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IN THE AUTOMOTIVE GLOBAL VALUE CHAIN

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The Philippines in the Automotive Global Value Chain

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Acronyms

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
BOI	Board of Investments
BPO	Business Process Outsourcing
CAMPI	Chamber of Automotive Manufacturers of the Philippines Inc.
CARS	Comprehensive Automotive Resurgence Strategy
CBU	Completely Built Up
CDP	Car Development Program
CESDR	Center for Engineering and Sustainable Development Research
CKD	Complete Knock Down
CUICAR	Clemson University International Center for Automotive Research
DTI	Department of Trade and Industry
EVI	Electric Vehicles Initiative
FAIP	Federation of Automotive Industries of the Philippines
FDI	Foreign Direct Investment
GVC	Global Value Chains
HEDP	Higher Education Development Project
IE	Industrial Estates
JV	Joint Venture
LCR	Local content requirements
MNC	Multi-national corporation
MVDP	Motor Vehicle Development Program
OE	Original Equipment
OICA	Organisation Internationale des Constructeurs d'Automobiles
PCMP	The Progressive Car Manufacturing Program
PEZA	Philippine Economic Zone Authority
PROCEI	Mexico-European Union Competitiveness and Innovation Program
PPMA	Philippine Parts Makers Association
PSIC	Philippine Standard Industrial Classification
R&D	Research and Development
SME	Small-Medium Sized Enterprise
TAI	Thailand Automotive Institute
TAMPA	Thai Auto-Parts Manufacturers Association
TAP	Toyota Auto Parts
UIL	University–industry linkages
WTO	World Trade Organization

Executive Summary

This report uses the Duke CGGC Global Value Chain (GVC) framework to examine the role of the Philippines in the global automotive industry and identify opportunities for upgrading. The country's strength in the sector is in electrical and electronic automotive components, with approximately two-thirds of its US$3.98 billion exports in 2014 falling in one of these categories. The Philippines has a particularly strong foothold in wire harnesses, exports of which increased by 129% from 2007 to 2014 to allow it to become the world's fourth largest global exporter. The prominence of the cluster affords the country a number of upgrading opportunities moving forward. Otherwise, the relatively small size of the domestic market has constrained the development of the industry, with local companies unable to generate the economies of scale necessary to compete in an increasingly consolidated global environment.

The Automotive Global Value Chain

The global automotive industry is one of the world's largest manufacturing sectors, and worldwide trade of final products and components accounted for roughly US$1.4 trillion in exports in 2014. Its organization is complex and in the midst of a profound transition. Since the 1990s, it has been shifting from a series of fairly discrete national industries, connected to the outside world mainly through exports and the local assembly operations of multinational firms, to a more integrated global industry in which value is added in multiple countries before finished vehicles are sold, and locations are more likely to specialize in specific sets of activities.

- **Motor vehicles tend to be designed, engineered, and tested in the industry's traditional design clusters in developed countries such as Detroit, Stuttgart, and Tokyo.** The largest automakers have concentrated vehicle development in a few centers to distribute the high cost of vehicle design and engineering across products sold in multiple end markets.

- **Production tends to be organized regionally or nationally in large countries, with bulky and model-specific parts-production concentrated close to final assembly plants.** Because many automotive parts tend to be heavy and efforts to reduce inventory have driven firms to employ just-in-time delivery to reduce costs, there are limits on how far apart parts production and final assembly can be. As a result, regional parts production tends to feed final assembly plants, which concentrate on national or regional markets. Because of deep investments in capital equipment and skills, local automotive clusters tend to be very long-lived once established.

- **Lighter, more generic parts are produced at a distance to take advantage of scale economies and low labor costs.** When product variety is high, parts for complex sub-assemblies are shipped from distant low-cost production locations to sub-assembly facilities adjacent to final assembly plants, where they can be tailored to the exact requirements of vehicles under assembly.

- **The automotive industry is in the midst of a profound transition from a technological point of view.** The relationship between global automakers and technology companies is improving, and with the increasing amount of electronics components in

motor vehicles, deeper partnerships can be expected in the future. Moreover, the spread of electric vehicles could offer a wealth of new opportunities. Roughly 665,000 e-vehicles are already in use around the world, and millions more are expected to be purchased in the years ahead in emerging markets such as India and China.

The Philippines in the Automotive GVC

The Philippines automotive manufacturing capabilities are mostly oriented towards the domestic market rather than regional or global chains. The lead firms active in the Philippines—Toyota, Mitsubishi, Mazda, Nissan, and Isuzu—are Japanese automakers that generate vehicles for the domestic market. Most have had a presence in the country for decade, although there has been frequent turbulence, with the 2012 closing of the Ford assembly plant in Laguna being the most recent example. The shuttering of the Ford site continued the trend of decreasing assembly of Complete Knock Down (CKD) units in the country—sales of CKD kits fell to 67,742 in 2011 from an 1996 apex of 137,365.

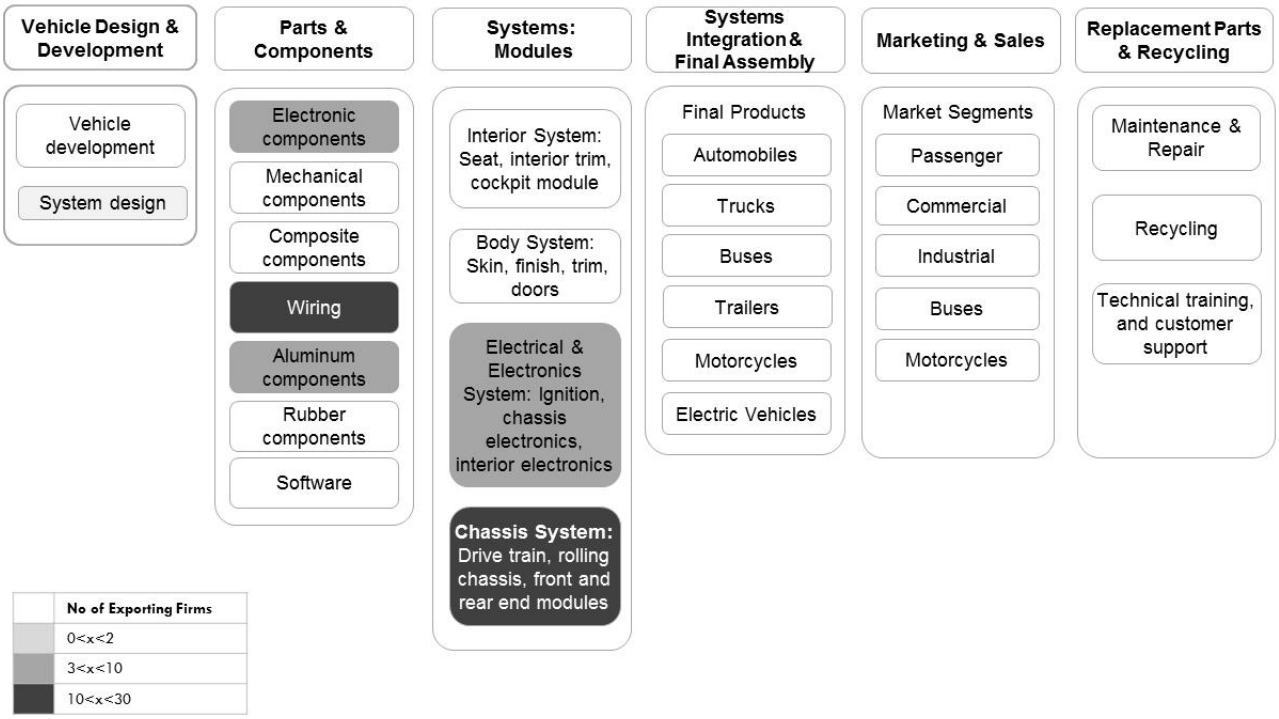
The erosion of the CKD base has, in turn, impaired the development of domestic suppliers; without requisite demand, lead firms have difficulty finding suppliers that have the ability to produce parts in sufficient volume. This has led to an overall stagnation that can be detected by analyzing the total number of domestic parts producers. In 1996, there were 240 companies manufacturing car parts and components, both producers of "Original Equipment" parts (OE) and producers of replacement parts; in 2014, that number was 256.

While there are at least 123 companies situated in the export processing zones, only a small handful of these firms export goods in high volume, with the 15 largest accounting for 80% of total revenue. Together, these companies helped the Philippines' increase its automotive exports by roughly 33% from 2007 to 2014 to nearly US$4 billion. Although that figure is only a small fraction of global automotive exports, it represented 6.4% of the Philippines' total goods exports in 2014.

Six of the largest 10 exporters are wire harness companies. Wire harnesses direct the flow of current and electronic signals throughout the vehicle. The sub-system is of growing importance as the electronics content of vehicles increases—global exports increased by 53% from 2007 to 2014. Because assembly is labor intensive, it is a promising niche for developing countries, which can use their cost advantages to attract foreign investment. The Philippines has exploited its competitively priced labor to increase its market share in the industry; its share of worldwide exports increased from 4.2% in 2007 to 6.3% in 2014.

Beyond wire harnesses, the second largest export category is a broad one that captures wheel and tire assemblies, drive trains, and vibration controls. However, growth in this segment has been stagnant in recent years—there were 44 different companies that exported US$862 million in 2007 but only 30 firms with exports of US$674 million in 2014. The third largest export category—gear boxes or transmissions—has been demonstrating more consistent growth, although there are only four companies active. Figure E-1 summarizes with an illustration of the Philippines' participation in the automotive GVC. Grey shading indicates the degree of Philippines participation in this segment.

Figure E-1. The Philippines' Participation in the Automotive GVC



Source: Duke CGGC.

These and other features translate to a number of advantages for the government as it attempts to facilitate upgrading in its automotive sector. These include:

- **Well-established global footprint in wire harnesses.** There are at least 15 wire harness firms active in the country, and two of the industry's leaders—Yazaki and Sumitomo—have long-standing investments, with major suppliers such as Lear and Furukawa also expanding to the Philippines in more recent years. All four companies have undergone a range of upgrades, cumulatively expanding or implementing new projects 25 times.

- **Commitment of leading industry stakeholders**. The lead firms active in the Philippines have displayed a strong commitment to the local market, giving vitality to a number of industry associations. Together, these organizations have collaborated on efforts such as formulating the industry road map while also playing important roles in shaping policy initiatives such as the Comprehensive Automotive Resurgence Strategy (CARS), which provides a regulatory framework that attempts to encourage the development of the domestic supply base. The strong commitment of industry stakeholders is mirrored by a supportive and collaborative environment for industry policy development in manufacturing sectors, which has been assisted through programs put in place by the Department of Trade and Industry and the Board of Investments.

- **Competitive labor environment.** The country's human capital advantages include relatively low wage rates, a deep pool of engineers, widespread English skills, and low attrition rates.

- **Effective Export Processing Zone (EPZ) regime.** There are large concentrations of firms in the EPZs in the Laguna and Cavite regions. The EPZ regime provides a range of specific benefits, including tax incentives, assistance with visas, and streamlined import and export procedures.

- **CARS' provision of incentives to lead firms.** The CARS program is an innovative attempt to generate economies of scale in the domestic market by offering US$600 million in incentives to a limited number of lead firms. By restricting the program output-based assistance to a maximum of three models, it hopes that local parts makers will be able to generate economies of scale from only having to produce components for a small number of products.

In order to capitalize on these strengths, there are constraints that can be addressed to facilitate industry upgrading. These challenges include:

- **Gaps in supply chain.** Only 330 of the 20,000-30,000 total vehicle parts are produced in the Philippines (DTI, 2014). The gaps span all levels of the supply chain—lead firms listed body shells and stamping plants, engines, air conditioning units and suspension systems, wire harness manufacturers import electrical switches, terminals, and specialized parts from both the region and Europe and North America, and transmission producers rely on India for polished metal and China for forged parts.

- **Comparatively small market for new motor vehicles.** While annual motor vehicle sales in the Philippines have been on a strong upward trajectory, the country still ranks well below regional peers such as Indonesia, Malaysia, and Thailand. Even if the market meets the projections of 500,000 annual sales of motor vehicles by 2020, demand will still likely be lower than Indonesia, Malaysia, and Thailand, making the country an unlikely candidate for investments by global lead firms. Without further expansion in assembly capabilities, there is risk there will not be sufficient demand for suppliers to increase their capacity.

- **Low to moderate support for R&D activities.** Automotive companies such as Furukawa, Denso, and F-Tech R&D have made recent investments in EPZs for knowledge-intensive business functions. However, government support for R&D activities trails regional peers such as Malaysia and Thailand.

Both the strengths and the weaknesses shape the upgrading trajectories that are available for the Philippines. Generally speaking, the Philippines has opportunities with smaller, lighter products that do not incur excessive transport costs but that nonetheless require technical knowledge and cost-competitive labor to assemble. The country's demonstrated strength in the wire harnesses and electrical wiring could serve as a springboard for higher-value activities.

Table E-1. Possible Upgrading Trajectories in Automotive GVC

Time Frame	Potential Upgrading Trajectory	Key Benefits	Capacities Required of Individual Firms	Philippines Challenges
Short-Medium Term	**Product & Process Upgrading to Increase Wire Harness Exports**	• Position the Philippines as the global automotive E&E hub • Leverages capabilities in the sector and economies of scale • Labor-intensive employment generator for semi-skilled workers	• Human capital • Access to inputs • R&D capabilities to adapt to increasing complexity	• Underdeveloped backward linkages for some inputs • Logistics & transportation infrastructure • Temporary decline in labor availability due to changes in education system
Medium Term	**Functional Upgrading into R&D for Wire Harnesses**	• Position the Philippines as the global automotive E&E hub • Potential to generate higher unit value products • Higher skilled employment	• Human capital • Technology • Access to customers	• R&D still being done in traditional manufacturing bases • Little clustering of automotive lead firms outside wire harnesses
Medium Term	**Chain Upgrading into Aerospace Wire Harnesses (Electrical Wiring Interconnection Systems)**	• Position the Philippines as the global producer of aerospace electrical systems • Leverage expertise for higher value products • Employment generation for semi-skilled and skilled workers	• Certifications • Technical knowledge • Access to customers	• No established reputation in the aerospace industry • No experience in regulated aerospace wire harness manufacturing
Medium Term	**Product & Functional Upgrading into Automotive Electronics**	• Leverages country's capabilities in electronics • Higher unit value exports • Continuation of success in segment where Philippines is competitive	• Human capital • Technical knowledge • Access to finance • Access to customers	• No established reputation in the automotive industry • Logistics • Lack of specialized human capital • Limited R&D commercialization experience
Medium-Long Term	**Chain entry into batteries for e-Vehicles**	• Position the Philippines to earn foothold in nascent industry • Potential spillovers of technology and skills into wire harness and electronics segments • Possible for both semi-skilled and high-skilled employment	• Human capital • Access to technology • Access to inputs • Access to customers	• Lack of specialized human capital • No major foreign investments in technology • Possible underdeveloped backward linkages

Source: Duke CGGC.

1. Introduction

The automotive industry has an iconic image in many countries around the world, with the sector often serving as a focus for policymakers as they attempt to generate economic opportunities for domestic constituents. The Philippines fits this template, with the government implementing a number of strategies to boost the sector over the last 50 years. The Comprehensive Automotive Resurgence Strategy (CARS) program, implemented in 2015, is the most recent effort to increase the domestic assembly of motor vehicles and create a robust supply base in the country.

