to obtain these technologies. So, they periodically endeavor to update their machineries and existing technology. They have also incorporated technology development as one of the key areas in their business plan in order to emphasize the importance of technology in affecting their production, efficiency and competitiveness.

Unfortunately, in all the remaining areas, the rating of Firm A has somehow been unremarkable. This means that Firm A should focus in translating the awareness of the need for improvements in technology and the desire to improve technology into operational action plans. Taking the dimension of Learning as an example, the firm got a rating of 2. The reason being that although it mentions the conduct of project feasibility studies in order to capture learning from projects, the firm provided no other

process or structure in place that would enable knowledge gained from the conduct of a project to be stored and disseminated. The project feasibility study at the beginning would only allow limited transfer of learning because it is done at the beginning of the project and no project evaluation is conducted after.

5.2. Firm B

Firm B is a small (less than 100 employees), Filipino-owned assembler of the electronic version of the jeepney (local public utility vehicle). Based on its answer on the simple survey tool (Table 8), Firm B is ranked as Type CStrategic with a score of, the score of Firm B (69). From Table 8, Firm B has achieved a perfect score for Awareness, Assessing and selecting technology and technology acquisition. It has also garnered high scores (greater than 75 percent) for all the other categories of technology activity except for exploiting external linkages and objectives. For this category, the firm only scored 25 percent of the maximum possible score.

Table 8: Results of Simple Survey Tool for Firm B

Categories of Technology Activity	Best Practice	Firm B Scores	Percentage
Awareness	8	8	1
Search	8	6	0.75
Building a core technological competence	8	7	0.88
Technology strategy	12	10	0.83
Assessing and selecting technology	8	8	1
Technology acquisition	8	8	1
Implementing and absorbing technology	8	6	0.75
Learning	12	10	0.83
Exploiting external linkages and objectives	24	6	0.25

A detailed analysis of the categories of technology activity using the interview tool may provide a better assessment of the innovation capability of Firm B. Figure 7 presents the results of the Simple survey tool juxtaposed with the results of the interview tool. Comparing the results of the interview tool with that of the simple survey tool, it can be seen that there have been discrepancies between the ratings of the two tools. There have been dimensions of innovation capability where the simple survey tool is lower than the interview tool (i.e. Building a core competence, exploiting external linkages). In contrast, the interview tool results for assessing and selecting technology, technology acquisition, implementing and absorbing technology and learning has ratings lower than the simple survey tool. To reconcile the discrepancy, it would be beneficial to look at the explanations and the responses in the interview tool and also the questions in the simple survey tool. This strategy shall be applied to all cases where the ratings between the two tools do not coincide.

In terms of Assessing and selecting technology, there has been apprehension in giving the full rating of 4. The reason behind this rating is the fact that the decision to acquire the technology rests only on the owners of the firm with no clear criteria used for assessing the applicability of the technology except that in the long term, the

technology should not be bad for the environment.

For technology acquisition, the interview tool rating is one degree lower than the simple survey tool because the firm has been limited to acquiring technology from external sources. This implies that Firm B tends to rely on “tried and true” approaches, particularly for equipment purchases.

Firm B has mechanisms in place to enable learning and continuous improvement within the firm. Among these are allowing the participation of management in industry trade shows, exhibits or forums and engaging employees to undergo training. In terms of project reviews, the firm undertakes some basic reviews but these seem irregular and informal.

In terms of implementing and absorbing technology, although the respondent agrees (based on the simple survey tool) that they have a “good system for assessing technology projects,” the response from the interview tool fails to elaborate on the framework for risk management. This explains the lower rating of the interview tool relative to the simple survey tool.

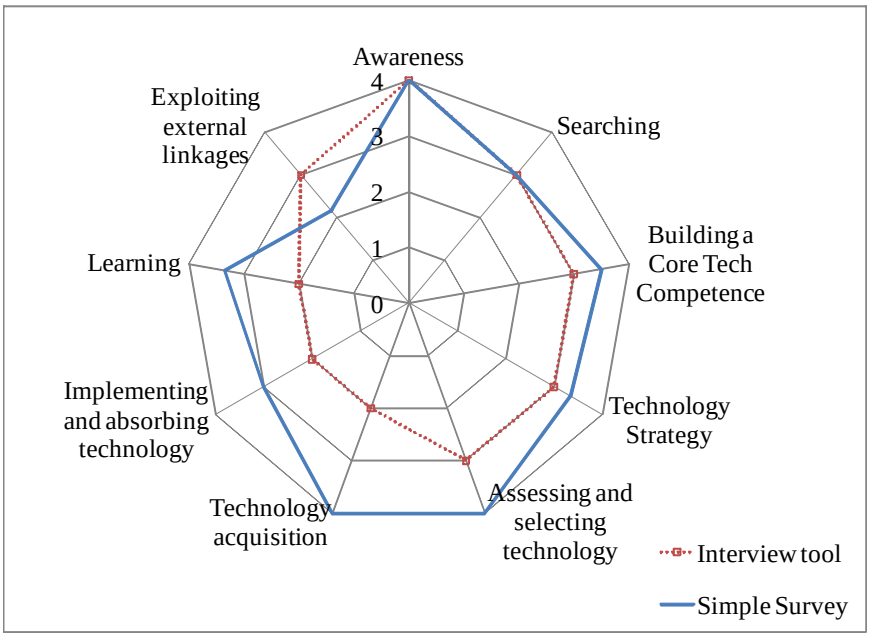
Regarding the external sources of technology, Firm B is aware of external sources of technology (i.e. their participation in numerous forums brought to their attention a type of fast-charging battery being manufactured in Taiwan). But this awareness of external sources is confined to a narrow field and occasional use. The simple survey tool actually indicates that Firm B has collaborations with universities and government research institutes regarding important technology projects.

There is also a slight discrepancy between the ratings for Building a core technological competence. The rating for the interview tool is based on the capability of Firm B to provide a product or service that its competitors are not able to provide.

The respondents relate that they were able to service electric jeeps produced by other manufacturers because of their capability to provide after-sales services.

Finally, the two tools agreed on the ratings for awareness and searching. The firm realizes the importance of technology in order to rise above its competitors. Technology upgrading would also allow the firm to expand to the production of electric tricycles. This level of awareness and appreciation of technology reflects the maximum rating on awareness.

Figure 7: Results of Simple Survey Tool and Interview Tool for Firm B



5.3. Firm C

Firm C is a large firm (more than 200 employees) which manufactures automotive parts and components, specifically, brake and power steering hoses. Similar to Firm A, it is a joint venture between Filipino and Japanese stockholders.

Table 9: Results of Simple Survey Tool for Firm C

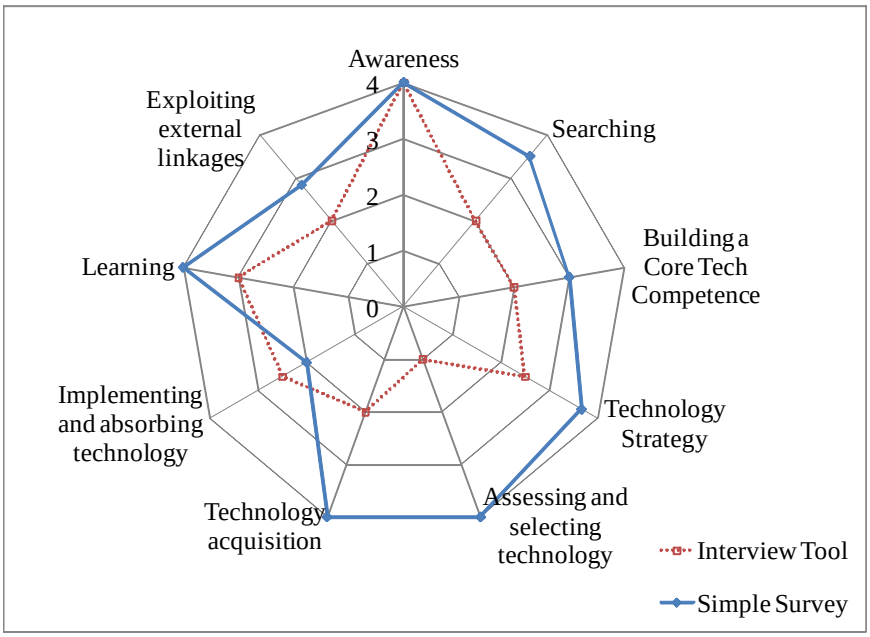
	Best Practice	Firm C Scores	Percentage
Awareness	8	8	1
Search	8	7	0.88
Building a core technological competence	8	6	0.75
Technology strategy	12	11	0.92
Assessing and selecting technology	8	8	1
Technology acquisition	8	8	1
Implementing and absorbing technology	8	4	0.5
Learning	12	12	1
Exploiting external linkages and objectives	24	17	0.71

Based on the results of the simple survey tool, Firm C can be classified as a Type D Creative firm. It scored a perfect score in the following indicators: awareness, assessing and selecting technology, technology acquisition and learning. On the other hand, Firm C scored lowest on implementing and absorbing technology (50 percent) and on exploiting external linkages and objectives (71 percent). However, similar to Firm B, there have been discrepancies on the results of the Simple survey tool and the interview tool. Figure 8 presents a comparison of the results of the two tools.