As the Philippines embarks on CARS, there are industry headwinds that will limit the upgrading trajectories that are available. At a time when automakers still tend to build where they sell, the Philippines' demand for motor vehicles is one of the lowest in the region, with the country's sales figures trailing peers such as Indonesia, Thailand, and Malaysia. While the demand dynamic is evolving to a degree, with the Philippines posting the largest growth in sales of motor vehicles in ASEAN from 2011-2015 (AAF, 2011-15), there is question whether future growth is likely to include high enough demand to attract widespread investment across multiple stages of the automotive Global Value Chain (GVC). Without the requisite demand, the country's supply chain may continue to struggle to generate the economies of scale necessary to compete in an increasingly consolidated global environment.[1]

While there are entrenched challenges, these should not obscure the opportunities that do exist. International trade in the industry is increasingly focused on supplying parts and components rather than final vehicles. While the Philippines' overall automotive exports are small—roughly 0.3% of the US$1.4 trillion in worldwide trade—the country has carved out a niche in specific growth segments of the chain such as wire harnesses.[2] With rising electronic functionality in all vehicle types, opportunities abound in electronic components and wiring systems. In order to fully take advantage of this strength, the Philippines can build its Research & Development (R&D) capabilities while also exploring spillovers related to the country's presence in related sectors such as electronics and aerospace. Moreover, if the country increases its skills in these areas, it may be positioned to take advantage of the possible industry shift to fully electric vehicles, especially since minimum scale economies for these vehicles are not well established.

This report uses the GVC framework to analyze the Philippines' current position and potential for upgrading in the automotive value chain. GVC analysis examines the full range of activities that firms and workers around the world perform to bring a product from conception through production and end use. As part of this analysis, multiple factors are considered; trade patterns, end markets, product characteristics, technology-intensity, labor, standards, and regulations, among others. This information is analyzed from a global perspective and from the viewpoint of

[1] CARS offers a strategic approach in its attempt to change this dynamic—by limiting the program to a maximum of three participants and three total models, it hopes to generate sufficient scale for domestic businesses that have historically been constrained by limited demand.

[2] The Philippines was the fourth-largest global exporter of wire harnesses in 2014, and exports have increased 129% from 2007 to 2014.

the Philippines in order to provide a holistic picture of the situation when identifying trajectories for entry, growth, and upgrading along that chain. Its recommendations work toward two goals—boosting the country's exports, and increasing the capabilities of producers that are focused on the domestic market.

This report is structured as follows: First, it analyzes the global industry, including an extended discussion on the key segments of the chain and how important stakeholders in the chain interact as well as the evolution of critical trends at the global, regional, and national levels. It then offers case studies of two countries—Vietnam and Thailand—to illustrate both effective and ineffective policy regimes for building a domestic supply base. The report continues by analyzing the Philippines presence in the industry before concluding with potential upgrading trajectories for the country as well as recommendations to assist these efforts.

2. The Global Automotive Industry

The global automotive industry is one of the world's largest manufacturing sectors. More than 90 million vehicles were produced in 2014, and the value of finished passenger vehicle exports totaled US$688 billion. The largest market segment is passenger vehicles (nearly 80% of the world market), followed by light and heavy commercial and industrial vehicles for on- and off-road use (about 20%), and finally buses (less than 1%).[3] Motorcycles (including motorbikes, scooters, and three-wheelers) comprise a separate industry (with a mostly distinct set of lead firms and suppliers), but are to some degree substitutes for automobiles. Motor vehicles are highly complex machines, but from the perspectives of technology, assembly, and supply chain, both commercial vehicles and motorcycles tend to be much simpler than passenger vehicles.

The automotive industry is in the midst of a profound transition, from geographic, organizational, and technological points of view.[4] Since the 1990s, it has been shifting from a series of fairly discrete national industries, connected to the outside world mainly through exports and the local assembly operations of multinational firms, to a more integrated global industry in which value is added in multiple countries before finished vehicles are sold, and locations are more likely to specialize in specific sets of activities.[5] Today, motor vehicles tend

[3] Passenger vehicles generally include automobiles (including taxis), sport-utility vehicles, and light-duty pick-up trucks.

[4] The move toward electric vehicles is one of the more profound technological changes under way in the industry. Global demand for electric vehicles has accelerated in recent years, posting annual gains of more than 100% in 2011 and 2012 and then increases of between 50-75% in 2013 and 2014. In April 2016, Tesla then announced pre-orders for its Tesla 3 Model had exceeded its forecasts and that it would have to adjust its production plans (Voelcker, 2016).

[5] One early, highly structured example are the "complementarity schemes" undertaken by major Japanese producers such as Toyota in ASEAN beginning in the late 1980s. Under this arrangement, small market countries received investment for the manufacturing of specific major subsystems and processes, such as transmissions in the Philippines, engines in Indonesia, electronics in Malaysia, and bodies and final assembly in Thailand. With the enlargement of ASEAN and the growing importance of tight, "just-in-time" supply linkages to final assembly, this system has faded as Thailand has become the dominant producer in the region, specializing in pick-up trucks and a multitude of parts and subsystems. However, investments in major vehicle subsystems such as transmissions and

to be designed, engineered, and tested in the industry's traditional design clusters such as Detroit, Stuttgart, and Tokyo, and then produced regionally or even globally. GVCs of this sort increase the complexity and variability of production systems, and open up new pathways for development through value chain fragmentation and investment in new locations.

However, effectively taking advantage of these opportunities remains a challenge, and there are a number of factors that work against the geographic fragmentation of the industry. These include the following:

- **Political pressure:** As highly visible and perhaps iconic goods, there is strong political regulatory pressure to produce automobiles in markets where they are sold, especially in large countries such as China and the US.

- **Just-in-time production:** Because many automotive parts tend to be heavy and bulky, and efforts to reduce in-process inventory has driven firms to employ "just-in-time" delivery to reduce costs and increase quality, there are limits on how far apart parts production and final production can be.

- **Economies of scale:** Unlike labor intensive industries, motor vehicles have high minimum scale economies in production, especially for key components such as engines and transmissions and key steps in the assembly process, such as large metal stamping, body welding, body undercoating and paint.

- **Consolidation in the supply base:** As in the commercial aircraft and other complex manufacturing sectors, consolidation in the automotive supply base has increased the size and scope of Tier I suppliers, and this has also worked to narrow opportunities for local actors in the second and third tiers of the chain.

These obstacles ensure that even with manufacturing moving closer to end markets, geographic separation of design from production can isolate firms in emerging economies from the higher-value, strategic and innovation-related segments of the chain. As a result, developing countries, even those with high volume production, can become confined to overly narrow, low-value added segments of the chain. When this happens, countries can remain insulated from innovation and product development for long periods of time, causing industrial upgrading and technological learning processes to stall.

This section proceeds by outlining the GVC for the automotive industry. It then discusses the geographic distribution of supply and demand before examining the lead firms in the sector and the manner in which they control the chain. After outlining recent changes in chain governance, the global section concludes by offering examples of potential upgrading trajectories for developing countries before offering a brief introduction to the wire harness segment.

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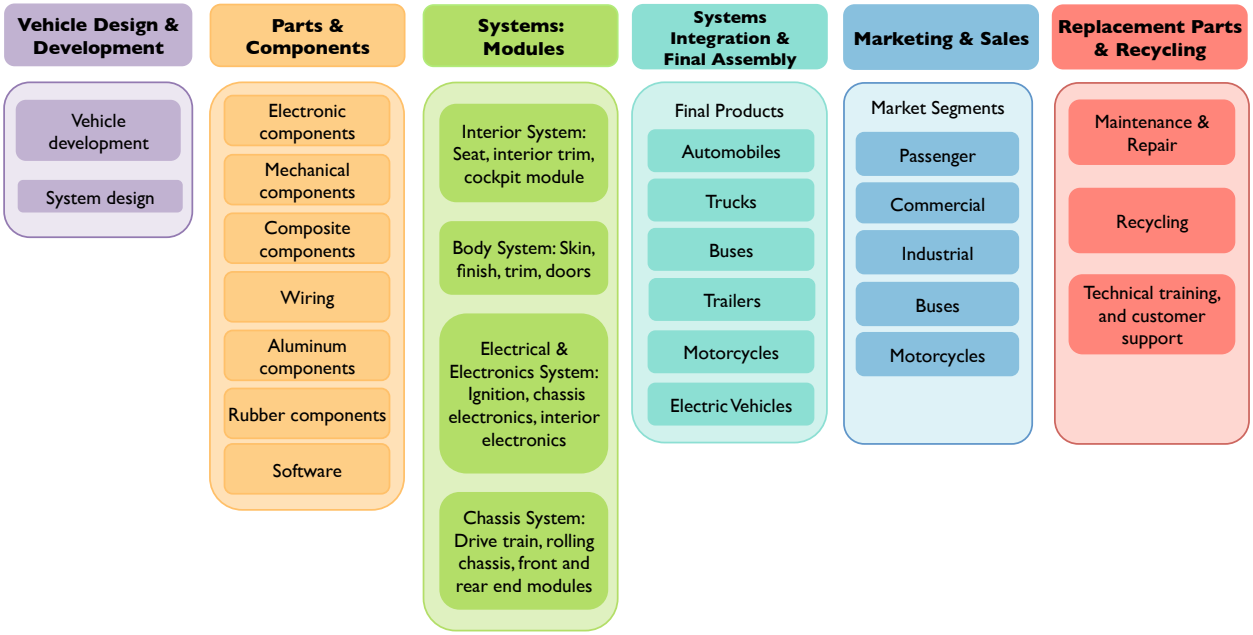
engines require extensive machining, are capital intensive, and thus tend to be long-lived. The existence of several export-oriented transmission plants in the Philippines reflects this.

2.1. Mapping the Automotive Global Value Chain

The principal stages of the automotive GVC include vehicle design and development; parts, component, module and sub-system production; and systems integration and final assembly. Distribution, repair, and recycling are also significant parts of the industry, with large-scale employment, but tend to be comprised mainly of local actors and are not included in the analysis. Marketing and sales are most often handled by the lead firms and are not outsourced. Figure 1 offers a simplified visual representation of the GVC.

Figure 1. The Automotive Global Value Chain



Source: Authors.

Vehicle Design and Development: Vehicle conceptual design is a mainly artistic process that focuses on appearance and external features, though vehicle handling and aerodynamic characteristics are also taken into consideration. It is generally carried out in-house in automaker design styling studios, although independent design houses such as Italy's Pininfarina (recently purchased by India's Mahindra) and Bertone regularly produce vehicle designs for multiple automakers. Moving from concept to a drivable vehicle that can be massed produced while also meeting private and public quality and safety standards has historically been a very complex, difficult, and long-term process that is carried out in large, multi-disciplinary engineering and test centers.

The heavy engineering work of vehicle development, where conceptual designs are translated into the parts and sub-systems that can be produced by suppliers and assembled into a drivable vehicle, remain centralized in or near the design clusters that have arisen near the headquarters

of lead firms (automakers).[6] This process is led by automakers, but over the years has been extended to include some collaboration among many of the largest suppliers.[7] The increased involvement of first-tier suppliers in design and purchasing of critical components has led to the spatial co-location of supplier engineering facilities. This is especially true in North America, where automakers have been the most aggressive in demanding that suppliers contribute to design efforts. Because the Detroit, Michigan area has been a center of vehicle design and engineering for nearly 100 years, the cluster has specialized labor markets, education and training, and a host of other institutions that have arisen to support the field of automotive engineering. As a result, the regional headquarters of foreign automakers and global suppliers—typically the site of regional sales, program management, design, and engineering—have gravitated to the greater Detroit area, even as parts manufacturing and final assembly have become dispersed nationally, regionally, and globally (the southern US, Mexico, and China).[8] Because vehicle programs take shape over several months or even years, and the largest lead firms have dozens of programs in the pipeline at any point in time, getting involved in these projects is difficult for suppliers without a presence in the cluster.

Parts and Components: The motor vehicle industry is a complex assembly sector with a "tiered" supply chain structure. A single passenger vehicle is made from thousands of parts produced by hundreds of suppliers. While this stage of the value chain involves SMEs that may only serve domestic markets, general supplier consolidation in higher tiers has left space in the supply chain for local suppliers and SMEs to access export markets in more generic parts. In recent years, global and regional suppliers have expanded their reach, allowing them to work for multiple lead firms or Tier I suppliers to alleviate capacity utilization concerns.

Systems/Module Manufacturing: Parts and components are used to build modules, which describe physically interconnected system of parts such as front ends (bumpers, grills, lighting, etc.), instrumentation or 'cockpit' clusters, or front or rear end suspension 'cradles' that include dozens of suspension parts (springs, shock absorbers, tie rods, etc.). Modules then form the basis of systems, which can be divided into four broad categories: interior (seat, trim, and

[6] The principal automotive design centres in the world are in Detroit, US (GM, Ford, and Chrysler, and more recently Toyota and Nissan); Cologne (Ford Europe), Rüsselsheim (Opel, GM's European division), Wolfsburg (Volkswagen), and Stuttgart, Germany (Daimler-Benz); Paris, France (Renault); and Tokyo (Nissan and Honda) and Nagoya, Japan (Toyota). In general, design work in developing countries remains focused on adapting vehicles to local market conditions.

[7] As with vehicle design, a set of independent vehicle engineering consultancies have become more prominent in recent years, such as Austria's AVL, which specializes in powertrains (engine and transmission combinations), Ricardo, and IAV, which offer a full range of services. Engineering and design functions have generally remained rooted in traditional automotive manufacturing hubs in the USA, Germany, and Italy. For example, South Korea's Hyundai established an important design studio in Frankfurt, Germany, within the cluster historically dominated by GM's European division, Adam Opel.

[8] For example, Toyota consolidated much of its North American design and R&D activities in Ann Arbor, Michigan in 2005, even though its regional manufacturing headquarters are located in Kentucky. In 2006, Nissan moved its North American headquarters from Los Angeles, California to the Nashville, Tennessee area. Nissan's conceptual design studio is in San Diego, California, but the eightfold larger engineering-oriented technology center is in Farmington Hills, a Detroit suburb. As the international consolidation of the supply base has proceeded, suppliers based in Europe and Asia, such as Yazaki (Japan), Bosch (Germany), Autoliv (Sweden), and many others (including China's Yengfeng Automotive, profiled below), have established major design centers in the Detroit region to support their interactions with American, and increasingly, Japanese automakers.

cockpit module); body (doors, skin, finish, trim); electrical and electronic (ignition wiring, chassis electronics, and interior electronics), and chassis (drive trains, radiators, front and rear end modules).

Modules can sometimes be built up separately from the final assembly line, commonly in nearby plants owned and operated by suppliers. These plants typically source components farther afield—in cases where parts have a high enough value-to-weight ratio (electronics) or are labor intensive and produced in lower cost locations (wire harnesses and seat covers), very far afield. However, even this complex picture is too simple, since capital-intensive subsystems such as engines and transmissions tend to be produced in a few centralized locations and shipped to multiple final assembly plants.