From Figure 8, the two tools agree on the degree of awareness (having a rating of 4 for both tools). The discrepancy between the two tools is relatively small for implementing and absorbing technology. The discrepancy has been largest for assessing and selecting technology and technology acquisition.

Firm C obtained a perfect score for awareness because it has displayed an appreciation of the contribution of technology to its competitiveness. The firm was also aware of its location in the technology frontier for its business, describing itself as a leading local firm in terms of technology. Relative to other foreign countries, however, the firm is still lagging behind in terms of the use of more modern technology.

Figure 8: Results of Simple Survey Tool and Interview Tool for Firm C



Because Firm C manufactures highly specialized rubber products specific to the demands and specifications of the customers, it faces limited competition in terms of the manufacture of these products. The firm also relies on its mother company (in Japan) for information and the supply of technology. These factors have resulted in some sense of complacency and dependence on the mother company on the part of the firm. This has reduced its activities on searching for new and modern technology, building a core technological competence, technology strategy, assessing and selecting technology and technology acquisition. This is the reason why the interviewer's rating for these innovation activities of the firm has been relatively lower than the results of the simple survey tool.

The reliance on the mother company has also contributed to the weak linkages with other sources of technology. The firm disagreed with statements 23 and 24 on the

simple survey tool pertaining to working with universities and governments research institutions respectively.

One bright spot for Firm C would be the activities it has undertaken to learn from the adoption of projects. They have a review and documentation system for each technology (machinery, equipment or process) in order to ensure that the knowledge derived from these would be available for the next projects, thus building upon the knowledge of derived from previous projects. To ensure continuous learning, the firm has also committed itself to frequent review of international standards and analyzes the applicability of these to the company.

5.4. Firm D

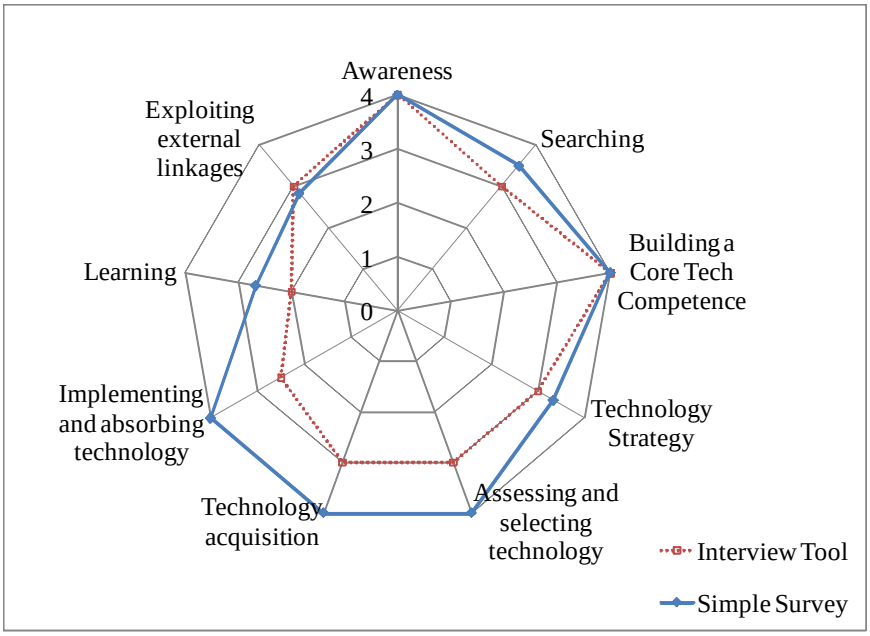
Similar to Firm C, Firm D is an automotive components and parts manufacturer, specifically manufacturing wire harnesses. With about 300 employees, it can be classified as a large firm. However, unlike Firm C, Firm D is a 100 percent Filipino firm.

The responses for Firm D show that it can be classified as a Type D Creative firm because of its perfect scores on Awareness, Building a core technological competence, Assessing and selecting technology, Technology acquisition and Implementing and absorbing technology. In terms of areas where it may need some improvement, Firm D has a relatively low score on Learning, and Exploiting external linkages and objectives.

Table 10: Results of Simple Survey Tool for Firm D

	Best Practice	Firm D Scores	Percentage
Awareness	8	8	1
Search	8	7	0.88
Building a core technological competence	8	8	1
Technology strategy	12	10	0.83
Assessing and selecting technology	8	8	1
Technology acquisition	8	8	1
Implementing and absorbing technology	8	8	1
Learning	12	8	0.67
Exploiting external linkages and objectives	24	17	0.71

Figure 9: Results of Simple Survey Tool and Interview Tool for Firm D



The results of the simple survey and interview tool have been relatively consistent for awareness, building a core technological competence (rating of 4 for both tools) and exploiting external linkages (rating of 3 for both tools). It also has relatively close ratings for searching, technology strategy and learning. The discrepancy is largest for implementing and absorbing technology.

In terms of awareness, the firm ranked high because similar to firm C, Firm D is aware of the technological frontier for its industry. This level of awareness of the types

of technology available locally and internationally provides the firm a point of reference from which it can compare itself. The firm understands that it is able to meet the demands of the customers because of technology. Thus, they take a pro-active stance in the search for new and applicable technology. To accomplish this, the firm sends its managers abroad to attend exhibits and to keep track of the changes in technology.

The high ranking for building a core technological competence is due to the fact that the firm is aware that its distinctive competitive edge is not just about providing a low price. A large part of it is meeting the highly technical and specific demands of the customer. To protect their technological edge, the firm has sought to acquire ISO certifications. The firm also provides trainings (locally and abroad) to the technical staff, and they are required to attend these trainings in order for them to update their knowledge and sharpen their competitive edge.

The firm has perfect scores for assessing and selecting technology, technology acquisition and implementing and absorbing technology. Despite these glowing scores, the interviewer has apprehensions in providing such a ranking to Firm D because the description for a perfect score implies that the Firm leads the market in terms of technology and defines the technology frontier. This clearly does not apply to Firm D as it is still below the technology frontier. Still, one can consider Firm D as a highly innovative firm because it has a well-developed framework (taking into consideration not only price but also support service, applicability and long-term use) in terms of assessing and selecting technology; it acquires technology by purchasing equipment, it has familiarized itself with the technology of the machines and equipment so that it is able to implement in-house modifications on these technologies

in order to suit their needs for the production of other products. Firm D has been aware of external sources of technology, but it has been confined to a narrow field of use. This observation calls for the need to improve the linkages between universities, government research institutions and other stakeholders to ensure that the technologies that are produced and developed are in line with the needs of the firms. Learning activities is one weakness of Firm D as reflected in the irregular and informal project reviews it conducts.

5.5. Firm E

Firm E manufactures plastic molded parts as inputs for automotive parts. Firm E is a large firm with more than 200 employees. It is a joint venture between Filipino and Japanese stockholders.

Table 11: Results of Simple Survey Tool for Firm E

	Best Practice	Firm E Scores	Percentage
Awareness	8	6	0.75
Search	8	6	0.75
Building a core technological competence	8	6	0.75
Technology strategy	12	11	0.92
Assessing and selecting technology	8	6	0.75
Technology acquisition	8	6	0.75
Implementing and absorbing technology	8	6	0.75
Learning	12	9	0.75
Exploiting external linkages and objectives	24	18	0.75

Garnering a total self-perception rating of 74, Firm E can be classified as type D Creative. But like the first few firms, it would be at the lower end of the spectrum for Creative firms. It has perceived Technology strategy as its area of strength. In terms of all the other areas, Firm E has scored about 75 percent (Table 11).