Systems Integration & Final Assembly: Similar to commercial aircraft, final assembly of motor vehicles is almost always undertaken by lead firms. This means that final assembly plants are strategic assets meant for the sole use by the lead firm, rather than shared assets of contract manufacturers producing for multiple brands. Furthermore, many production fixtures for high volume assembly plants continue to be platform or even model-specific, and product variety is typically limited to variations on vehicle colors and options, although innovations in assembly techniques and equipment are gradually leading to increased assembly-line flexibility. This pattern contributes to a common problem in the industry: low capacity utilization rates for automakers and their suppliers. Markets (including exports) must be large enough for single brands to support dedicated final assembly plants. Even parts production is sometimes dedicated to a single automaker.

To solve this problem, automakers seeking to produce in small-market developing countries have resorted to Complete Knock Down (CKD) production models to overcome tariff barriers and meet local content requirements. With this approach, "kits" of parts are collected from high-volume assembly plants, placed in shipping containers, and send to low volume final assembly plants in small market countries.[9] An alternative production method is the Completely Built Up (CBU) model, which describes when motor vehicles are assembled in a centralized location and then shipped final destinations where finishing touches such as bumpers or tires are applied.

In CKD production, vehicles are assembled using labor-intensive techniques suitable to both the prevailing labor costs and the lack of justification for investments in large scale automation typically seen in high volume plants. CKD plants commonly produce as few as 5,000 units per year. Typically, integrated production can begin when annual production volumes rise well above 50,000 units. A fully scaled passenger vehicle assembly plant produces about 350,000 units per year.

As these figures suggest, there are a range of production models between "complete" knock down kits and fully integrated production, and most small developing countries with automotive industries exist somewhere along this continuum, working under constant regulatory pressure

[9] For an extended discussion on CKD assembly, please see: Sturgeon, Timothy & Richard Florida. (2000). "Globalization and Jobs in the Automotive Industry." MIT IPC Globalization Working Paper 01-003.

for rising local content. But, given the economics of the industry, such targets usually go unmet, forcing automakers to pay fines and high import duties, costs that are typically passed on to consumers in the form of higher prices.

2.2. Global Supply and Demand in the Automotive GVC

The geographic organization of automotive GVC is complex and can be analyzed at three levels: globally, regionally, and nationally. Global integration has proceeded the farthest at the level of major automakers and their largest suppliers, which have global capacity across almost all regions. Production tends to be organized regionally or nationally in large countries, with bulky, heavy, and model-specific parts-production concentrated close to final assembly plants to assure timely delivery and minimize transportation costs, and lighter, more generic parts produced at a distance to take advantage of scale economies and low labor costs. When product variety is high, parts for complex sub-assemblies such as seats and suspension cradles are shipped from distant low-cost production locations to sub-assembly facilities adjacent to final assembly plants, where they can be tailored to the exact requirements of vehicles under assembly. Vehicle development is, again, concentrated in a few design centers as the largest automakers have sought to distribute the high cost of vehicle design and engineering across products sold in multiple end markets.

Because centrally designed vehicles are manufactured in multiple regions, buyer-supplier relationships typically span multiple production regions. Automakers increasingly demand that their largest suppliers have a global production presence as a precondition to being considered for new parts. However, production arrangements also have persistent regional patterns (Lung et al., 2004; Dicken, 2007). Because many automotive parts tend to be heavy and bulky, and efforts to reduce inventory have driven firms to employ just-in-time delivery to reduce costs and increase quality, there are limits on how far apart parts production and final assembly can be. As a result, regional parts production tends to feed final assembly plants producing largely for regional and national markets.

Within countries, automotive production and employment are typically clustered in one or a few industrial regions. In some cases, these clusters specialize in specific aspects of the business, such as vehicle design, final assembly, or the manufacture of parts that share a common characteristic, such as electronic content or labor intensity. Because of deep investments in capital equipment and skills, local automotive clusters tend to be very long-lived, which partially explains why the automotive industry is so often the target of industrial promotion policies.

Many of these trends—the assembly of vehicles in final markets, the regional trade in systems and sub-systems, and global trade in parts and components—are reinforced by international trade flows. Table 1 shows that about 46% of the value of international trade was of parts and components in 2014, up from about 41% in 2007. Bodies and drivetrain subassemblies, which made up about 5% of trade in 2014, tend to be produced by the in-house manufacturing facilities of automakers; from this, it can be estimated that final vehicles directly account for about 49% of total exports.

Table 1. Global Automotive Exports by Value Chain Stage and Subsector

Value Chain Stage and Sector	Value (US$, billions)				Share of Auto-Related World Trade (%)				CAGR (%)
	2007	2010	2012	2014	2007	2010	2012	2014	2007-14
Total	**1,159**	**1,104**	**1,296**	**1,399**					**0%**
Components	**474**	**495**	**591**	**637**	**41**	**45**	**46**	**46**	**3%**
Of the Body system	193	201	240	262	17	18	19	19	4%
Of the Drive train	113	120	149	159	10	11	11	11	4%
Electrical systems	73	82	99	114	6	7	8	8	5%
Of the Body system or Drive train	95	92	103	103	8	8	8	7	7%
Subassemblies	**69**	**59**	**69**	**74**	**6**	**5**	**5**	**5**	**1%**
Body system	3	3	4	3	0	0	0	0	1%
Drive train	65	56	64	70	6	5	5	5	0%
Final Products (Passenger Vehicles)	**616**	**550**	**636**	**688**	**53**	**50**	**49**	**49**	**1%**

Source: UN Comtrade, HS02 6D codes, reporters exports to the world. Retrieved on October 28, 2015.

Global Demand

Vehicle demand in the motor vehicle industry is growing the fastest in large developing countries. China (23.4 million vehicle sales or registrations in 2014), the US (16.8 million), and Japan (5.5 million) are the world's largest markets for the 88.2 million vehicles sold in 2014. Market growth in newly industrialized, transition, or developing countries has been especially strong, with China (15.1%), Indonesia (8.5%), India (8.2%), and Brazil (7.4%) displaying the highest growth rates while nations such as Germany (minus 0.7%), Japan (minus 0.5%), and the US (minus 0.4%) seeing a reduction in demand. That trend that is likely to continue as purchasing power increases in emerging markets along with the growth in the middle class, despite strong post-crisis recovery of the market in the US.

Vehicle sales tend to be sensitive to short-term economic cycles because they can be delayed in hard economic times. For evidence of this, see new vehicle registration figures for the US, Japan, and the UK at the nadir of the financial crisis in 2009. This was offset in some European countries such as Germany, France, and Italy by aggressive incentives provided by governments keen on "bailing out" local producers through programs as varied as "cash for clunkers" type incentives and outright government loans (Sturgeon & Van Biesebroeck, 2009).

Global Supply

Automakers tend to build where they sell. Because market saturation means that auto sales are generally sluggish in home markets of the "Triad" region (North America, Europe, and Japan), and because of the aforementioned political, regulatory, and operational pressure to manufacture motor vehicles within or near markets where they are sold, production now takes place in more locations than it did 30 years ago, with automotive manufacturers and their global suppliers having made substantial investments in the world's largest and most dynamic emerging economies.

China became the largest consumer and producer of motor vehicles in 2010. In 2014, more than 23 million vehicles were sold in China, according to the OICA (Table 2 lists all countries that manufactured more than 1 million vehicles in 2014). The country's huge and rapidly growing market is mainly supplied by the local production of foreign joint ventures, most prominently with Volkswagen (with SAIC) and General Motors (with FAW). India has similar characteristics, but growth has been more modest. It is also dominated by foreign brands, despite the success of a few local companies (mainly Tata and Maruti).

Table 2. Global Leaders in Motor Vehicle Production, 2013-2014

Country	Units Produced (thousands)		% Change
	2013	2014	
China	22,037	23,661	6.9%
USA	17,262	18,489	6.6%
Japan	9,891	10,043	1.5%
Germany	5,996	6,211	3.5%
South Korea	4,712	4,700	-0.3%
Mexico	4,049	4,470	9.4%
India	4,187	4,024	-4.0%
Canada	3,774	3,850	2.0%
Brazil	4,247	3,631	-17.0%
Thailand	3,758	2,986	-25.9%
Spain	2,524	2,852	11.5%
France	2,022	2,143	5.7%
Russia	2,264	1,935	-17.0%
United Kingdom	1,647	1,638	-0.5%
Turkey	1,530	1,524	-0.4%
Indonesia	1,205	1,325	9.1%
Czech Republic	1,128	1,246	9.5%
Iran	840	1,223	31.3%

Source: OICA, 2015.

Foreign investment is also strong and production growing in lower cost countries that are proximate to the heartland of the automotive industry (the US and Europe). For low cost passenger vehicles, in particular, countries "peripheral" to the largest established markets have become attractive places to locate final assembly. This helps to explain why countries such as Mexico, Thailand, Turkey, and the Czech Republic have increased their volume of total vehicle production.

2.3. Firms and Governance Structures in the Automotive GVC

The automotive GVC is dominated by a small handful of large, powerful lead firms that use their size and technological prowess to exert control over upstream actors. These companies operate, in large part, within their own "world" of standards and dictate the characteristics of parts and subsystems as well as the location of suppliers' production, at least to a degree. Globally, there were 19 companies that generated at least 1 million units in 2014. Table 3 provides a list of these firms.

Table 3. Motor Vehicle Companies that Eclipsed 1 Million Unit Threshold, 2014

Rank	Company	Country	Units Produced (thousands)	Share
1.	Toyota	Japan	10,475	11.5%
2.	Volkswagen	Germany	9,894	10.9%
3.	General Motors	USA	9,609	10.6%
4.	Hyundai	South Korea	8,008	8.8%
5.	Ford	USA	5,969	6.6%
6.	Nissan	Japan	5,097	5.6%
7.	Fiat	Italy	4,865	5.4%
8.	Honda	Japan	4,513	5.0%
9.	Suzuki	Japan	3,016	3.3%
10.	Peugeot	France	2,917	3.2%
11.	Renault	France	2,761	3.0%
12.	BMW	Germany	2,165	2.4%
13.	SAIC	China	2,087	2.3%
14.	Daimler	Germany	1,973	2.2%
15.	Changan	China	1,447	1.6%
16.	Mazda	Japan	1,328	1.5%
17.	Dongfeng	China	1,301	1.4%
18.	Mitsubishi	Japan	1,262	1.4%
19.	BAIC	China	1,115	1.2%
Total from companies manufacturing more than 1m units			**79,813**	**87.9%**
Global total			**90,717**	**100%**

Source: OICA, 2014.

Within Table 3, there are only eight truly large producers, manufacturing more than 4.5 million units. Of these eight, only one (Hyundai) is headquartered in a country without significant motor vehicle production prior to 1970. However, China now has many smaller producers that as a group, now account for 12.5% of world production. Significantly, a few of Chinese firms specialize in the production of electric vehicles, such as the motor vehicle division of BYD, a large producer of batteries headquartered in the heart of China's largest electronic manufacturing cluster in Shenzhen, Guangdong Province.

There are a number of key features of how these lead firms interact with suppliers and how power is distributed. Some of the most relevant are outlined below.

The largest lead firms have rationalized their supply base around a smaller number of increasingly large global suppliers. There has been a dramatic consolidation at the Tier 1 level since the 1990s, and as of 2014, there were 56 automotive suppliers with more than US$4 billion in sales into final assembly. Table 4 lists the largest 15. Many of these suppliers such as Robert Bosch, Magna, and Magneti Marelli provide a wide variety of complex systems, while others—Denso and Mando—are more specialized and a few focus on a specific item, such as Goodyear, which produces tires.

Table 4. Top 15 Global Suppliers in 2014 by Sales

Rank	Company	Country	Sales (US$, billions)	Value Chain Segment
1.	Robert Bosch	Germany	$44,240	Chassis systems; electrical and electronic systems
2.	Magna	Canada	$36,325	Interior systems; body systems; electrical and electronics systems; chassis systems
3.	Continental	Germany	$34,418	Interior systems; chassis systems; electrical and electronics systems
4.	Denso	Japan	$32,365	Electrical and electronics systems
5.	Aisin Seiki	Japan	$28,072	Chassis systems; electrical and electronics systems
6.	Hyundai Mobis	South Korea	$27,405	Interior systems; chassis systems; electrical and electronics systems
7.	Faurecia	France	$25,043	Interior systems; electrical and electronics
8.	Johnson Controls	USA	$23,589	Interior systems
9.	ZF	Germany	$22,192	Chassis systems
10.	Lear	USA	$17,727	Interior systems; electrical and electronics systems
11.	Valeo	France	$16,878	Interior systems; electrical and electronics systems
12.	TRW Automotive	USA	$16,240	Interior systems, electrical and electronics systems
13.	Delphi Automotive	USA	$16,002	Electrical and electronics systems
14.	Yazaki	Japan	$15,200	Electrical and electronics systems
15.	ThyssenKrupp	Germany	$12,801	Interior systems, chassis systems

Source: Automotive News, 2015; authors.

Contracts for parts and sub-systems are large and long-lived. There is good reason for Tier 1 suppliers to make the investments needed to win contracts from lead firms. Motor vehicles typically take several years to design, and platforms can stay in production for up to 10 years, with only modest changes to appearance and features. This means that contracts for parts and sub-systems have a long lifecycle, even if automakers systematically switch suppliers between vehicle development projects to keep supplier power at in check, as some US and Europe-based automakers have been reported to do.

As automakers set up final assembly plants in new locations, they pressured existing suppliers to move abroad. While Tier 1 suppliers are not considered 'risk-sharing partners,' as some of the largest aircraft systems suppliers are, with profit-sharing tied to sales performance of final products, they do undertake R&D, collaborate with automakers during the vehicle development process, produce parts in multiple geographic locations, and take on warranty responsibility for the parts and subsystems they produce. Increasingly, these characteristics—especially having broad capabilities to design and produce modules and systems as well as having a "global footprint" with technical engineering centers located near automaker design facilities and an international network of plants to serve automakers in or near the markets where final assembly takes place—have become prerequisites for being considered for a project. As a result, countries with very large-scale production—nations such as China, India, and Mexico—stand the best chance of developing domestic first tier automotive suppliers with the scale, capabilities, and relationships required to compete internationally.

A complex global supply base is emerging in the automotive industry. The competing pressures of centralized sourcing (for cost reduction and scale) and regional production (for just-in-time and local content) are sometimes in conflict. The need for full co-location of parts with final assembly varies by type of component, or even in stages of production for a single complex component or sub-system. Suppliers with a global presence can concentrate volume production of specific components in one or two locations and ship them to warehouses close to their customer's final assembly plants where modules and sub-systems are built up and transferred to final assembly lines as needed.

Many of the largest suppliers focus almost exclusively on the motor vehicle industry, although it should be stressed that some are automotive divisions of diversified companies, especially from adjacent industries such as consumer electronics and semiconductors.[10] While all of the suppliers listed in Table 4 can be considered "first tier" in the sense that they sell directly to automakers, some also sell components to suppliers of more complex systems, and therefore play a "lower tier" role in some instances. In certain cases,[11] these suppliers can have substantial market power, technical capability, and intellectual property ownership and provide complex parts, even as "lower tier" suppliers.

Ownership of large suppliers is highly concentrated in industrialized countries that have been traditionally been home to market-leading automakers (based in Europe, the US, and Japan). There are only a handful of exceptions among the largest suppliers in the world—Yanfeng AutoTrim Systems (ranked 26th in the world and based in China), Samvardhana Motherson (ranked 41st, based in India), and Nemak Libramiento (ranked 51st, based in Mexico), along with four South Korean companies, three of which are Hyundai group companies (ranked 6th, 32nd 45th, and 54th).

2.4. Upgrading in the Automotive GVC

The motor vehicle industry has long been emblematic of industrial development. Highly successful brands have been a source of national pride, domestic production a source of (relatively) stable employment, and exports are an important source of foreign exchange. Fully integrated automotive industries create large-scale manufacturing and are anchored by vehicle design and development centers with the wage, employment, and education spillovers associated with high technology clusters. However, technological and investment barriers to the industry are extremely high—only a few internationally successful automotive companies have been founded after World War II, with the most prominent being Hyundai in South Korea.

Nevertheless, because of its emblematic character and perceived benefits, industrial policies often focus on the development of the automotive sector, even in cases when the industry is a poor match for a country's markets, industrial base, geography, skills, or level of development (Humphrey & Memedovic, 2003. Trade barriers to the import of finished vehicles are common, as are local content requirements for domestically produced vehicles. The result is a bevy of

[10] The automotive divisions of Panasonic and Hitachi are two examples.
[11] Electric motors made by Bosch or semiconductors made by Hitachi would be two examples.

small, incomplete production clusters throughout the developing world, dominated by foreign assemblers that operate in high tension with policies that demand increasingly higher local content. Table 5 presents an overview of both traditional and emergent policy approaches to upgrading in the sector.

Table 5. Possible Industrial Policy Strategies for Upgrading in the Automotive GVC

Strategic Approach	Description	Examples
Traditional Path		
Fully vertical export-oriented industry	— National brands and suppliers	— South Korea: Hyundai
Fully vertical for local market	— Attract FDI to serve local market — Institute local content rules to stimulate assembly employment and local supply base — Assemble vehicles for local market	— China — South Africa — Thailand
Specialization within regional production network	— Attract FDI for assembly and/or parts manufacturing — Integrate into low cost portion of regional production systems	— Mexico — Turkey — Poland — Czech Republic
Parts specialization for regional or global exports	— Specialize in one or a few parts and subsystems for export	— Taiwan — Nicaragua — Macedonia
Emergent Path		
Entry as systems integrator for finished vehicles	— Branded motor vehicles — Rely on design and engineering consultancies and major global module and sub-systems suppliers — Shift to electric vehicles could open up opportunities for new entrants	— China: Chery — Iran: Iran Khodro — Malaysia: Proton (failed) — China: BYD (electric, mass market) — USA: Tesla (electric, high end)
Parts production → exports → outward FDI	— Focus on product and process upgrading to expand capabilities and scope — Move from components to sub-assemblies (functional upgrading) — Gradually increase competencies — Growth through acquisition (FDI) — Locate technical centers in global design clusters	— Argentina: Basso — China: Yanfeng Automotive Trim Services

Source: Authors.

The first strategy for upgrading listed—(1)development of a fully vertical industry, with national brands and suppliers—is generally not feasible for many developing countries. Other traditional options for spurring development in the automotive manufacturing GVC at the country level include the following: (2) Attracting FDI to serve the local market and instituting local content rules to stimulate assembly employment and the local supply base (examples include China, South Africa, Thailand, and the Philippines); (3) Attracting FDI for assembly and/or parts manufacturing as a low cost portion of regional production systems (Mexico, Turkey, Poland, and the Czech Republic); and, (4) Specializing in one or a few parts and subsystems for export, either for use in final assembly for parts sold as replacement parts aftermarkets and to repair shops (Taiwan, Nicaragua, and Macedonia).

Changes in the structure of GVCs and in vehicle technology could be opening up new, more promising upgrading alternatives for emerging economies. Specifically, two upgrading trajectories can be added to the four mentioned above: (5) Systems integration, where local vehicle companies rely on global suppliers and engineering consultancies to develop their own branded products; and (6) Development of new products and mobility solutions based on simpler electric drive trains, and localizing as much production as possible. The rest of the section outlines why smaller market countries should consider concentrating on pursuing two promising upgrading strategies—functional upgrading into systems integrator status, and product upgrading in existing, export-oriented parts and components production—rather than developing a fully vertical industry.

Functional upgrading into acting as systems integrator. This describes entry into the value chain at the level of vehicle development, branding, and marketing. Traditionally, this path has not been open for new entrants to the automotive industry because of the integrated nature of motor vehicles as well as high product complexity, capital, and knowledge requirements. While noise, vibration, and handling characteristics can quickly become unacceptable to consumers in vehicles that are poorly engineered, with the rise of global design and engineering consultancies as well as module and system engineering capabilities in first-tier global suppliers, companies such as China's Chery and Iran Khodro have been able to develop and market vehicles suitable for their local markets, if not large-scale export. This upgrading strategy could become easier with the advent of fully electric vehicles, which are simpler and less demanding from a vibration and handling perspective (see Box 1 below).

Box 1. E-Vehicles Could Lead to Transformative Change

Electric vehicles are the source of global interest, with roughly 665,000 e-vehicles in use around the world at the end of 2014 (IEA, 2015). With high-population countries such as China and India embracing the technology, demand is expected to continue to surge in the decades ahead.

As e-vehicle development gains further traction, it could lead to transformative change within the industry. Possible results include a new era of "modular" vehicle design and industry standards that encourage the emergence of brands that break the dominance of the largest automakers as well as fresh opportunities for chain entry in both design and production.

A dynamic that is currently percolating through the industry involves which technologies will become dominant. E-vehicles replace the internal combustion engine with an electrified powertrain and can be divided into four categories: 1. Plugged-in hybrid electric vehicles (PHEVs); 2. Range Extended Electric Vehicles (REEVs); 3. Battery Electric Vehicles (BEVs); and 4. Fuel Cell Electric Vehicles (FCEV). Various lead firms are betting on the different power-generation models, with Japanese manufacturers favoring FCEVs (or hydrogen fuel cells), while the Chinese market is concentrating on BEVs and PHEVs.

Sources: IEA, 2015; Reuters, 2015.

Box 2. Wire Harnesses, an Evolving Niche for Developing Countries

Systems that were once controlled in motor vehicles through mechanical systems—instrumentation, acceleration, seat adjustment, window and brake actuation—are now controlled through electronic controls. Wire harnesses help distribute and control the flow of these electrical and electronic power and impulses through the vehicle and are a part of the chassis electronics module shown in Figure 1.[12] More than just bundles of wires with connectors, they include many high-cost electronic control modules and tend to be one of the more costly components in an automobile. By some estimates, wire harnesses account for roughly one-quarter of the value of the vehicle, and the market for the units is projected to be the second largest for automotive electronics in 2020, trailing only telematics (GPS and other navigation systems) (Deloitte, 2013). Leading global companies specializing in wiring systems include Yazaki (Japan), Sumitomo (Japan), Denso (US), Leoni (Germany), Delphi (US), Fujikura (Japan), Furukawa Electric (Japan), and Lear (US).

Developing countries have managed to use some of their competitive advantages to establish themselves as significant exporters of wire harnesses. The assembly process is labor intensive—as much as 400-500 minutes to complete a single unit—and allows for locations with low labor costs to be attractive targets for FDI. Additionally, the current market dynamics allow for country-level product and process upgrades—while wire harnesses are increasingly complex in one sense as new systems are added to vehicles and electric and hybrid drive trains introduce higher electronic content, there is also decreasing complexity in another sense as electronic control modules encapsulate more features. Table 6 the top 10 global exporters of wire harnesses. Mexico is the leading exporter, but the countries in the top 10 with the highest growth rate in exports are Morocco, the Philippines, and China.

Table 6. Top 10 World Exporters of Wire Harnesses in 2014, 2007-2014

Exporter	Value ($US, Billions)				World Share (%)				CAGR (%)
	2007	2010	2012	2014	2007	2010	2012	2014	2007-14
World	**21.1**	**22.7**	**28.3**	**32.2**					**6%**
Mexico	5.1	3.9	5.4	7.2	24.3	17.2	19.1	22.5	5%
China	2.1	2.5	3.3	3.2	9.9	10.9	11.6	9.9	6%
Romania	1.9	1.9	2.2	2.6	8.8	8.2	7.9	8.1	5%
Philippines	0.9	1.1	1.4	2.0	4.2	4.9	5.1	6.3	13%
USA	1.7	1.5	1.9	1.9	8.1	6.6	6.6	5.9	2%
Germany	1.1	1.1	1.2	1.5	5.1	4.8	4.3	4.7	5%
Morocco	0.0	1.1	1.0	1.3	0.0	4.7	3.4	3.9	313%
Poland	1.3	0.9	0.9	1.2	6.0	4.1	3.1	3.7	-1%
Czech Rep.	0.9	0.8	0.9	1.1	4.3	3.5	3.2	3.3	2%
Ukraine	—	0.6	0.8	1.0	—	2.8	2.8	3.2	—
Top 10 (2014)	**14.9**	**15.4**	**19.0**	**23.0**	**70.6**	**67.7**	**67.1**	**71.5**	**6%**

Source: UN Comtrade. HS02 code 854430, reporters' exports to the world. Retrieved on October 28, 2015.

[12] In reality, wire harnesses have come to connect many more systems in the vehicle, and in fact provide interconnection across all four major vehicle systems: interior (safety systems such as airbags), chassis (electronic engine control, active suspension, anti-lock brakes, across all the components of a vehicle including its lights, wipers, electrical devices and other electronics components.

Product and process upgrading to increase sub-assemblies and component manufacturing capabilities. This trajectory involves a gradual increase of competencies and acquisition of skills from the bottom up through simple components manufacturing and assembly support to providing engineering and design support in the development of new sub-assemblies. Then the path involves increasing the scope of goods and services provided, to system and module design and production, and eventually, outward FDI to serve international lead firms more effectively.

There are prominent examples of this trajectory. Basso SA is an Argentinian-based producer of combustion engine valves for General Motors, BMW, Ford, Audi, Ferrari, and many others. Basso began in 1963 as an aftermarket producer, but began to supply the local affiliate of Peugeot in the 1970s. The company upgraded its capabilities and expanded its international customer list through competition with another valve producer in Argentina, Edival (acquired by the Brazilian subsidiary of Germany's Mahle Group on 2007). When Peugeot withdrew from Argentina in 1981, Basso was able to survive; today, it produces more than 18.5 million valves per year according to 2,500 designs, employs 900, and exports 85% of its production to 33 countries on five continents. In order to comply with its commitments regarding just-in-time delivery services, the company maintains a permanent stock of goods in warehouses and is able to cope with various transportation and/or logistics eventualities in the country (González et al, 2012, Basso).

Another example is Yanfeng Automotive Trim Systems, which produces interior, exterior, car seating, electronics, and safety components and is based in Shanghai, China. The firm began as a division of SAIC, formed JV with Ford's spun off internal parts division in 1994 and remains a wholly owned subsidiary of HASCO, the component group of SAIC. As it has evolved, the company has set up facilities in India, Germany, and the US. In North America, the company operates two facilities in the Detroit region with a third facility added in 2012 in Missouri, where the company will provide door trim panels, floor consoles, and instrument panels to nearby General Motors assembly facilities. In 2014, the US-based global supplier of industrial controls and automotive interior systems, Johnson Controls, sold its automotive division to Yangfeng, while retaining a 30% stake in the JV. The new company represents US$7.5 billion in sales (Automotive News, 2014).

3. Lessons for Upgrading from Vietnam and Thailand

The fragmentation of the production network and the general industry trends described in the global section—global trade in parts and components, regional trade in sub-systems, and assembly of vehicles in final markets—have allowed a host of countries to enter and improve their positions in the automotive GVC. Table 5 provided examples of many of these, organizing them into six overall industrial policy strategies. This section focuses on the experiences of Vietnam and Thailand as they have attempted to develop their automotive industries.

Each case study has relevance for the Philippines as it tries to improve its position in the chain. Vietnam is most useful in providing examples of steps that should be avoided—the development

of the country's supply base has been hurt by the excessive issuance of investment licenses in the mid-1990s. Meanwhile, Thailand has had success in becoming a regional automotive hub, thereby providing a number of policy lessons for countries looking to replicate its accomplishments.

3.1. Vietnam[13]

While Vietnam is a key production hub for the world's leading motorcycle producers,[14] its automotive industry has been characterized by low demand and excessive fragmentation of assembly plants. With the exception of wire harnesses, domestic production of auto parts to date has failed to develop in a significant manner or enter global or regional chains, despite considerable government efforts. The following section examines the dynamics surrounding the country's automotive industry in further detail.

Industry Development

Prior to 1991, the domestic automotive industry in Vietnam consisted mainly of Auto Hoa Binh, a state-run manufacturer of military vehicles that first opened in Hanoi in 1951. Some parts were supplied by other state-run enterprises, located mostly in the Hanoi area, and others were imported. The tiny demand for passenger vehicles in Vietnam was met through the import of fully assembled Soviet-built sedans. Other state-run companies manufactured agricultural vehicles, freight trucks, and construction vehicles, but these companies struggled to compete with imports from the Soviet Union and China.

The capabilities of local producers were enhanced in 1991 by a series of government-backed JVs. Auto Hoa Binh formed a JV partnership, called Vietnam Motors Corp. (VMC), with Colombian Motors (Philippines) and Nichmen Corp. (Japan), two companies with a pre-existing JVs to assemble passenger vehicle kits in the Philippines under license from various automakers. This set a pattern of multiple brand contract assembly that still dominates the business models of local producers. VMC began to assemble passenger vehicle kits supplied by Kia (Korea), Mazda (Japan), BMW (Germany), and Subaru (Japan). In 1992, VMC was joined by Mekong Corp., another JV—this one backed mostly by financial capital from Korea—to assemble sport-utility vehicle kits supplied by Mitsubishi (Japan), and a few passenger car kits supplied by Fiat (Italy). Although the Vietnamese market for motor vehicles was and is very small, these two assemblers remained fairly profitable because they manufactured unique vehicle types for the market and had little other competition.

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[13] The following section is based on two World Bank studies conducted on the Vietnamese automotive industry: one led by the author (Timothy Sturgeon), the other by Roland Berger Strategy Consultants. (2014). Automotive Value Chain—Global Outlook: Study on Future Automotive Growth Markets. The following publication provided additional insight: Sturgeon, Timothy. (1998). "The automotive industry in Vietnam: Prospects for development in a globalizing economy Industrial Competitiveness Review." Ministry of Planning and Investment, Hanoi, Vietnam.

[14] Motorcycles and scooters are the most common means of transport in Vietnam. Approximately 40 million units were registered in 2014 for a population of 90 million, making Vietnam the fourth largest two-wheeler market in the world after China, India, and Indonesia. The five largest motorbike makers in the country—Honda (Japan), Yamaha (Japan), SYM (China), Suzuki (Japan) and Piaggio (Italy)—are expected to raise their annual capacity to a total of 5.5 million units by the end of 2015, up from 4 million units. Vietnam's motorbike exports have grown between 10-20% annually in recent years.