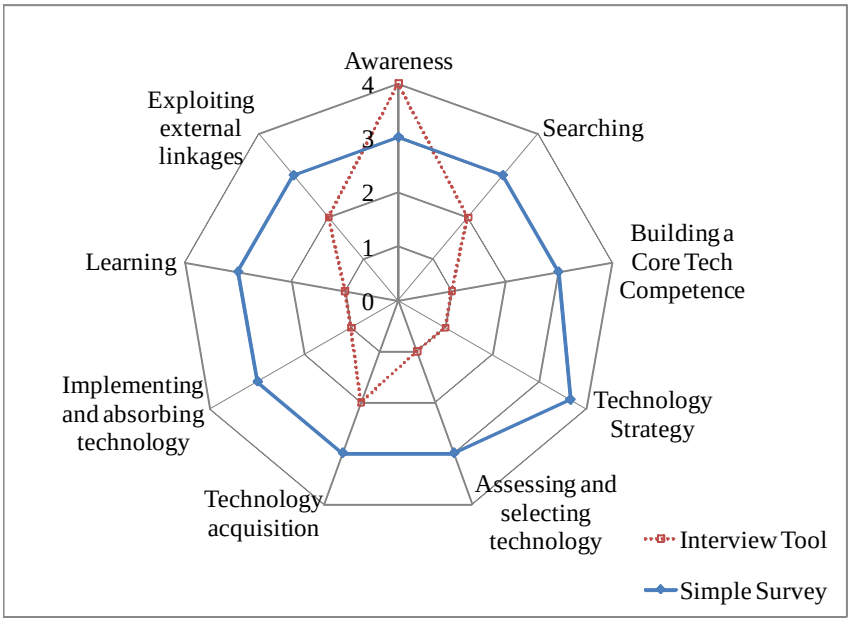
Further analysis using the interview tool shows that among the 9 activities of

innovation activity, Firm E is strongest in terms of awareness. It would be interesting to note, though, that it has not translated this awareness into innovation and technology development activities (Figure 10).

The main issue with Firm E is that its research and development is mainly dependent on its mother company (much like Firm C). Similarly, Firm E manufactures highly specific products which make competition limited. It seems that Firm E has more intense dependence on its mother company than Firm C. The processes for innovation and upgrading of the Firm lie solely on the mother company with very minimal input. This can be seen in the process by which they assess, select and acquire technology, which is mainly resting on the tried and true methods without exploring other new methods.

The discrepancy can then be explained by the fact that the respondent sees the mother company and the local company as just one entity. In contrast, the interviewer sees the local company as a separate entity that should be engaging in upgrading and innovation with the support and leadership by the mother company. For instance, in terms of using technology, the respondent mentioned that the local firm has limited linkages with university and government research institutions, but the mother company is more likely to interact with these research and development bodies. With the perception that the Mother Company and local company are just one entity, the responses in the simple survey tool reflect a higher score than the responses in the interview tool which views the identities of the two companies separately.

Figure 10: Results of Simple Survey Tool and Interview Tool for Firm E



5.6. Firm F

Firm F is a foreign-owned firm with more than 100 employees. Firm F manufactures fans which are used as inputs for the manufacture of automotive engines. Based on the results of the simple survey tool, Firm F can be classified as a type D Creative firm.

Table 12 shows that the strengths of Firm F are in terms of Awareness, Assessing and selecting technology and learning. Search, Building a core technological competence, implementing and absorbing technology and exploiting external linkages and objectives are among the weaker dimensions of Firm F.

The result of the interview tool is presented as Figure 11. Firm F is very much similar with Firm E (highly Mother Company reliant) and this can be seen in its performance in terms of assessing and selecting technology, technology acquisition, implementing and absorbing technology, learning and exploiting external linkages.

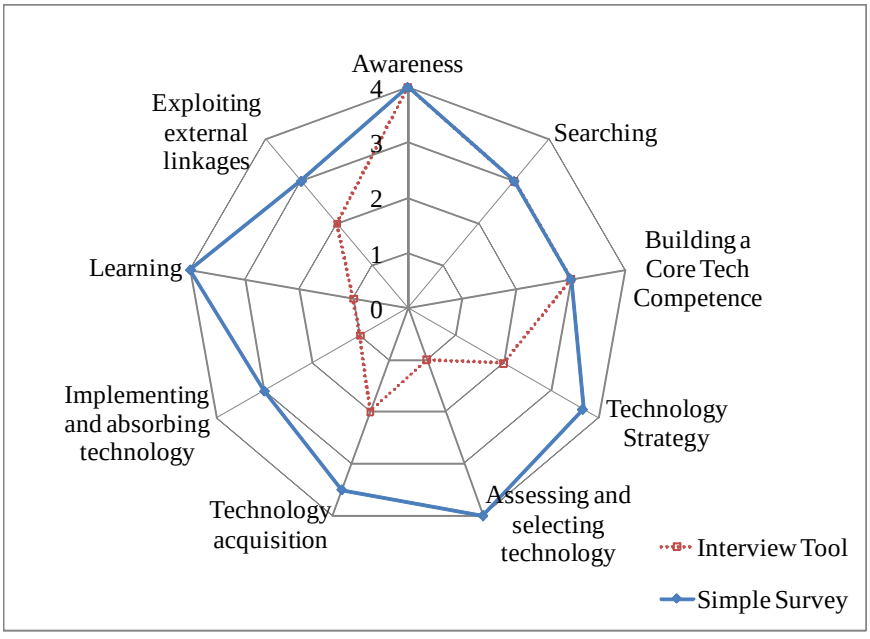
Firm F however has relatively high ratings in terms of awareness, searching and

building a core technology competence. Because the ratings of the interview tool and simple survey tool are consistent for these three dimensions, these activities may indeed be the strong points of Firm F upon which they can build on to improve the ratings in the other innovation and technology activities.

Table 12: Results of Simple Survey Tool for Firm F

	Best Practice	Firm F Scores	Percentage
Awareness	8	8	1
Search	8	6	0.75
Building a core technological competence	8	6	0.75
Technology strategy	12	11	0.92
Assessing and selecting technology	8	8	1
Technology acquisition	8	7	0.88
Implementing and absorbing technology	8	6	0.75
Learning	12	12	1
Exploiting external linkages and objectives	24	18	0.75

Figure 11: Results of Simple Survey Tool and Interview Tool for Firm F



Similar to all the earlier firms, Firm F acknowledges the importance of technology especially since they export their products to other countries. They face tough

competition so they rely on modern technology to be very competitive and maximize production with minimal rejects and other costs. The firm is confident that the technology that they have in their plants are comparable to the ones in other foreign companies because the source of these technology is their mother company who has a strong research and development team. The respondent has expressed openness to technology changes and development.

Despite relying on the research and development of the mother company for technology assessment, acquisition and adoption, Firm F still has its own research and development division that is in charge of searching for the appropriate technology that may be applicable to the firm. Apart from technology, the research and development division also develops some internal processes that may improve the efficiency of the company. Still, these processes and technology have to be forwarded to the Mother Company for evaluation and approval.

Apart from price, the firm understands that there are other important factors in maintaining its competitive advantage (like maintaining high quality in terms of production and ensuring on-time delivery). This implies that the firm understands the need to develop a competitive edge that can be protected. The firm is aware how technology helps (and they have an idea where and how to get it) but they have made limited moves on protecting their advantage.