The roots of Vietnam's poorly performing passenger vehicle industry can be traced to the excessive issuance of investment licenses in 1995-1996. In 1995, the Vietnamese government, seeking to both decrease consumer prices and build up the automotive industry, issued three additional licenses for automotive assembly JVs. By 1996, Mitsubishi (Japan), Daewoo (Korea), and Daimler Benz (Germany) had opened JV enterprises in to assemble passenger vehicles, light utility trucks, and passenger vans. After these plants were established, the Vietnamese government issued eight additional licenses—this time the list included the world's largest producers setting up their own, single-brand factories. By the end of 1997, Isuzu, Hino, Daihatsu, Toyota (all from Japan and the latter three from the Toyota Group of companies), and Ford (US) had plants in operation, bringing the total number of vehicle assembly plants in Vietnam to eleven (Berger, 2014). By early 1998, in the face of stiff competition and sagging demand, Nissan (Japan) put the construction of its assembly plant in Da Nang on hold, and Peugeot (France) and Chrysler (US) chose not to act on their license agreements.

Today, Vietnam's passenger vehicle final assembly sector continues to suffer from excessive fragmentation, which leads directly to low volume production, high cost, excess capacity, and low profitability at most facilities. In 2013, total passenger vehicle production capacity in Vietnam's 14 assembly plants amounted to 182,500, while sales were only 127,000 (Berger, 2014).[15]

Automobile assembly is both a capital and a labor-intensive process. Even with the smallest and simplest plants, a great deal of plant and equipment must be built and installed before the first vehicle can be manufactured. These include plant structures, machining and welding stations, galvanizing facilities and paint shops. Because automakers must maintain good rates of capital utilization to return a profit on their investments, the profitability for the automotive JVs in Vietnam depends on maintaining reasonably high production volumes.

In addition, low volume production does not justify large-scale localization of parts production. While vehicles use similar parts, the exact design and configuration of many parts tend to be model-specific, so parts makers have difficulty reaping economies of scale with a fragmented production base. As a result, most parts are imported from high volume facilities overseas. Because auto parts constitute about 90% of the value of finished vehicles, Vietnam's passenger vehicle industry will continue to languish as long as the market is characterized by low domestic demand and negligible exports.

3.2. Thailand

In contrast to Vietnam's weak performance, in 2013, Thailand's automotive industry manufactured 2.5 million units, 46% of which were destined for export markets (Maybank, 2015). The industry, which began in the early 1960s with the construction of plants to assemble CKD units, has developed into competitive clusters of multinational assemblers and their parts and components suppliers for whom Thailand has become a key regional hub (Natsuda & Thoburn, 2013). With strong growth periods in the 1970s and 1990s, auto clusters, such as Eastern Seaboard, attracted significant number of part manufacturers in Industrial Estates (IEs)

[15] For sake of comparison, that represents roughly 60% of the capacity of a typical plant in a large market such as the US.

that offered quality infrastructure, and tax and tariff incentives for investors (Lecler, 2002). By 2012, the Thai automotive industry comprised of 2,355 firms, 635 of them Tier I suppliers, and employed 525,000 workers (Debrand, 2014).

Most of the assemblers are subsidiaries of multinational corporations (MNCs). The landscape is populated by Japanese lead firms as well as one of the big three American companies (General Motors) (Intarakumnerd & Charoenporn, 2015). Pick-up trucks are a focus for all lead firms and account for over half of vehicles produced in Thailand, positioning the country as the world's second largest producer after the US (Brimble & Doner, 2007).

Among foreign assemblers, Toyota was the largest brand with domestic sales of 516,086 units in 2012, followed by Isuzu, Honda, Mitsubishi and then Nissan (Doner et al., 2013). Since the early 2000s, foreign auto assemblers have also exhibited greater interest in conducting technologically sophisticated activities of research and development (R&D) in Thailand. Toyota set up the "Toyota Technical Centre Asia Pacific Thailand" as one of its five worldwide R&D centers (Doner et al., 2013). Subsequent to the impressive growth of the industry output over the past decades, the country has been proactively promoting university–industry linkages (UILs) to support functional upgrading into R&D activities.

Policy Environment

Since the 1960s, the Thai government has effectively implemented selective industrial policies encouraging inflow of FDI in the automotive industry. The dynamic policy framework has shifted its focus from the initial import substitution and assembly of CKD kits to promoting domestic parts manufacturing, exports, and functional upgrading in product R&D activities. The following section presents an overview of the Thai government policies to support development of automotive industry since the 1960s.

Initial Policies of Import Substitution: Thailand's 'Industrial Investment Promotion Act' in 1960 introduced the first set of trade and investment incentives to support local automotive industry (Natsuda & Thoburn, 2013). Throughout the 1960s and 1970s, these incentives included temporary corporate tax exemptions, tariff reductions on imports of inputs and machinery, and infrastructure development, including deregulation of land ownership. Supporting local assembly operations in a domestic-oriented automotive industry, tariff rates on imported CKD kits were set at 50% of that for CBU units for which tariff rates were 60 and 40%, respectively, for passenger and commercial vehicles (Natsuda & Thoburn, 2013). In response to these policy incentives, Thai automobile company, a JV between Ford, UK, and Anglo Thai Motor, was established in 1961 and launched the first local assembly operations for imported CKD kits in the country. By late 1960s, six major foreign automobile companies were established and the number of vehicles produced in Thailand during this period rose from a 525 vehicles in 1961 to over 10,000 units (Natsuda & Thoburn, 2013).

Promoting and Consolidating Domestic Part Manufacturing: During the 1970s and 1980s, the Thai government supported domestic parts manufacturing industry through protective trade barriers and investment incentives, favoring FDI and JVs with MNCs. Support to the local parts manufacturing industry was triggered by the serious balance of trade and payment deficits arising from the heavy reliance on imported CKD kits for a domestic-oriented automotive

industry (Doner, 1991). In response, the Ministry of Industry, through the Automotive Development Committee, introduced special tax incentives to promote local production of particular parts such as tires, batteries, radiators, and leaf springs (Natsuda & Thoburn, 2013).

In 1971, the government introduced a package of policies which imposed local content requirements (LCR) of 25% to reduce dependence on parts imports (Natsuda & Thoburn, 2013). It also restricted market entry in the assembly segment to production capacity of at least 30 units per day in order to better achieve economies of scale. Driven by the LCR policy, MNC parts manufacturers, particularly from Japan (such as Denso), established JVs in Thailand in order to supply locally produced parts to the Japanese assemblers.

To consolidate domestic part manufacturing industry, the government introduced more explicit industry-specific policies in 1978 where LCRs were progressively raised, particularly on pick-up trucks. Starting in 1978, LCRs for passenger vehicles were raised from 25% to 35% in the first two years and then increased by 5% every year until 1983. LCRs for commercial vehicles was raised from 20% in 1978 to 51% in 1987 (Natsuda & Thoburn, 2013). Additionally, the Ministry of Commerce (MOC) imposed an outright ban on import of passenger vehicle CBUs for the period 1978 to 1991.

Whereas LCR remained a key part of government policy and it steadily brought about greater participation of Thai firms in the industry, a "mandatory deletion" scheme was later introduced in 1986. The scheme enforced complete local sourcing of specific parts such as brake drums and exhaust systems, for which domestic industry was capable to manufacture locally (Doner, 1991). Furthermore, the government mandated assemblers to use locally-made diesel engines for their pick-up trucks in 1989 (Natsuda & Thoburn, 2013).

Promoting Liberalization and Exports: The 1990s marked a turning point for Thai government policies. There was a shift from the domestic-oriented protected industry to liberalization and export promotion. To facilitate increased FDI inflow, foreign ownership in the automobile assembly industry was deregulated, allowing 100% foreign ownership through JVs provided they exported 60% of their total production (Natsuda & Thoburn, 2013). In 1991, the government lifted the ban on imports of passenger CBUs and substantially reduced tariffs on both CBUs and CKDs. The abolition of LCR came in early 2000s after Thailand became a member of World Trade Organization (WTO).

The liberalization policies also spurred increased competition in parts manufacturing, particularly, by attracting FDI from non-Japanese automobile assemblers. American components suppliers such as Dana, Visteon, and Delphi followed American assemblers such Ford, Chrysler, and GM in establishing operations in Thailand (Natsuda & Thoburn, 2013). In the late 1990s, however, the Thai auto industry was severely affected by the Asian currency crisis in 1997 and the sharp decline in domestic demand of vehicles.

Supporting 'Product Champions': In the aftermath of the 1997 Asian crisis, there was a sharp decline in domestic demand of vehicles. The Thai government followed by abolishing the LCR in 2000 before it then adopted a selective policy of picking a winner product model, or *product champion.* In 2002, the "New Automotive Investment Policy" chose pick-up trucks, and later in

2007 "Eco-cars," creating particular market demands that were used as leverage to attract FDI in specific models and the associated part manufacturing industries (Natsuda & Thoburn, 2014). To facilitate development of local industry capabilities, the plan tailored both excise and corporate tax policies including exemption of corporate tax for a period of 3-8 years for parts manufacturers.

In response to these policies, Toyota and Isuzu relocated their global pick-up truck production base from Japan to Thailand. In 2005, Toyota also established in Thailand its first R&D center outside of North America and Europe, and it was followed by Isuzu and Honda (Natsuda & Thoburn, 2013). Although five Japanese firms—Nissan, Honda, Suzuki, Mitsubishi, and Toyota—as well as Volkswagen and Tata Motors initially obtained investment approval in 'Eco-car' industry, only the Japanese firms established operations. In 2010, Nissan commenced its first 'Eco Car' production operations, manufacturing 59,441 units and exporting 42,328 units mostly to Japanese market (Natsuda & Thoburn, 2013).

***Formalizing Government-Business Relationship*:** To promote effective interaction between government and the automotive industry, MOI approved creation of the Thai Auto-Parts Manufacturers Association (TAPMA) in 1978 (TAPMA, 2016). TAPMA is a union of auto parts manufacturing firms and it aims to serve as the central voice for auto parts firms in the country in order to protect, support and develop Thai industry. Later in 1998, MOI ordered creation of the Thailand Automotive Institute (TAI), an independent organization facilitating links between the government and the private sector (TAI, 2016). TAI responsibility is broader in scope. TAI's committee, comprised of representatives from the government, industry and the academia, is mandated to advise policy and strategic opportunities for public and private collaboration related to production technology development, human capital and market development. In addition, TAI provides services in product analysis, testing, inspection and certification in its ISO/IEC 17025 certified testing laboratories (TAI, 2016).

Infrastructure Development: The Thai government encouraged FDI inflow by establishing IEs that offered quality infrastructure. Ladkrabang in Bangkok area and Samrong in the Samut Prakan Provinces—which is a 40-minute drive from central Bangkok—were the first IEs the Thai government established to attract foreign investors in the automotive industry in the 1970s-80s (Lecler, 2002). The next wave of IEs, Chonburi, Laem-Cha-Bang, and Eastern Seaboard, were established in the 1990s along highways connecting the Central Bangkok area, and they were equipped with modern infrastructure, including broadband communication and transport links to deep sea ports and airports (Lecler, 2002). To promote economic opportunities in outskirts of the capital, high incentives were also associated with investment in these new IEs, depending on their distance from Bangkok. The incentives supported three zones of industrialization with a classification in terms of tax exemptions, tariffs reductions, and lower cost of energy (Lecler, 2002).

***Human Capital and Research and Development Capabilities*:** Since the 1990s, the Thai government has initiated several policy measures to improve UILs for enhanced R&D and human capital development in the automotive industry. During the 1999-2005, the Higher Education Development Project (HEDP), partly financed by the Asian Development Bank, created seven centers of excellence designed to foster collaboration between universities and

the private sector (Doner et al., 2013). The HEDP was followed by the National Research University (NRU) project in 2009, and the National Science Technology and Innovation Policy and Plan (NSTIPP) 2012–2021, which increasingly have grown in sophistication (Doner et al., 2013; Siripitakchai & Miyazaki, 2015). These initiatives both provided policy incentives including the provision of R&D research grants, matching grants, and tax-incentives as well as support to establishment of technology licensing offices (TLOs), business incubation units in universities, and geographic area-based networks of industry, university and local government agencies to solve local problems. These networks has encompassed three regional science parks in major universities in the north (Chiang Mai University), northeast (Konkaen University) and south (Prince of Songkla University) of Thailand by 2015, and 10 centers of excellence in universities, public research institutes and government agencies by 2017 (Doner et al., 2013).

The resulting UILs include Toyota's supported bachelor-degree program in its automotive engineering at Chulalongkorn University, graduating 15 automotive engineers every year since the early 1990s (Doner et al., 2013). Additionally, a master program on automotive engineering, with a focus on industrial R&D practice and on modern manufacturing processes of vehicles and their subsystems, was established in 2004 as a result of collaboration between companies like BMW, DaimlerChrysler, Siemens, as well as Asian and American manufacturers and the Thai-German Graduate School of Engineering at King Mongkut's University of Technology in North Bangkok (Doner et al., 2013).

Due to the important role of "technicians" both at the shop floor lever and also in making prototype for new products, Toyota has set up its own technical college in 1998 under the name 'Toyota Automotive Technological College' (Doner et al., 2013). In 2006, with the encouragement of TAI, several large Japanese firms created the Automotive Human Resources Development Project (AHRDP) which is essentially a 'train-the-trainer' program involving cross-firm agreement on skill-specific certification standards and training curricula for technicians (Doner et al., 2013).

Nevertheless, R&D and human resource development have occurred largely 'within' foreign firms, such as the Toyota Technical Center—Asia-Pacific (TTCAP), which operates as an R&D base for Toyota's global operations and offers product design, testing and evaluation services for regional conditions (Brimble & Doner, 2007; Doner et al., 2013).The largest hurdle keeping Thai universities from being valuable innovation partners has been the generally low level of scientific and technological research capacity and limited commercial orientation within the university system (Doner et al., 2013). Most universities in Thailand are primarily devoted to teaching. From the 74 public and private universities in the country, only nine universities, including King Mongkut's University of Technology Thonburi (KMUTT), Mahidol University (MU), Suranaree University of Technology (SUT), were qualified as NRUs and provided 3,000 million Baht per year (US$100 million) to undertake research (Doner et al., 2013). These weaknesses are in turn a function of weak downstream demand by indigenous Thai firms.

4. The Philippines and the Automotive Global Value Chain

Once an automotive pioneer within Southeast Asia, the Philippines' motor vehicles industry largely atrophied over the second half of the 20th century. Low demand and insufficient economies of scale were perhaps the most pronounced reasons for the decline, although shifting policy focuses, outdated production processes, high raw material prices, and a robust market for smuggled vehicles also played a role (Ofreneo, 2016). Constrained by these factors, the country today occupies a peripheral place in automotive GVCs; while it exports wire harnesses in high volume, exports of other automotive parts are relatively modest—overall, the country accounted for just 0.3% of world automotive sector exports in 2014. Table 7 lists the country's exports from 2007 to 2014 by value chain segment as well as the share Philippines' share of exports by category. Wire harnesses represented 85% of exports within the electrical systems category in 2014, which in turn accounted for nearly 60% of the country's auto exports in the same year. Exports of finished vehicles fell from US$127 million in 2010 to US$8 million in 2014.

Table 7. Philippine Automotive Exports by Value Chain Segment, 2007-2014

Value Chain Stage and Sector	Value (US$, millions)				Philippines Share of World Exports (%)		Share of Philippines Auto Exports (%)	CAGR (%)
	2007	2010	2012	2014	2007	2014	2014	2007-14
Total	**2,988**	**3,351**	**3,479**	**3,988**	**0.3**	**0.3**		**4%**
Components	**2,923**	**3,223**	**3,423**	**3,980**	**0.6**	**0.6**	**99.8**	**5%**
Of the body system	896	769	558	514	0.5	0.2	12.9	-8%
Of the drive train	170	354	366	405	0.2	0.3	10.1	13%
Electrical systems	995	1,213	1,725	2,387	1.4	2.1	59.9	13%
Of body or drive train	862	888	773	674	0.9	0.7	16.9	-3%
Subassemblies	**1**	**0.003**	**0.007**	—	**0.0**	—	—	—
Body system	—	—	—	—	—	—	—	—
Drive train	1	0.003	0.007	—	0.0	—	—	—
Final Passenger Vehicles	**63**	**127**	**56**	**8**	**0.0**	**0.0**	**0.2**	**-25%**

Source: UNComtrade, HS02 6D, Philippines exports to the world. Retrieved on 10/28/15. Updated 4/11/16.

There are indications the landscape is evolving. While the country's sales of 288,609 vehicles in 2015 still put it behind ASEAN peers such as Indonesia, Malaysia, and Thailand, strong macroeconomic growth has helped boost demand for passenger and commercial motor vehicles by 104% from 2011-2015,[16] the highest growth rate in the region (see Table 15 for a comparison of vehicle sales in ASEAN). Furthermore, the Chamber of Automotive Manufacturers of the Philippines (CAMPI) projects that total demand for automobiles will reach

[16] The country's annual GDP growth rate averaged 5.8% from 2011-15 (Economist Intelligence Unit, 2016). Additionally, the Philippines' large population compared against its relatively low car density has also been credited for helping fuel high vehicle sales (Ofreneo, 2016).

500,000 units by 2020 (CAMPI, 2015).[17] Although progress is notable, it is important to highlight that 500,000 units is roughly equal to 1.5 fully scaled passenger vehicle assembly plants.

To take advantage of the country's favorable demand trajectory, the Philippines' government introduced the Comprehensive Automotive Resurgence Strategy (CARS) program in 2015 in order to increase the number of vehicles that are assembled in country. Incentives will be provided to manufacturers who commit to producing at least 200,000 units of a particular model in the country while also using domestically produced inputs to account for at least 50% of the body weight of the vehicle over a six-year period. The hope is the program will not only help the country increase its assembly capabilities,[18] but that it will generate the necessary economies of scale to boost the local network of Tier I, II, and III suppliers and help close the most prominent gaps in the supply chain.

This section analyzes the evolution of the automotive industry in the Philippines, first examining the various policy regimes that helped give shape to the sector. After identifying critical players within the country, it discusses the country's participation in automotive GVCs by analyzing the composition of critical export niches. An analysis of industry upgrading then follows before the chapter outlines the sector's workforce and institutional context. It concludes by assessing potential upgrading trajectories, concentrating on the segments of the chain where the country appears to have meaningful advantages.

4.1. The Development of the Auto Industry in the Philippines

The Philippines government has implemented a range of programs throughout the years to stimulate and support the country's automotive industry. As a result of attention paid to the sector, several lead firms or branded automakers have had a presence in the Philippines for an extended period, although external events as well as the changes in government policies have caused fluctuations in the identity and investment profile of these prominent actors. The current period is notable for having a small circle of lead firms, especially since the exit of Ford in 2012. Table 8 summarizes the policy regimes in various periods of the industry's development.

[17] It should be noted that the addition of roughly 200,000 motor vehicles to the Philippines' streets will have negative implications for Manila's already congested highways and roads, possibly impairing demand for new motor vehicles. The difficulty that traffic presents when traveling around the country by car was one of the reasons the World Economic Forum ranked the Philippines 97th out of 140 countries in the world for road infrastructure, which was the lowest score for regional peers in Southeast Asia (World Economic Forum, 2015). The National Economic Development Authority (NEDA) commissioned a study that led to the 2014 Dream Plan, which is a roadmap for transport infrastructure development in metro Manila and surround regions. Recommendations from the project included the construction of major arterial roads and the expansion of a mass transit system (Almec Corporation, 2014). However, there are questions about the financing of the proposals, which may delay some of the projects.

[18] In this regard, the Philippines still lags behind regional peers—it was the only ASEAN nation to generate less than 100,000 CKD motor vehicles in 2015 (AAF, 2015).

Table 8. Investment Regimes for the Philippines Automotive Industry, 1916-2015

Era	Years	Features
CBU Importation period	1916-1950	Importation of CBUs from the US.
Import-substitution industrialization	1951-1972	Import Control Law (1950) prohibited the import of automobiles. Ford, Chrysler (eventually became Mitsubishi), General Motors set up CKD facilities.
Progressive Car Manufacturing Program (PCMP)	1972-1986	Local content requirements that started at 15% but eventually reached 80%. Participants had to establish parts plants for export, and CKD facilities were limited to PCMP companies.
Car Development Program (CDP)	1987-2001	Local content requirements at 32%-40%. Eventually attracted 13 lead firms before Asian Financial Crisis.
Motor Vehicle Development Program (MDVP)	2002-2015	Tariff reductions for importation of auto parts and raw materials. Incentives for exporters of CBUs and parts. Instituted a value-based excise system that levied taxes against popular models of vehicles.
Comprehensive Automotive Resurgence Strategy (CARS)	2015-present	Financial incentives for companies that commit to sourcing 50% of body weight of vehicle domestically and generating 200,000 units of one model of car in the Philippines over six years. The program is open to no more than three companies (and models), thereby attempting to ensure suppliers have sufficient demand to generate economies of scale.

Source: PACCI, 2012; Ofreneo, 2016; authors.

4.1.1. Investment Regimes[19]

The automotive industry in the Philippines began to take shape in the 1930s and 1940s assembling completely built up units (CBUs) from American manufacturers.[20] That changed in 1950, when the country passed an import controls law designed to boost domestic production through import bans and high tariffs. American companies such as General Motors, Ford, and Chrysler set up completely knocked down (CKD) operations during this time period to conform to the laws, and the first assembly plant was established by Fabar, Inc., which put together passenger cars and trucks from CKD kits. Import controls were lifted in the 1960s, but import-substitution industrialization remained the dominant paradigm with tariffs as high as 100%. The Progressive Car Manufacturing Program (PCMP), implemented in 1972, then followed this trajectory by including local content requirements that eventually reached as high as 80%.

PCMP had its successes—the number of domestic suppliers jumped from 34 in 1974 to more than 200 in 1979—but a series of economic crises in the Philippines in the 1980s forced many participants to exit the market. In response to the changed landscape after the restoration of democratic rule in 1986, as well as stipulations mandated by the World Bank as part of their

[19] The material presented in this sub-section is based on PACCI (2012), DTI (2014), and Ofreneo (2016).
[20] As highlighted earlier, CKD unit involve parts that are collected from high-volume assembly plants, placed in shipping containers, and send to low volume final assembly plants in small market countries. CBU models are when motor vehicles are assembled in a centralized location and then shipped final destinations where finishing touches such as bumpers or tires are applied.

structural adjustment program associated with loans to the government, the PCMP was replaced with the Car Development Program (CDP), which greatly liberalized the sector. Ofreneo (2016) suggests this liberalization in the late 1980s and early 1990 which reduced CBU, CKD and car parts tariffs to 30%, 10%, and 3%, respectively, undercut the competitiveness of domestic parts producers in their home market too suddenly and went unnecessarily far beyond ASEAN peers.

The policy regime since the 2000s has been criticized for being "incoherent" (Ofreneo, 2016). Executive Order 156 was signed in 2002 to initiate the Motor Vehicle Development Program (MVDP). It focused primarily on reducing tariffs on parts and raw materials used by domestic automotive suppliers, although it did provide incentives to companies that exported CBUs and parts and components. However, it also instituted taxes against popular models of cars with high local content that ultimately hurt vehicle sales, and its goal of curbing the import of smuggled vehicles was undermined by haphazard legal enforcement.

The CARS program is the country's latest effort to stimulate sector growth. It seeks to use the growing domestic demand for motor vehicles to attract lead firms to establish final assembly production in the Philippines. Critically, the US$600 million incentive program is limited to three models of cars, one each by a maximum of three possible participants—by restricting the number of potential models and providing output-based assistance of US$1,000 per unit,[21] it hopes to generate sufficient economies of scale to facilitate the development of tooling, stamping, and plastic injection capabilities within the country (Government of the Philippines, 2015). The requirement that production targets be met on a per-model basis is an innovative policy choice specifically intended to improve economies of scale, since many parts and aspects of vehicle assembly are model-specific. In many developing countries, vehicle production is fragmented across many vehicle models, and even single manufacturers will produce several models.

4.1.2. Key Firms

The lead firms with assembly facilities in the Philippines include five Japanese companies—Mitsubishi, Toyota, Honda, Nissan, and Isuzu—located in the Laguna area south of Manila that generate vehicles for the domestic market. Most have had a presence in the Philippines for decades.[22] Toyota and Mitsubishi are the largest assemblers of CKD units, generating 49,000 and 15,000 total vehicles of two models in 2015, respectively.[23] Overall, CKD sales have followed a downward trajectory for the better part of two decades, falling to 67,742 in 2011 from its 1996 apex of 137,365 (DTI, 2014). Meanwhile, CBU imports have steadily gained market share and accounted for 59% of vehicles sales in 2011.[24]

[21] Manufacturers must agree to produce a minimum of 200,000 units over six years (33,000 units per year) while also domestic suppliers to generate 50% of the body weight of the vehicle.
[22] Mitsubishi is the oldest operators still operating in the country, tracing its lineage to 1963. Ford recently closed its plant. The plant's production volume was less than half of its 36,000-vehicle capacity. Mitsubishi bought the closed plant from Ford and commenced production at the facility in 2015.
[23] Toyota's production is split between Innova and Vios models, while Mitsubishi's largest output is its L300 model followed by the Adventure.
[24] Table A-1in the Appendix provides a breakdown between CKD and CBU sales from 1990 to 2011.

The erosion of the CKD base has impaired the development of a local supply base, which has subsequently contributed to a further decline in CKDs. Major CKD assemblers reported aiming for 40-70% domestic content depending on the manufacturer and the model. Lead firms noted, however, that they have difficulty finding suppliers that have the ability to produce parts in sufficient volume to meet their needs. Depending on the company and their network of suppliers, the most prominent gaps at the Tier I level of the supply chain include body shells and stamping plants, engines, air conditioning units, and suspension systems. The inputs that are most readily available in the domestic market are wire harnesses, transmissions, chassis, tires, batteries, and switches. Nearly all of these categories have experienced rationalization in recent years—where there were three tire and glass suppliers five years ago, now there is one, and producers of other goods such as seat belts have left the country entirely.

Partially as a result of these factors, the total number of domestic parts producers has plateaued in recent years. Between 1996 and 2014, the total number of parts suppliers has only increased by 16 to a total of 256 (DTI, 2014). These are divided fairly evenly between Tier I and Tier II suppliers, with producers of "Original Equipment" parts (OE) and those of replacement parts. The 124 Tier I suppliers are most often multi-nationals that have close relations with global lead firms, either through shared ownership, co-location of production facilities, co-location of technical centers or a combination of all three. These global suppliers generally produce in multiple locations and have greater financial and technical resources than their Tier II counterparts.[25] In other cases, the Tier I suppliers are "captive suppliers," and represent cost centers for MNCs based in the region. The road map offered the following breakdown of Tier I-level facilities: wiring harnesses (6); transmission (5); stamping plants (3); suspension systems (3); and large-injection molding (2) (PACCI, 2012).[26] Table 9 lists some of the most prominent auto parts companies in the Philippines.

The approximately 132 Tier II and III suppliers are mostly Filipino-owned and generate products for multiple lead firms and Tier I suppliers as well as other industries. Aggregated, Filipino producers manufacture an estimated 330 parts, 60% of which are OE and 40% of which are replacement parts (DTI, 2014). Metal-working businesses are the most common—48% of the firms in the industry can be classified as metal-working businesses, followed by seat and trim companies (18%), rubber manufacturers (10%), plastic producers (10%), and electrical firms (8%). Most of these are small family-run businesses with limited ability to generate quality products (Aldaba et al., 2010). With the smaller businesses in the supply chain lacking the financial wherewithal to invest in new technologies or pay licensing fees to produce specialized parts, lead firms and Tier I suppliers are forced to import inputs in significant volumes.

[25] Asian Transmission Company (ATC) is a sister company of Mitsubishi that supplies the company with engines and transmissions; Toyota Auto Parts produces transmissions and velocity joints for the parent company; and Honda Parts Manufacturing Corporation similarly generates transmissions.

[26] The original industry road map included the Ford assembly plant, which had stamping capabilities. It subsequently closed in 2012.

Table 9. Major Auto Parts Companies in the Philippines

Product	Value Chain Stage	Firm	Quality Accreditation	Major Clients (Countries)
Chassis Systems				
Transmissions	Drive Train	Asian Transmission Corporation	ISO 14000	Mitsubishi (Japan, Thailand, Philippines, Indonesia), Isuzu, Nissan
		Honda Parts Manufacturing	ISO 9000	Honda (Japan, Indonesia, India, Thailand, UK, USA, Pakistan)
		Toyota Auto Parts	ISO 14000	Toyota (Thailand, India, Indonesia, South Africa, Philippines, Argentina)
		Isuzu Auto Parts	ISO 9001	Isuzu (Thailand)
Radiators, stamped parts	Front and rear end modules	Roberts Automotive & Industrial Parts Manufacturing.	ISO 9002	Mitsubishi, Honda, Hino, Columbian, Universal Motors
Body System				
Chassis	Chassis systems	KPC	Unavailable	Mitsubishi (Philippines, Brazil, Iran), Toyota, Isuzu (Philippines, Vietnam), Nissan, Suzuki Motorcycles, Kawasaki, Suzuki Motors Pakistan, Vietnam Motors
Electronics/Electrical Systems				
Wire Harnesses	Chassis Electronics	Yazaki-Torres Manufacturing	QS 9000, ISO 14001, ISO 9001, Ford Q1	Ford, Jaguar, Toyota, Mitsubishi, Mazda, Honda, Isuzu, Nissan, Universal Motors Corp.
		International Wiring Systems Corp. (Phils)	ISO 9002, QS 9000, ISO 14000	Sumitomo Wiring Systems (Japan, USA, Australia)
		Pilipinas Kyohritsu	ISO 9002, QS 9000	Nissan Motor (Japan, Philippines), Nissan Diesel, Universal Motors Corp.
Electronic Components	Chassis Electronics	Continental Temic	ISO/TS16949, ISO 14001, ISO 17025, ISO 50001	Tier I suppliers in North America (44%), Europe (37%), Asia (19%).

Source: Authors; DTI, 2014.