5.7. Firm G

Firm G is a large, foreign-owned firm (more than 200 employees) producing electronic horns as automotive parts. The results of the simple survey tool show that Firm G is a type D Creative firm. It has garnered a score of 84 with Awareness,

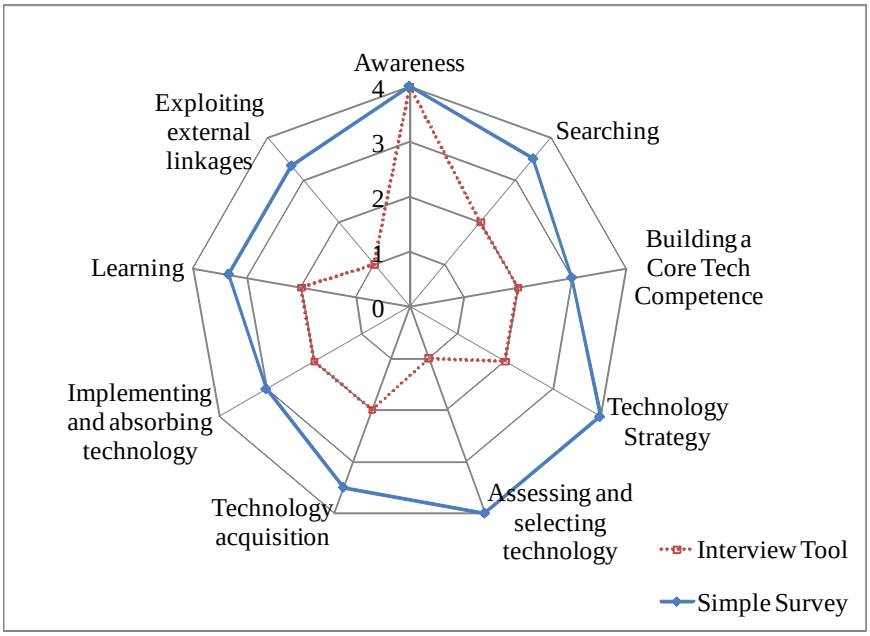
Technology Strategy and Assessing and selecting technology as the areas receiving a perfect score. The weakest (75 percent) areas for Firm G is Building a core technological competence and implementing and absorbing technology. Learning and Exploiting external linkages have also achieved a relatively low score (83 percent) (Table 13).

Table 13: Results of Simple Survey Tool for Firm G

	Best Practice	Firm G Scores	Percentage
Awareness	8	8	1
Search	8	7	0.88
Building a core technological competence	8	6	0.75
Technology strategy	12	12	1
Assessing and selecting technology	8	8	1
Technology acquisition	8	7	0.88
Implementing and absorbing technology	8	6	0.75
Learning	12	10	0.83
Exploiting external linkages and objectives	24	20	0.83

Based on the interview tool, the level of awareness of the importance of technology for Firm G is high (rating of 4). This indicates that Firm G greatly appreciates technology in terms of improving the efficiency of its production process. Unfortunately, it would seem that this awareness is not translated into other innovation activities mainly because of the limitations imposed by the mother company.

Figure 12: Results of Simple Survey Tool and Interview Tool for Firm G



In fact, one of the major weaknesses of Firm G is in terms of exploiting external linkages. Firm G responded to questions pertaining to the use of external sources of technology by saying that that technology is "closed to mother company's approval" indicating some limitations on the part of Firm G to make use of external sources of technology. This weakness can also be seen in the low rating given to assessing and selecting technology. Being highly dependent on the mother company's inputs on which technology to use, Firm G has not developed mechanisms to assess and select technology.[11]

5.8. Firm H

Firm H is a small automotive parts manufacturer producing wire harnesses. It is a joint venture between Japanese and Filipino stock holders.

[11] The discrepancy of the ratings of the Simple Survey tool and interview tool follows the explanation used for Firms C and D.

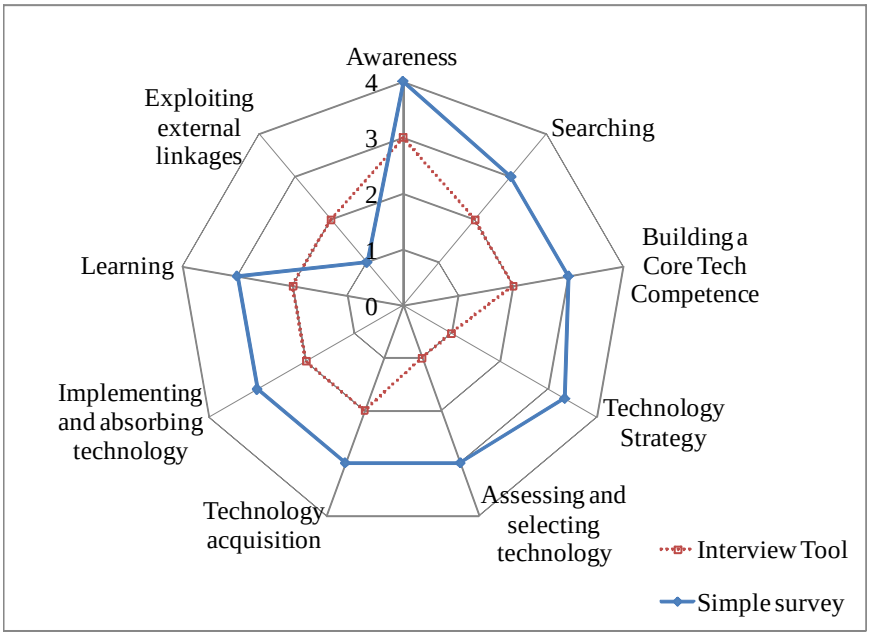
The results of the simple survey tool have classified Firm H as a Type C Strategic firm. Firm H strengths are Awareness (100 percent) and Technology strategy (83 percent) while exploiting external linkages and objectives is the dimension of innovation activity where it scored lowest (25 percent). However, according to the results of the interview tool, the weak points of Firm H are in terms of technology strategy and assessing and selecting technology.

The reason for a low rating in technology strategy is that Firm H has not incorporated its main technology strategy in its key strategic targets. The impression made by the respondent of Firm H is that they are not aware of a technology strategy in the first place.

Table 14: Results of Simple Survey Tool for Firm H

	Best Practice	Firm H Scores	Percentage
Awareness	8	8	1
Search	8	6	0.75
Building a core technological competence	8	6	0.75
Technology strategy	12	10	0.83
Assessing and selecting technology	8	6	0.75
Technology acquisition	8	6	0.75
Implementing and absorbing technology	8	6	0.75
Learning	12	9	0.75
Exploiting external linkages and objectives	24	6	0.25

Figure 13: Results of Simple Survey Tool and Interview Tool for Firm H



In terms of assessing and selecting technology, Firm H was given a low rating because the head of the firm assesses the technology that the firm would use. According to the respondent, it is the Japanese head who is more familiar with technology however the basis for assessing the technology is arbitrary and it is not communicated to the rest of the firm.

Firm H received relatively better ratings for technology acquisition, implementing and absorbing technology, learning and exploiting external linkages, despite that, Firm H is still relatively weak in terms of these activities. Firm H is able to bring in new technology into the company by allowing their managers and technical personnel to undergo training. The firm has relied on tried and true methods of bringing in external technology, and has not expanded their list of methods to consulting external experts. In terms of learning, Firm H undergoes basic reviews of its projects, but they follow no specific framework for risk management. Thus, most of the reviews are irregular and

informal. Firm H is aware of external sources of technology but are constrained by the impression that these technology are difficult to access and unsuitable for the firm.

5.9. Firm I

Firm I is a large (more than 200 employees) automotive assembler that is a joint-venture between Japanese and Filipino stockholders. The results of the simple survey tool indicate that Firm I is a Type D creative firm with a rating of 89 (Table 15).

Table 15: Results of Simple Survey Tool for Firm I

	Best Practice	Firm I Scores	Percentage
Awareness	8	7	0.88
Search	8	7	0.88
Building a core technological competence	8	7	0.88
Technology strategy	12	11	0.92
Assessing and selecting technology	8	8	1
Technology acquisition	8	8	1
Implementing and absorbing technology	8	7	0.88
Learning	12	11	0.92
Exploiting external linkages and objectives	24	23	0.96

The strength of Firm I is Assessing and selecting technology (100 percent), technology (100 percent) acquisition, exploiting external linkages (96 percent), technology strategy and learning (92 percent). For the remaining dimensions of technology activity, Firm I still has a relatively high score of 88 percent.

The results of the interview tool are consistent with the results of the simple survey tool. Firm I's knowledge about technology being used in other international automotive assemblers indicates a strong degree of awareness of the importance of technology. The respondent was able to identify the technology frontier and indicated that the Firm is still lagging behind other international assemblers about the use of technology.