4.2. Current Participation in the Automotive GVCs

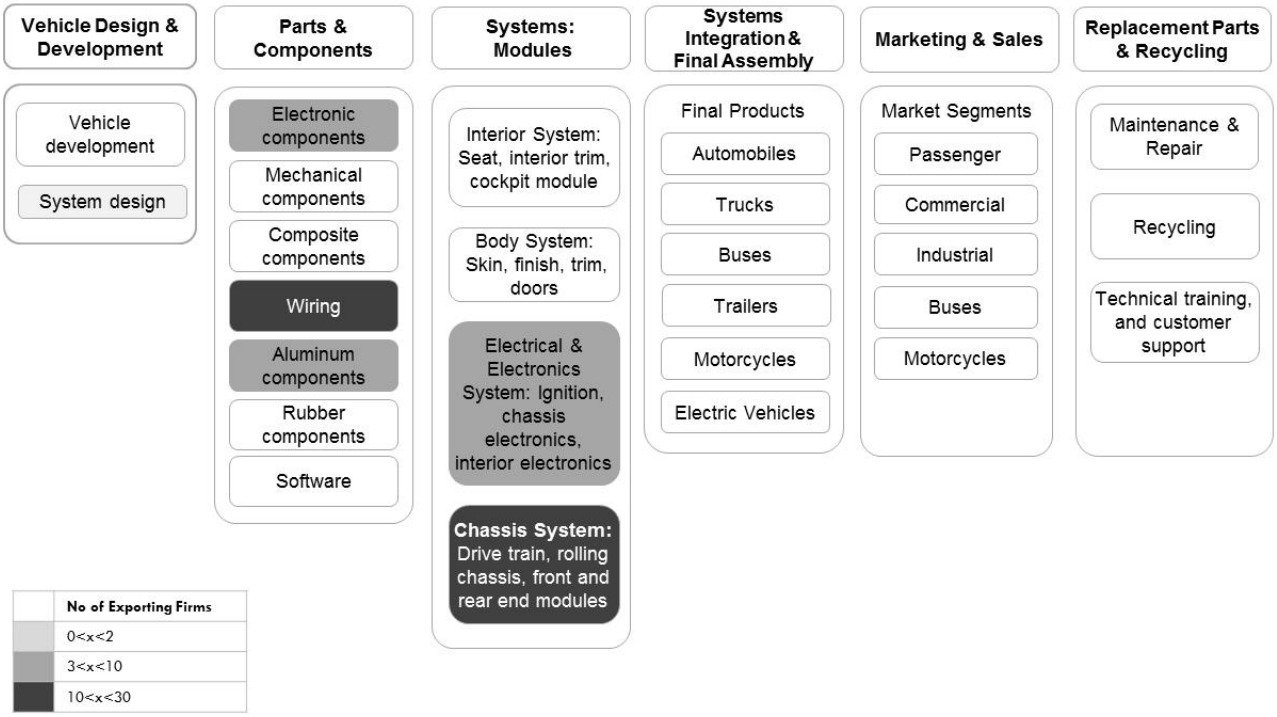
While the majority of the 256 firms located in the Philippines serve the domestic market, there are at least 123 companies located in the country's Philippine Economic Zone Authority (PEZA) areas that export at least 70% of their products and generate goods destined for automotive value chains.[27] Businesses listed under PSIC industry classification "motor vehicle, trailers and

[27] The 123 companies were identified by using PEZA data from September 2015. Categories identified included "motor vehicles, trailers, and semi-trailer", "other transport company". From there, the following five search terms were used to identify companies participating in the automotive GVC in the Philippines: "auto," "vehicle," "car," "engine," and "motor." Additionally, the following five PSIC Industry Classifications were aggregated into

semi-trailer" are the most common (42%) in the PEZA database,[28] followed by fabricated metal manufacturers (23%), rubber and plastic parts producers (15%), and electrical machinery firms (11%). The other categories of actors are firms that specialize in Research & Development (R&D) and services (7%), and chemical and chemical products (less than 1%).

Data provided by the Philippine Statistic Authority (PSA) indicated the number of firms that export at a meaningful level is smaller still. According to PSA, there are 63 distinct companies that had more than US$1 million in exports in a single product category in 2014. While there has been some change in the identity of some of these actors in recent years,[29] the industry is mostly concentrated around a small handful of firms, with the 15 largest accounting for 80% export revenue. Figure 2 provides an illustration of the segments of the automotive GVC where the Philippines is most active.

Figure 2. Philippine Participation in the Automotive GVC



Source: Duke CGGC.

Together, these companies helped push the Philippines' automotive exports to nearly US$4.0 billion in 2014, an increase of 33.5% from 2007. While that is a relatively low figure when compared against total global automotive exports (nearly US$1.3 trillion in 2014), there are

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one broad "R&D and services" category: research and development; engineering and architectural services; other IT-enabled services; software development and Business Process Outsourcing (BPO).

[28] Companies that self-identify as having "motor vehicles, trailers, and semi-trailer" PSIC industry classifications are a mix of lead firms (Mitsubishi Motors), Tier I suppliers (Asian Transmission Corporation), or companies that sell directly to lead firms (Continental Temic).

[29] Only 30 of the 63 had revenue above $1 million in 2007, although there were 40 other companies whose revenues have subsequently fallen below that threshold.

individual product segments where the Philippines enjoys a strong foothold in the auto GVCs. Table 10 provides a summary of the Philippines' exports by HS code—the top 10 codes are all components, although, beyond the leading electronics and suspension categories, most categories only have one or two exporters.

Table 10. Philippine Top 10 Automotive Exports in 2014 by Value, 2007-2014

Products	HS Codes	Value (US$, millions)				Share of Philippines Auto-Related Exports (%)				CAGR (%)	Distinct Exporters
		2007	2010	2012	2014	2007	2010	2012	2014	2007-14	2014
Total		**2,988**	**3,351**	**3,479**	**3,988**					**4%**	
Wire harnesses (electrical)	854430	892	1,107	1,446	2,042	29.8	33.0	41.6	51.2	13%	16
Other (body system or drive train)	870899	862	888	773	674	28.9	26.5	22.2	16.9	-3%	30
Gear boxes	870840	168	352	363	380	5.6	10.5	10.4	9.5	12%	4
Other (body system)	870829	81	124	122	186	2.7	3.7	3.5	4.7	13%	2
Lead acid batteries (electrical)	850710	57	80	92	128	1.9	2.4	2.6	3.2	12%	1
Ignition (electrical equipment)	8511	10	22	161	124	0.3	0.7	4.6	3.1	42%	4
Radios (electronic instruments)	852721, 852729	47	93	35	107	1.6	2.8	1.0	2.7	12%	1
Brakes (body system, suspension)	870839, 870831	530	286	104	99	17.7	8.5	3.0	2.5	-21%	1
Steering wheel (body system, suspension)	870894	1	0	5	50	0.0	0.0	0.1	1.2	65%	1
Wheels (body system, suspension)	870870	27	17	15	49	0.9	0.5	0.4	1.2	9%	3
Top 10		**2,675**	**2,970**	**3,117**	**3,840**	**89.5**	**88.6**	**89.6**	**96.3**	**5%**	**63**

Source: UN Comtrade, HS02 6D, Philippines exports to the world. Retrieved on October 28, 2015. Distinct exporters based on PSA firm-level exporter data and indicates number of establishments with exports >$US1 million in 2014 in the product category.

Leading Product Categories

The Philippines' strength in the automotive industry is in electrical and electronic components, with approximately two-thirds of exports in one of these categories.[30] The most prominent example is wire harnesses, which accounted for a little more than half of the country's total auto-related exports in 2014. From 2007 to 2014, the value of the country's wire harness exports increased 129%, while wire harnesses' share of automotive exports jumped from 29.8% to 51.2%.

As detailed in Box 1, wire harnesses direct the flow of current and electronic signals throughout the vehicle. The sub-system is of growing importance as the electronics content of vehicles increases—global exports increased by 53% in the time period from 2007 to 2014, from US$21 billion to a little more than US$32 billion. Because the assembly of wire harnesses

[30] In terms of global exports, E&E components comprise approximately one-fifth of auto-related component exports.

is labor intensive, it is a promising niche for developing countries, which can use their cost advantages to attract foreign investment; however, there are counter-trends, especially the use of shared cables and lighter gauge wires, which reduces material costs and makes hand assembly more difficult.

The Philippines has had success against this global backdrop. It ranked fourth in the world in 2014, and the country's share of worldwide exports increased from 4.2% in 2007 to 6.3% in 2014. There are at least 15 firms in the country producing wire harnesses. Many are Japanese owned, and six of the companies are among the country's largest 10 exporters of automotive products. Two of the segment's leading firms—Yazaki and Sumitomo—have long-standing investments stretching back to 1974 and 1988, respectively (see Table 11). Those companies have been joined by major suppliers such as Lear and Furukawa in more recent years, giving the Philippines four of the world's largest suppliers. All four companies have undergone a range of upgrades, cumulatively expanding or implementing new projects 25 times at their EPZ locations (PEZA, 2015). More recently, Denso, a prominent Japanese MNC, a diversified producer of automotive electronics and electrical systems, including wire harnesses, established a software development operation in the country in 2008 for electronic engine controls.

Table 11. Wire Harness Companies in the Philippines by Year Established

Company	Location	Year Established	Year Established in PEZA	Ownership
Yazaki-Torres	Laguna	1974	2002	60% Filipino, 40% Japanese
International Electric Wiring Systems (Philippines) Corp. (Sumitomo)	Tarlac	1988	1993	90% Japanese, 10% Filipino
Pilipinas Kyohritsu	Batangas	1989	—	Unavailable
FCC Corporation	Laguna	1993	1993	100% Japanese
Oakwave (Philippines) Corp.	Cavite	1994	1995	70% Japanese, 30% Filipino
Ryonan Electric Philippines	Laguna	1995	1995	100% Japanese
Chiyoda Philippines	Batangas	1996	2009	99.9% Japanese, 0.1% Filipino
BK Electronics Philippines	Cavite	1998	1998	66% Korean, 34% Filipino
Yumex Philippines	Cavite	1996	1999	99.9% Japanese, 0.1% Filipino
Lear Automotive Services	Cebu	2002	2002	100% Dutch
A.C.E. Mannix Electronics	Cavite	2004	2004	60% Filipino, 40% Korean
Philippine Matsuden	Cavite	2011	2011	99.9% Japanese, 0.1% Filipino
Furukawa Electric Autoparts	Batangas	2012	2012	99.9% Japanese, 0.1% Filipino
Taisei Electronics	Batangas	2013	2013	80% Hong Kong, 19.9 Japanese, 0.1% Filipino
THN Autoparts	Laguna	2014	2014	100% Korean

Source: PEZA, 2015; BOI, 2015.

In interviews, wire harness companies cited low labor costs as the main advantage for being located in the Philippines. Additionally, the country's relative proximity to final assembly plants in Japan has allowed it to carve out its position in the regional production networks, similar to Mexico in North America and Central-East Europe in Europe. Yazaki-Torres and International Wiring Systems (Sumitomo) are subsidiaries Japanese-based MNCs, while Pilipinas Kyohritsu has close relationships with Japanese lead firms such as Nissan. The sector is also assisted by

the fact that a moderate to high amount of inputs, including copper wire, are available in the domestic market (see Functional Upgrading in "Evidence of Industry Upgrading" section).

These dynamics have helped Japan solidify its position as the Philippines' leading export market for wire harnesses over the last eight years. In 2007, Japan (US$370 million) and the US (US$351 million) received comparable amounts of the Philippines' exports; in 2014, Japan was the destination for 46% of the Philippines' wire harness exports compared to 23.5% for the US.[31] Table A-3 in the Appendix provides a complete list of the country's end markets. The country's three largest export destinations—Japan, the US, and Canada—accounted for almost 84% of the country's total exports in 2014. Notably, Thailand, which is a hub for Toyota's regional production network, is emerging as an important destinations —wire harness imports increased from US$400,000 in 2007 to US$75 million in 2014, boosting Thailand's overall share from 0% to 3.7%.

Aside from wire harnesses, the primary export category demonstrating growth is gear boxes or transmissions. Lead parts suppliers ship the majority of their outputs to other countries, with Thailand, Japan, Indonesia, and Argentina being the most frequent destinations for finished product. In interviews, transmission producers reported that, depending on the model, anywhere from 15-60% of their supply base was located in the Philippines, with steel machine parts, pressed parts, electronic parts, aluminum ingots, forged parts, and rubber and plastic being the most readily available materials. Bearings are imported from India because Filipino firms do not have the technology to polish them or add grooves, while forged parts that are not available in the domestic market are sourced from China.

There are two useful distinctions to make in the two "other" categories in Table 10. The first—HS code 870899—represented the second highest amount of exports in 2014 and captures a range of goods, from wheel and tire assemblies to drive trains to vibration controls.[32] While PSA data indicates there were 30 distinct exporters in the Philippines using the 870899 HS code in 2014, both the raw number of exporters as well as the value of the goods has been declining in recent years—the number of companies exporting dropped from 44 to 30 in 2007, with export values also declining from US$862 million to US$674 million.

The second "other" category—HS code 870829—describes door assemblies and body stampings for vehicles and tractors. According to PSA data, there are only two firms active in this segment of the chain in the Philippines, with one company having a 97% share of the market. These two businesses have exports in other categories, with the largest firm also shipping seat belt fabric to international destinations.

4.3. Evidence of Industry Upgrading

While the Philippines automotive industry has experienced some country-wide downgrading in the last two decades with assembly facilities closing and critical suppliers exiting the market,

[31] In 2014, the Philippines exported US$934 million of wire harnesses to Japan and US$481 million to the US.
[32] There are at least three companies in the Philippines producing alloy wheels: Philippine Aluminum Wheels, Enkei Phils, Inc., and Kosei Inc. (Asia Pacific), (DTI, 2014).

each form of GVC upgrading can be detected. Product and process upgrading are the most prominent and can be widely observed, especially in the country's EPZs managed by PEZA. The industry's ability to functionally upgrade is somewhat constrained by the fact that many of the lead firms and Tier I suppliers operating in the country are subsidiaries for MNCs with centralized hubs for high value activities such as design and development, although wire harness companies have integrated upstream by adding copper wire production capabilities, and the country has added general automotive R&D capabilities in the last decade. Chain upgrading can be observed through automotive companies that have moved into the aerospace industry while some electronics firms have expanded product lines that are used in motor vehicles. The following section outlines strides that have been made within the domestic industry.

Product and Process Upgrading

Broadly speaking, there appears to have been less upgrading in the automotive GVC compared with other manufacturing industries in the Philippines. PEZA data has captured the total number of expansions and new projects that have been initiated to facilities located in export zones, and the totals of each—expansions and new projects—serve as proxy variables, albeit imperfect ones, for process and product upgrading, respectively.[33] Firms in the automotive GVC represent 4% of the original investments in the database, 12% of the expansions, and 6% of the new projects. For the sake of comparison, firms in the electronics industry appeared to have undergone product and process upgrading in higher frequency—such companies represent 12% of the original investments in the database, 23% of the expansions 37% of the new projects.[34] Table 12 below provides a summary.

Many of the firms interviewed for this report described making improvements to production facilities and work technologies or introducing more advanced product lines. While these upgrades are the result of corporate strategies determined at headquarters, many officials interviewed for this report indicated that their largest source of competition was from other branches within the company. In order to demonstrate the viability of the Philippines as a base of operations, there is emphasis on improving individual plant operations, with many companies highlighting steps to enhance employee productivity through employee training and work organization improvements without direct prompting by headquarters.