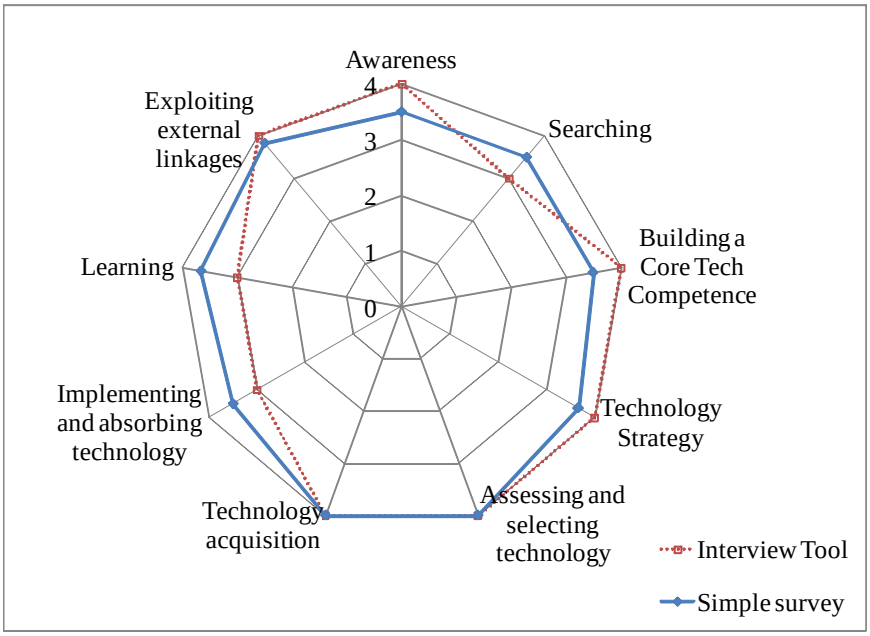
Searching for technology implies an understanding of the firm's customers and

meeting their needs. For Firm I, they believe that the customers choose to purchase their products not only because of the competitive price that they offer, but also because of other factors like advanced design and features, high quality of goods, availability of service parts and reliable after-sales service. This knowledge of the customer's needs influences the searching for the needed technology activity of the firm. One of the approaches that Firm I uses to search for technology is benchmarking with the technology being used by the Mother Company and other affiliates.

Among the examples of Firm I's competitive edge are its paint application system and its waste water technology. Because it has a number of affiliates around Asia, Firm I understands that there is a need to search continuously and constantly for other ways to improve. To create future advantage, they maintain benchmarking activities with the Mother Company and they are also currently rehabilitating their plants to improve their production processes. This implies that Firm I is building a strong core technological competence.

In terms of technology strategy, Firm I was able to relate the technological requirements of the firm to its strategic business targets. Thus, their process of assessing and selecting technology does not only depend on the availability and applicability of the technology, but also on the volume of production that is required of them to put out. Apart from these factors, Firm I also takes into account safety, equipment efficiency, return of investment (ROI), and even labor issues in assessing and selecting technology.

Figure 14: Results of Simple Survey Tool and Interview Tool for Firm I



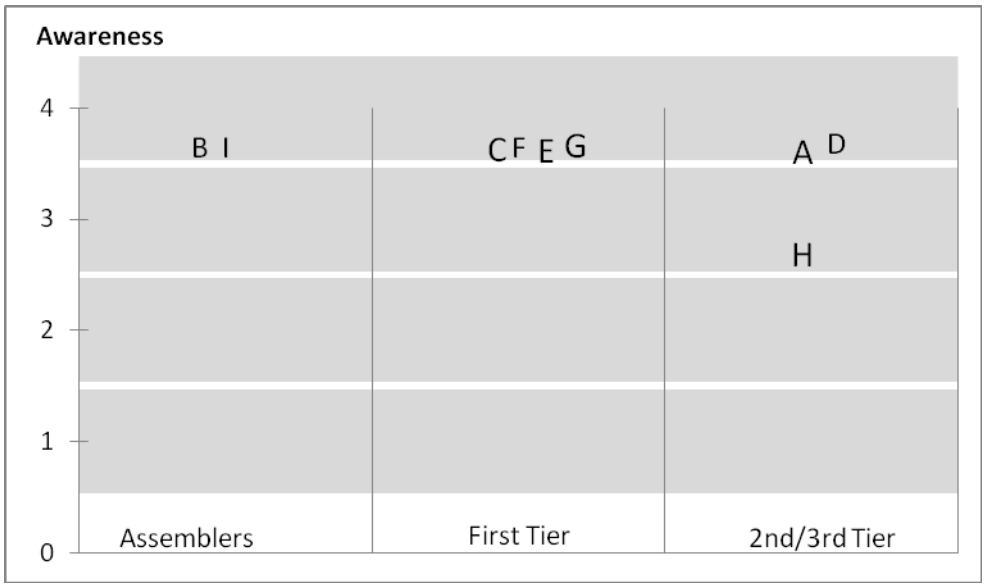
Firm I manages the process of bringing in outside technology by involving its purchasing department in handling costs and its Project leaders in handling the technical evaluation and production compliance. To ensure that knowledge is captured from their projects, the project leaders are involved in technical consultations with the Mother Company and Affiliates and even with its network of suppliers. Firm I does not only rely on purchasing of equipment as its method of bringing in technology. It also relies on local research and development that is capable of adopting the technology to its specific needs.

6. Analysis and Findings

The following section lists the findings about technology activities of automotive firms in the Philippines. These observations are made by looking at patterns, similarities and differences of the 9 firms included in the study.

All the surveyed firms in general have relatively high awareness of the importance of technology but some firms have not been able to translate this awareness into technological competence or innovation (Figure 15). Because of increasing competition and the rapid pace of technological development, firms cannot help to be drawn to technology as a means of improving their production process. However, as can be seen in the previous section, a number of firms have not converted their awareness into other activities like searching for technology, building a core technological competence, technology strategy, assessing and selecting technology and others.

Figure 15: Distribution of Firms by Awareness Score and Level of Production

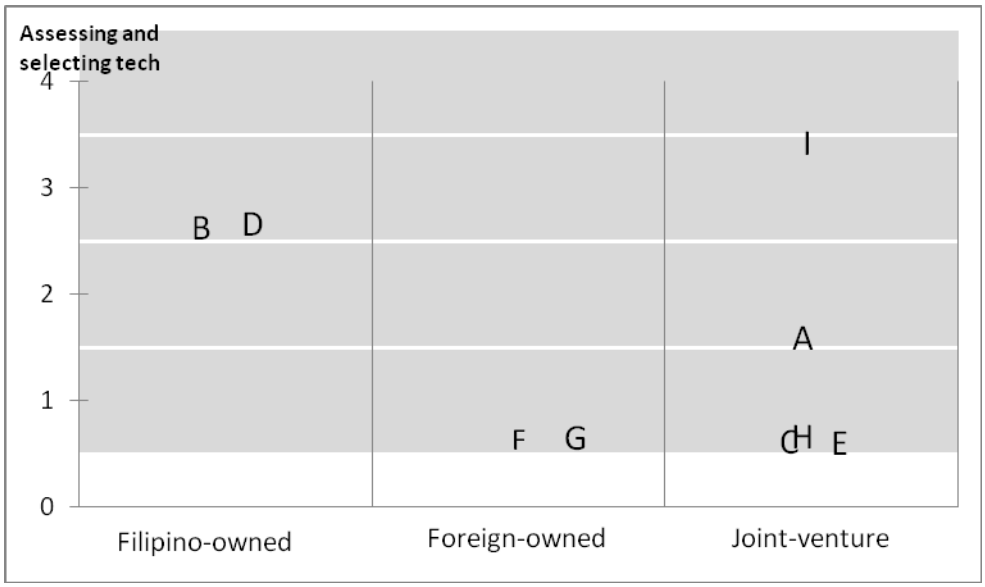


This observation gives impetus to the Department of Science and Technology (DOST) to continue pursuing its Technology Transfer Programs namely, Small Enterprises Technology Upgrading Program (SET-UP), Technological Innovation Commercialization Program (TECHNICOM) and Technology Support Program for E-

Governance (SUPRE-GOV) to assist firms in undertaking technology activities.

Firms reliant on its mother company for the technology to be used in the firm tended to have less technology activities. This observation is particularly evident in terms of assessing and selecting technology (Figure 16). The five firms (Firms C, E, F, G, and H) that have expressed some reliance on the mother company for their research and development and technology assessment have all received low ratings on assessing and selecting technology.

Figure 16: Distribution of Firms by Assessing and Selecting Technology Score and Ownership



The fact that a number of firms in the automotive sector are reliant on its mother company has been observed in earlier studies. Aldaba (1997) observed that for a number of Joint-venture firms, the technology is transferred by the mother company through direct infusion of production system. She also found that some firms would have an existing technical assistance agreement program in order to bring in outside technology. The problem with relying too much on the mother company for research

and development and even innovation is that the firm tends to pass up opportunities for locally-occurring technology development and innovation. Some technology, machineries and equipment developed locally may be ignored because these have not caught the attention of the mother company of the firm. There might also be some reluctance in the mother companies to share the technologies that they have developed especially if these technologies have been the result of years of research and investment (Aldaba 2007).

Related to the previously discussion is the observation that **Filipino-owned firms tend to have utilized external linkages more than foreign-owned firms or joint ventures (Figure 17).** Perhaps this is because the Filipino-owned firms are not restricted by a Mother Company that would dictate or control the technology for the firm. The similarity between Firms B, D and I in terms of external linkages is that all three firms have strong connections with local research institutions and other government agencies. They were able to use their connections in order to improve the level of technology and expertise in their company but these were confined to selected fields.

Assemblers tend to have more innovative activities than first-tier or second-tier firms. Figures 18, 19 and 20 show that the two assemblers included in the survey, Firm B and Firm I have relatively better ratings in technology strategy, assessing and selecting technology and exploiting external linkages. Firm D which is a second-tier firm may be considered as an outlier among the second-tier firms. The other first-tier firms and second-tier firms are all ranked lower than Firm D or the assemblers.

Figure 17: Distribution of Firms by Exploiting External Linkages Score and Ownership

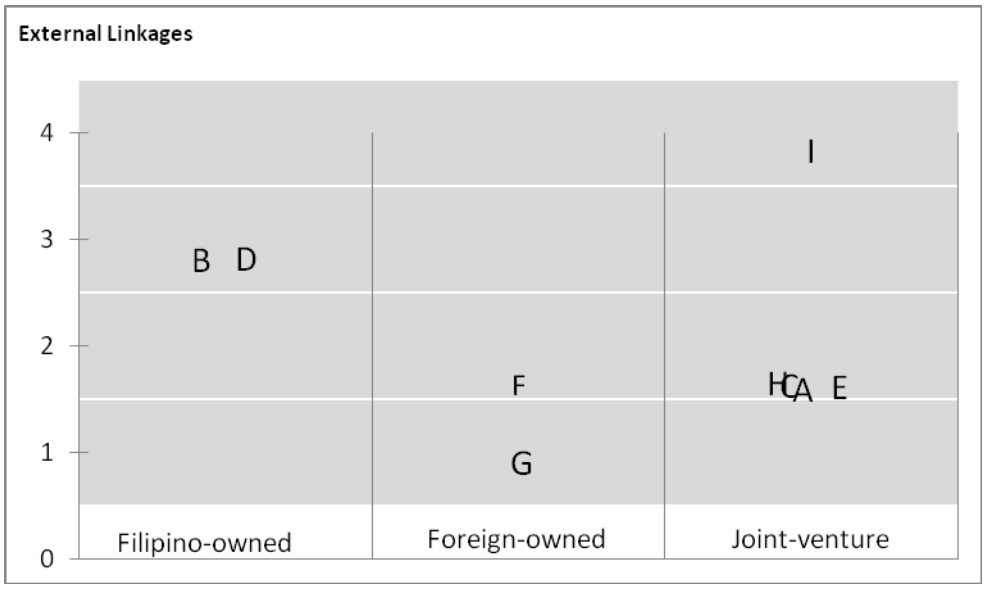


Figure 18: Distribution of Firms by Technology Strategy Score and Level of Production

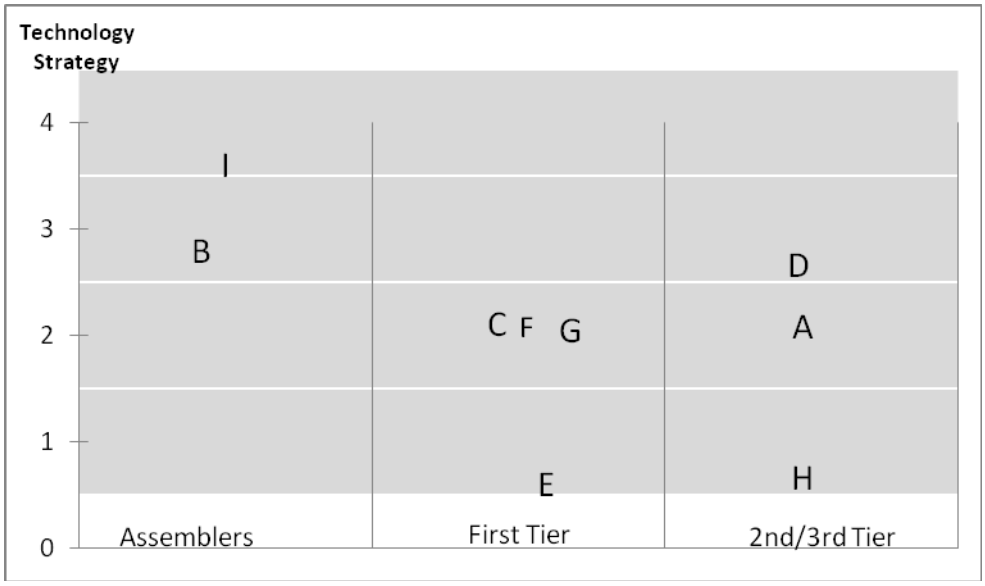


Figure 19: Distribution of Firms by Assessing and Selecting Technology Score and Level of Production

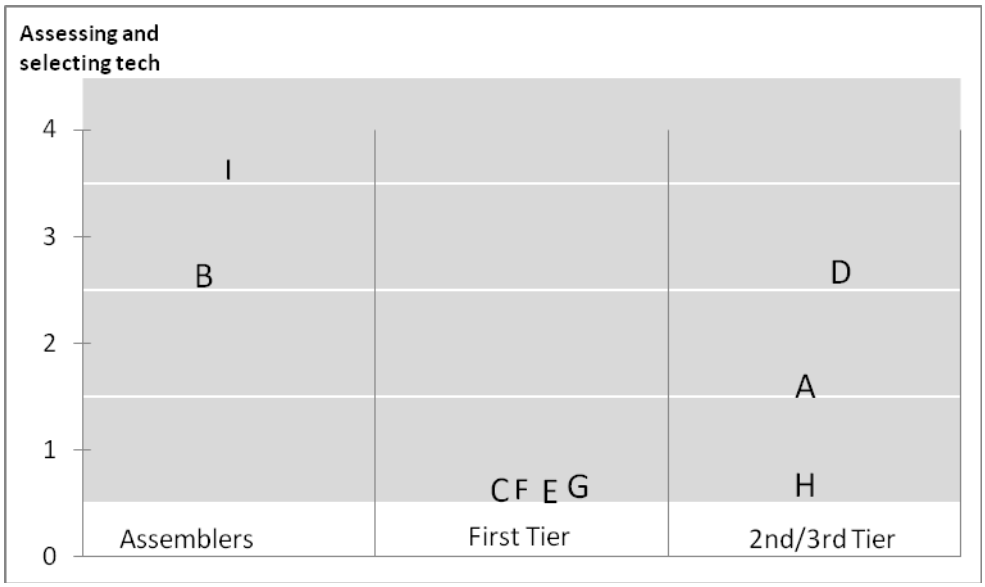
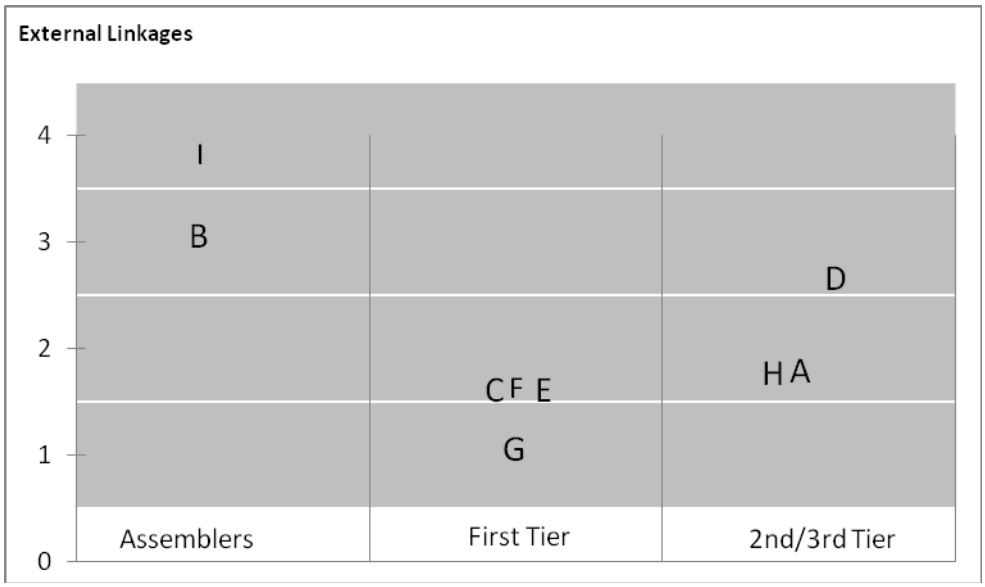


Figure 20: Distribution of Firms by Exploiting External Linkages Score and Level of Production



This observation then implies that assemblers should take the lead role in pushing for innovation of the first-tier and second-tier firms. The local automotive parts and components manufacturers recognize this leadership role of the assemblers when they

called for the revival of the People's Car Program (Go 2006). When the local assemblers incorporate as many locally manufactured parts that meet the quality, cost and delivery requirements as they can into the People's Car, this would encourage innovation to the first-tier and second-tier firms.

There is no observable pattern relating firm size with innovation activities. Figures 21 and 22 show that there are large firms like Firms I and Firms D that engage in innovation activities, while at the same time there are large firms that have limited innovation activities (Firms C, G and E) especially in terms of building a core technological competence, technology strategy, assessing and selecting technology and technology acquisition. Similarly, a small company (like Firm B) rates relatively high in terms of building a core technology strategy and assessing technology while another small firm (Firm H) rates comparatively lower.

This observation is consistent with the empirical findings of Shin (2002) in analyzing the determinants of innovation activity of firms in South Korea. Using data from a number of innovation surveys covering the period of 1997 to 1999, Shin showed that firm size is not a significant determinant of innovation activity.

The results of the interview tool have also pointed to a number of internal and external factors that affect innovation activity of automotive firms. Table 16 summarizes these factors according to selected innovation activities.

Figure 21: Distribution of Firms by Building a Core Technical Competence Score and Firm Size

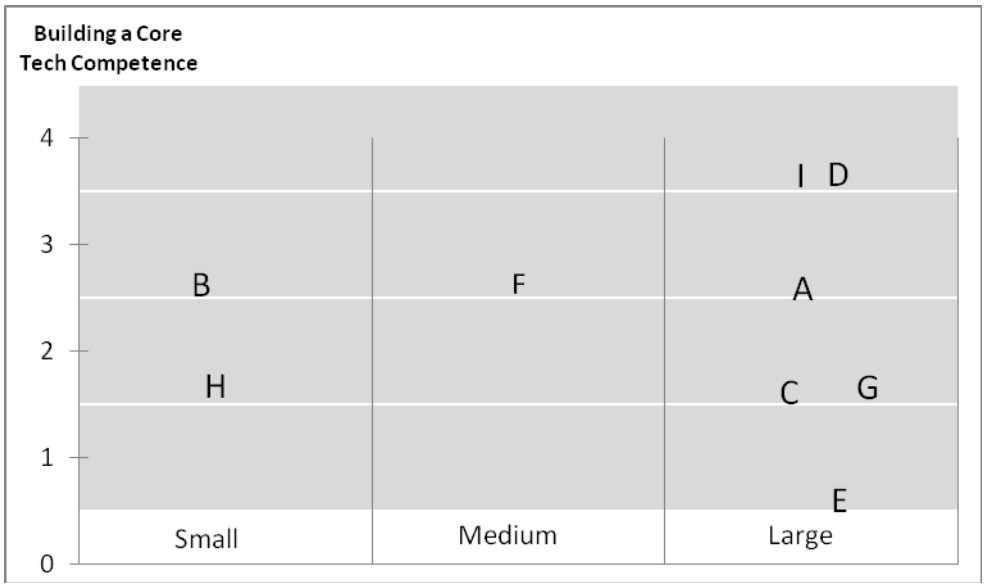


Figure 22: Distribution of Firms by Assessing and Selecting Technology and Firm Size

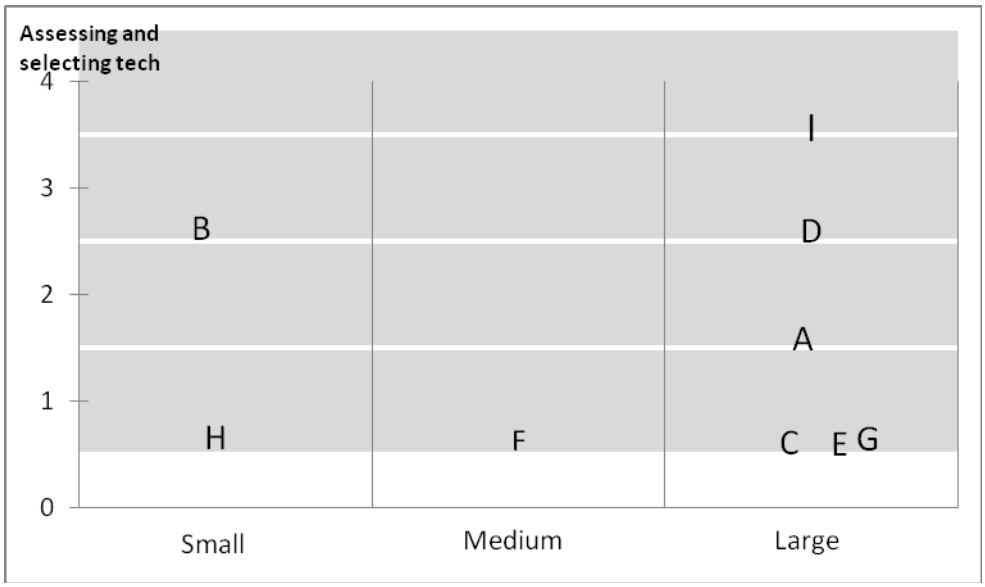


Table 16: Internal and External Factors by Selected Innovation Activity

Innovation Activity	Internal Factors	External Factors
Awareness	A management that recognizes the importance of technology	Availability of information on the technology on which firms can benchmark their innovation capability
Searching	Participation in conferences, trainings	A competitive environment that fosters innovation
Building a Core Tech Competence	A plan that has a technology development component	Mother company dictates the technology that would be used by firms
Assessing and selecting technology	Degree of Independence from Mother Company in terms of innovation/ technology activities	
Technology acquisition	Availability of resources (financial, human capital) for in-house R&D	
Learning	Receptiveness to training	
Exploiting external linkages	Openness to cooperate with external sources of technology	An environment that enables working together between firms and external sources of technology

Management characteristics comprise the bulk of the different internal factors affecting the innovation capability of firms. For instance a firm's level of awareness is affected by the degree of the management's appreciation of technology. A firm that appreciates technology because it is a means of improving its performance tends to have a higher degree of awareness. Similarly, learning and assessing technology is highly dependent on the management style of the firm in terms of asserting its independence especially with regard to relating with the mother company. Management characteristics like receptiveness to training and openness to cooperate with other sources of technology also affect different innovation activities. Availability of resources has always been one factor that has affected innovation activities of firms. **External factors also affect innovation capability of firms pertain mostly to market, information and policy environment.** A competitive market fosters innovation by motivating firms to innovate or else they would be left behind by other firms. The information environment across firms in the same type of product would

affect awareness of a firm because a firm needs to benchmark itself relative to the technology frontier which it can only perceive through knowledge of the types of technology that are available to it and its competitors. The policy environment affects the use of external sources of technology because it provides a policy direction that would guide all the players towards cooperation among firms and other sources of technology like the academe and other science and technology institutions in the country. The policy environment would also have to provide incentives for research, technology development and the transfer of these results to firms. Apart from market, information and policy environment factors, another external factor that has been a recurring theme throughout the discussion of the survey results would be the presence of a mother company. **A mother company that dictates the technology strategy and even the technology/machines that the firm will utilize affects the firm's innovation capability.** If this is the case, a firm would become highly reliant on the mother company for almost every innovation and R&D activity.

6.1. Policy Implications

Based on the observations presented in the earlier section, the following policy recommendations are made to address the policy gaps.

The observations and descriptions of the selected automotive firms indicate that there is a weakness in the automotive sector in terms of undertaking technology activities. To persuade these firms to innovate, they should be given incentives for innovating.

Strengthen the innovation system in the country is of paramount importance, and this can be accomplished by first undertaking a nationwide assessment of the country's

level of innovation. The results of this study will only provide a snapshot of the automotive sector's innovation capability and technology activity. A better assessment is necessary in order to fully understand the sectors. The experience of the authors shows that firms are generally not receptive to surveys relating to innovation because of company policies aimed at protecting their competitive advantage. It is important to make these firms understand that their participation in innovation surveys is important, and the information that they would provide would be kept in strictest confidence.

As a number of automotive firms rely on their mother company for the technology that they will use, it is important for the country to strengthen its policies on intellectual property rights (IPR). Information campaigns on IPR protection should also be bolstered to allay the concerns of mother companies that their technology would be stolen or copied in the country.

It is also important for the country to strengthen the research and development institutions and universities by establishing better linkages with the industries. It has been recognized that one of the weaknesses of the innovation system of the country is the weak technology transfer process which limits the flow of knowledge and technology from RDI and Universities to industry. Related to this would be the need for the country to also improve the number of R&D personnel and scientists and public R&D spending.

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APPENDIX

Table A1: Exports of Auto Parts and Components (in thousand USD)

	2007	2008	2009
Tyres new for motor car	205,814.7	257,715.0	195,465.4
Tyres,new,bus or lorry	7,290.8	1,182.6	376.2
Piston eng fuel/wtr pump	24,628.1	19,956.2	20,944.5
Transmission shafts	3,278.0	7,018.8	3,418.3
Gears and gearing	380.2	219.0	139.0
Flywheels/pulleys/etc	14.6	48.6	12.3
Clutches/sh coupling/etc	418.5	239.7	37.0
Gear/flywheel/cltch part	8,543.4	7,768.2	2,673.7
Pass motor vehexc buses	63,181.5	95,395.3	94,354.2
Motor vehchassis+engine		13.7	
Uh rubber tube no fittng	20.6	102.5	13.2
Uh rubber tube + fitting	1,623.3	1,127.4	1,184.2
Tyresnes,herring-bone			
Tyresnes,other		4.5	3.6
Inner tubes	4.0	124.2	5.4
Asbestos manuf-friction	556.9	466.9	578.9
Tempered safety glass	2,441.8	7,256.5	16,963.3
Laminated safety glass	272.5	0.9	34.1
Vehicle rear-view mirror	0.9		
Locks/keys/clasps/parts	24,771.6	28,374.2	30,402.4
Iron,steelsprings,etc	844.1	120.5	10.2
Recip piston engs>1000cc	1,064.7	7.9	
Diesel etc engines	284.8	2.7	4.8
Spark-ign piston engnes	456.4	230.8	226.0
Diesel engines nes	41.8		
Parts nes spark-ignengs	15.2	81.7	27.3
Parts nes diesel engines	1,258.5	2,675.0	979.4
Gen sets with pistnengs	805.4	1,176.7	96.8
Air-conditioners nes	40.5		
Gas heat exchange units	2.3	217.3	
Pumps/etcnes	4,487.0	765.9	1,401.1
Engine oil/petrol filter	76.6	27.1	14.1
Engine air filters	10,402.5	12,521.8	10,944.0
Ball/roll bearing housng	64.4	57.3	
Bearing housings nes	153.5	65.2	16.4
Vehicle etc ignition wir	891,577.2	901,884.5	752,051.4
Veh elect light/etcequ.	29,644.8	33,282.4	4,346.8
Veh elect light/etc part	4,678.7	505.6	279.9
Electro-magnets/devices	12,553.3	18,543.9	11,920.9
Buses etcnes	2.2		
Motor car bodies	283.9	144.9	
Motor vehicle bodies nes	129.6	593.6	65.8
Motor vehicle bumpers	193.3	229.5	206.9
Motor veh body parts nes	81,079.1	102,626.9	78,911.7
Motor vehicle brake/part	529,948.9	724,950.7	473,228.2
Motor vehicle gear boxes	167,699.4	240,705.1	211,545.7

Motor veh drive axle etc		12.0	43.5
Mot veh non-drive axles			
Other motor vehcl parts	892,764.4	983,500.9	658,761.1
Parts/access motorcycles	27,599.6	31,773.7	25,480.8
Motor vehicle seats	16.2	14.0	344.5
Pressure gauges etc	1,501.7	2,490.6	1,497.3
Fluid instrum parts/acc	3,352.5	1,397.6	950.4
Grand Total	3,006,263.8	3,487,620.0	2,599,960.7

Table A2:Imports of Auto Parts and Components (in thousand USD)

Row Labels	2007	2008	2009
Tyres new for motor car	12,741.9	15,617.4	27,054.8
Tyres,new,bus or lorry	56,044.0	48,325.2	54,280.5
Piston eng fuel/wtr pump	3,149.1	1,595.3	2,252.8
Transmission shafts	5,100.3	5,187.6	6,197.3
Gears and gearing	8,885.4	11,890.9	13,247.5
Flywheels/pulleys/etc	650.0	1,107.6	994.4
Clutches/sh coupling/etc	2,446.0	2,737.0	2,263.0
Gear/flywheel/cltch part	6,120.1	7,121.0	5,903.8
Pass motor vehexc buses	699,293.5	982,533.2	955,442.3
Motor vehchassis+engine	10,389.6	7,506.1	6,516.1
Uh rubber tube no fittng	474.0	747.4	465.0
Uh rubber tube + fitting	3,382.8	5,272.1	3,327.8
Tyresnes,herring-bone	2,024.6	1,703.1	1,086.3
Tyresnes,other	7,191.2	8,470.0	14,393.6
Inner tubes	2,536.6	2,507.5	2,041.8
Asbestos manuf-friction	614.1	740.8	1,011.8
Tempered safety glass	5,841.4	12,645.7	9,499.9
Laminated safety glass	1,325.6	3,146.2	3,977.0
Vehicle rear-view mirror	592.7	343.8	411.2
Locks/keys/clasps/parts	7,861.5	9,291.8	8,261.4
Iron,steelsprings,etc	3,663.2	3,461.9	2,653.8
Recip piston engs>1000cc	9,195.1	8,835.0	7,813.9
Diesel etc engines	14,578.7	15,621.4	19,273.8
Spark-ign piston engnes	11,939.6	8,676.1	4,239.8
Diesel engines nes	19,569.2	13,324.5	9,911.1
Parts nes spark-ignengs	18,407.6	15,171.2	11,071.9
Parts nes diesel engines	32,908.9	36,744.0	36,251.5
Gen sets with pistnengs	56,556.1	49,578.2	49,581.7
Air-conditioners nes	21,584.3	24,832.0	9,065.8
Gas heat exchange units	12,314.6	13,012.8	12,548.9
Pumps/etcnes	23,898.2	16,446.7	20,481.3
Engine oil/petrol filter	5,589.0	5,391.5	5,205.0
Engine air filters	1,079.6	1,450.4	1,715.1
Ball/roll bearing housng	2,375.8	3,190.0	3,891.1
Bearing housings nes	3,312.2	3,773.5	3,229.4
Vehicle etc ignition wir	33,060.4	38,369.8	13,501.0
Veh elect light/etcequ.	6,327.5	6,678.2	5,636.8
Veh elect light/etc part	951.6	2,435.4	2,893.0
Electro-magnets/devices	48,510.6	40,781.7	19,658.8
Buses etcnes	78,515.1	53,738.3	63,486.8
Motor car bodies	164.6	161.7	272.1
Motor vehicle bodies nes	4,803.6	6,592.1	13,054.3
Motor vehicle bumpers	5,620.9	4,414.5	3,540.9
Motor veh body parts nes	13,246.3	18,954.1	13,848.4
Motor vehicle brake/part	9,161.9	20,876.0	13,566.8
Motor vehicle gear boxes	26,048.1	23,952.7	17,635.2

Motor veh drive axle etc	8,477.0	6,712.7	13,373.6
Mot veh non-drive axles	165.0	50.4	37.4
Other motor vehcl parts	237,310.0	242,032.9	207,467.5
Parts/access motorcycles	90,044.9	131,847.3	152,883.8
Motor vehicle seats	511.9	355.1	599.7
Pressure gauges etc	3,305.1	3,507.9	2,868.2
Fluid instrum parts/acc	2,868.0	3,205.7	2,915.8
Grand Total	1,642,728.8	1,952,665.7	1,862,802.4