The product and process upgrades initiated throughout the sector have expanded capacity at several plants, although field research indicated that only certain segments of the chain have the requisite demand to match supply. For instance, while wire harness companies reported that

[33] In addition to the type of project (expansion or new project), the PEZA dataset lists the reasons for the activity. For expansions, most correspond to process upgrading—"increase in the production capacity of its transmission assembly" or "increase in the production capacity of its manufacture of motorcycle engine knockpins" or "increase in the production capacity of its manufacture of airbag fabric, and production of head side airbag (HSAB) assembly" are some of the stated reasons. For new projects, the majority of the stated reasons align with product upgrades— "manufacture and export of Short Range Radar," "manufacture of automotive pressed parts such as busbar parts and blade terminal," and "manufacture and production of automatic adjustment system components "cam chain tensioner" are some of the cited reasons for the new facilities (PEZA, 2015).

[34] There are other variables that could explain the high number of expansions and new projects in electronics compared to the automotive sector, including the long product life cycles in the auto industry.

their output was at or near full capacity, some of the transmission manufacturers interviewed indicated they were only using only 20-40% of their capacity.

Table 12. PEZA Investments by Firms Serving Automotive Value Chain, 1978-2015

PSIC Industry	Original	Expansion	New Projects
PEZA Totals	**3,094**	**528**	**1,727**
Chemicals and Chemical Products	1	—	1
Electrical Machinery and Apparatus, N.E.C.	14	11	18
Fabricated Metal Products, Except Machinery and Equipment	28	13	20
Motor Vehicles, Trailers and Semi-Trailers	52	28	69
Research & Development and Services	9	3	1
Rubber and Plastic Products	19	11	7
Automotive & Components Totals	**123**	**66**	**116**
Automotive & Components Share of All PEZA Entries	**4.0%**	**12.5%**	**6.7%**

Source: PEZA, 2015. Note: The table above only includes entries in the above categories. For all categories, only companies with activities related to auto are included. Footnote #27 on page 28 provides additional detail on the methodology associated with the table.

Backward Linkages

The firms that export wire harnesses from the Philippines provide some examples of integrating with operations upstream to produce some of the copper wiring that is used in their products. There are different strategies at different companies for procuring wire—some began producing it as far back as the 1980s, while others rely on sister companies that have co-located in the same industrial parks. Many companies plan to expand wire production capabilities further.

Functional Upgrading

The Philippines has expanded its functional capabilities in the last decade through a handful of original investments in EPZs to perform automotive engineering, software development, and research activities that can broadly be defined as R&D or knowledge-intensive services. Some of the more prominent examples include Denso establishing a facility in the Jazz IT Center in Makati to develop software for electronic engine controls, Furukawa opening a site in the Lima Technology Center in Batangas to design wire harnesses through computer-aided design, and International Wiring Systems (Phils.) Corporation (Sumitomo) investing in design engineering functions (PEZA, 2015). Box 3 on the Laguna Technopark has additional examples of functional upgrading.

Most were made by Japanese-based companies, although the Flextronics has headquarters in the US. Furukawa has expanded and added to its original 1998 investment in Laguna at least nine times. While its original focus was the manufacture and assembly of parts such as steering roll connectors and wire harness assembly, it functionally upgraded into R&D in 2010 with engineering and computed-enabled support services. Similarly, the Japanese engineering company Chiyoda's first investment in the Philippines focused on producing and assembling wire harnesses before it expanded its engineering presence. Table 13 provides a list of some of the sector's notable R&D investments since 1989.

Table 13. Functional Upgrades into Automotive R&D in the Philippines

Company	PEZA Location	Original Investment	Activity
Flextronics	Mactan Economic Zone II	2007	* Electronic hardware/software design of automotive control modules * Mechanical design and flexible circuit assembly (FCA) of all these automotive mechanical components
F. Tech R&D	Laguna Technopark	2008	* To engage in R&D of Automotive Products
Denso	JazzIT Center	2008	* To engage in embedded software development
Chiyoda	Sun Plaza	2009	* To engage in Engineering Design and IT-enabled engineering services
Furukawa Automotive Systems Design	Laguna Technopark	2010	* To engage in the business of design and development of criteria for wire harness and parts using computer aided design (CAD)
Philippine Auto Components	Northgate Cyberzone	2012	* To engage in the design and testing of instrument clusters and other auto parts for Original Equipment Manufacturer (OEM) car assemblers
Philippine EDS Techno-Service	Aseana One	2012	* To provide technical services for Yazaki Corporation's automotive electrical distribution systems (EDS) development centers around the world * To engage in electronics and instrumentation design and development
International Wiring Systems (Phils.) Corp. (Sumitomo)	Luisita Industrial Park SEZ	2012	* To include Design Engineering Function

Source: PEZA, 2015.

Chain Upgrading

Some of automotive suppliers have begun selling products in the aerospace value chain. This has required extensive shifts in operations—the automotive sector is based on high-volume, low-mix production operations with relatively low regulatory control where orders could include half a million pieces for less than ten product parts, whereas the aerospace sector is characterized by product numbers into the thousands with ten pieces per unit produced under high regulatory control.

In the same vein, there are a number of electronics firms that have expanded their product segments in the automotive chain (or vice versa), selling specialized parts to major Tier I suppliers. The Philippines is assisted in this upgrading trajectory by large numbers of engineers as well as experienced personnel from abroad. To cite one example, Ogami Corporation's original investment in the Philippines was in 1995 to manufacturer plastic auto parts such as pivot cap covers and bushings for windshield wipers; in 2012, the company registered a new project with PEZA for the assembly and testing of printed circuit boards (PCBs) (PEZA, 2015).

Box 3. Upgrading within the Automotive GVC in Laguna Technopark

The Laguna Technopark has the largest single cluster of firms in the automotive GVC in the Philippines; since 1989, 18% of the total original auto investments in the country's EPZ zones have taken place within the park that is less than an hour's drive southeast of Manila.[35] An analysis of the investments, expansions, and new projects within Laguna Technopark shows that product and process upgrades were the most common upgrades in the earliest time periods (1989-2000), while more sophisticated upgrades have occurred in the period since 2000. Table in the Appendix provides a summary of the upgrading with the park organized by time period.

As a whole, the Philippines has only recently undertaken functional upgrading into R&D and service activities. One of the examples is the investment of F-Tech R&D Philippines, which is a subsidiary of a diversified Japan-based automotive parts and services company with offices in Japan, the US, China, Thailand, Indonesia, and Mexico. Its clients include Honda, Toyota, Nissan, and Mitsubishi. The Philippines facility conducts research into automotive parts such as clutches, brakes, accelerators, sub-frames and suspensions (FDRP, 2016).

F-Tech R&D has quadrupled its workforce since opening in 2008 with 44 employees in 2014 (FDRP, 2016). Job postings listed on the Laguna office's website indicated that higher-skill positions were in demand—vacancies included jobs for mechanical engineers and Japanese translation.

Sources: PEZA, 2015; FDRP, 2016.

4.4. The Philippine Automotive Workforce

As of 2010, the automotive sector employed close to 57,000 workers or 6% of the total manufacturing workforce in the Philippines (DTI, 2014). Categories of workers can be divided into two groups: the assembly of motor vehicles mostly for the domestic sector, and the manufacture of parts and component units oriented to the export market. There were 6,635 people that had jobs in the assembly sector, which represented a 30% decline from 1999. Parts and assemblies employed 49,784 people, with the largest number (51%) working in ignition systems (wire harnesses) (DTI, 2014). The largest wire harness company interviewed during field research reported having 13,700 employees in the Philippines, making it the largest single employer in the automotive sector.

The majority of these workers are line workers with either high school education or vocational training after school. A high school diploma was usually the only required qualification—firms interviewed generally reported that 70-80% of their workers fit into this classification, with the remaining 20-30% split between managers who had been promoted from line positions, or skilled staff that had university training. University graduates accounted for a maximum of 15% of their workforce; for these individuals, electrical and mechanical engineering degrees were the

[35] The majority of the original investments made in the country's PEZAs for the automotive industry have occurred in two regions just south of Manila—40% has been made in the Laguna region, while 26% has occurred in Cavite. Of the 14 PEZAs in Laguna (of which Laguna Technopark has the highest number of auto firms), 12 have sites that generate output for the automotive value chain. Meanwhile, six of the parks in the Cavite region have investments that service the auto GVC.

most common, although administration positions required other skill sets (accounting, business, etc.). Most firms reported annual turnover rates of less than 5%. Many companies reported that high school degrees associated with the majority of workers meant that deficiencies in maturity and soft skills were their most prominent challenges and necessitated company-wide training sessions. The sense of loyalty among Filipino workers as well as reasonable skill levels were cited by almost all interviewed stakeholders as one of the advantages of being located in the country.

While many categories of jobs in the automotive sector are dominated by male workers, wire harness companies use female employees in high numbers. In 2010, 68% of the hours worked in the ignition systems sub-sector were worked by female employees. This ratio is roughly reversed in the rest of the auto parts sub-sectors, where male workers comprise 66% of the employees in non-ignition systems categories (DTI, 2014). Firms interviewed for this report indicated that women workers were prized for their "manual dexterity."

4.5. Advantages and Challenges for GVC Participation and Upgrading

A mature industry with a history that stretches back into the first half of the 20th century, the Philippines' automotive sector has entrenched characteristics that can be expected to continue to shape the landscape for the foreseeable future. Some of these features provide the automotive sector with a competitive advantage, while others are weaknesses that could constrain the upgrading or require intervention from domestic stakeholders. Table 14 outlines the general features of the industry, while the section that follows elaborates on each in further detail. The emphasis is on the local institutional context as it relates to the auto industry—country-level factors such as the strong labor environment and robust PEZA leadership are framed with their relevance to the sector. Meanwhile, the weaknesses highlighted in this section represent some of the most prominent constraints for automotive companies.

Table 14. The Philippines in the Automotive GVC 'SWOT' Analysis

Strengths	**Weaknesses**
• Established global footprint in wire harnesses segment • Commitment of leading industry stakeholders, including industry associations, DTI, BOI, others • Competitive labor environment • Effective PEZA regime • CARS' provision of incentives to lead firms	• Gaps in supply chain at all tiers • Comparatively small market for motor vehicles • Widespread smuggling of cars • Low to moderate support for R&D activities
Opportunities	**Threats**
• While domestic demand is still relatively low, the growth rate is one of the highest in ASEAN • Increasing electronic content in motor vehicles • Growing demand for e-vehicles, especially in Asia-Pacific region • Parts exports to Japan	• Competition from strong other locations in ASEAN, including Vietnam at the low end and Thailand at the higher end. • Possible instability in policy regimes after election • Traffic congestion in Manila

Source: Authors.

4.5.1. Advantages

There are both industry-specific and country-wide advantages associated with the Philippines automotive sector. Some of the more prominent include the following:

1. Well-established global footprint in wire harnesses: The country's position as a magnet for wire harness investments, discussed at length in the section on the Philippines participation in the automotive GVCC, can be detected through analysis of firm-level exports. The number of high-volume exporters as measured by annual sales greater than US$1 million has increased in recent years from 10 companies in 2007 to 16 in 2014, with the market share of the leading firms becoming less concentrated—sales of the largest five accounted for 80% of total exports in 2014. Nearly all of these actors specializing in wire harnesses.

2. Commitment of leading industry stakeholders: The lead firms in the country, Mitsubishi, Toyota, Honda, Isuzu, and Nissan—have displayed a strong commitment to the local market, giving vitality to industry associations such as CAMPI, the Federation of Automotive Industries of the Philippines (FAIP), and the Philippine Parts Makers Association (PPMA).[36] Together, these organizations have collaborated on efforts such as formulating the industry road map and have played important roles in shaping policy initiatives such as CARS, which provides a regulatory framework that attempts to encourage the development of the domestic supply base.

The strong commitment of industry stakeholders is mirrored by a supportive and collaborative environment for industry policy development in manufacturing sectors, which has been assisted through programs put in place by the Department of Trade and Industry (DTI) and the Board of Investments (DTI-BOI). The collaborative development of the Investment Priorities Plan, the Industrial Development Program and the Manufacturing Resurgence Program (DTI, 2016b)—developed with the private sector, academe and government agencies—has played a central role in coalescing industry stakeholders into a more cohesive group and has clearly helped to establish strong lines of communication between the public and private sector.

3. Competitive labor environment: Virtually every source interviewed cited labor considerations as being the primary reason they had located in the Philippines. The country's human capital advantages include relatively low wage rates, a deep pool of engineers—local universities graduate approximately 60,000 engineers annually in mechanical, electrical & electronic, and chemical engineering (CHED, 2016)—widespread English skills, and low attrition rates. The opening of the Center for Engineering and Sustainable Development Research (CESDR) at the De La Salle University in Manila may provide further opportunities to buttress this strength—the school's five research areas include: 1. Sustainable technologies research group; 2. Robotics and mechatronics research; 3. Hydro-power technology research; 4. Industrial and hazardous waste management research; and 5. Lean systems and operations research.

[36] Table A-5 in the Appendix provides a complete list of domestic stakeholders organized by focus area

4. Effective PEZA regime: Although the majority of auto companies in the Philippines are focused on the domestic market, there are 123 based in PEZA-managed EPZs that generate parts destined for foreign markets, with large concentrations in the EPZs in the Laguna and Cavite regions. Firms interviewed in these zones were near universal in their praise of PEZA. "The PEZA policies are stable, and that's a critical piece of our success here," said one official. "They block a lot of trouble. If the conditions were not stable, the plant would be moved." The PEZA administration provides a range of specific benefits, including tax incentives, assistance with visas, and streamlined import and export procedures.

5. CARS' provision of incentives to lead firms: The CARS program is an innovative attempt to generate economies of scale in the domestic market by offering US$600 million in incentives to a limited number of lead firms. By restricting output-based assistance to a maximum of three models, it hopes that local parts makers will benefit from only having to produce components for a small number of final products. A critical challenge in the automotive sector is the question of scale—by having a limited number of lead firms and models, domestic companies have a chance to overcome the high costs associated with product design and the platform and model-specificity of parts. Thus, as the country attempts to build economies of scale for Tier II and Tier III suppliers, it may be advantageous for these smaller businesses not to have fragmented markets. Two of the lead firms active in the Philippines—Mitsubishi and Toyota—have expressed interest in joining the program.

Vietnam's experience provides an example of the hazards of having a wide base of assemblers with shallow ties to the country. The case study highlighted the primary dynamic that has hindered the development of the sector—excessive fragmentation of assembly plants through the government's aggressive pursuit of foreign investments. With 14 CKD assembly plants having a total production capacity of roughly 182,000 vehicles (13,000 vehicles per site), suppliers have insufficient demand to generate economies of scale for model-specific parts (Berger, 2014).

4.5.2. Challenges

If the Philippines' auto industry has identifiable strengths, it also has a number of constraints that have prevented it from upgrading its position in the GVC. A number of economy-wide weaknesses—infrastructure and power costs, to name two—also apply to the automotive industry; although, interviews with stakeholders indicated these were less pronounced than in other sectors.

1. Gaps in supply chain: Only 330 of the 20,000-30,000 total vehicle parts are produced in the Philippines (DTI, 2014). The gaps span all levels of the supply chain—lead firms listed body shells and stamping plants, engines, air conditioning units and suspension systems,[37] wire harness manufacturers import electrical switches, terminals, and specialized, and transmission producers rely on India for polished metal and China for forged parts. Locally based Tier III generally produced generic parts such as rubber mats, rather than higher value specialized parts. These

[37] Ford had the largest body stamping capabilities in the country, but it closed its facility in 2012.

specialized parts require licenses, and a local company would have to purchase rights from the owners of the IP.

Interviews with industry stakeholders indicated the current environment is characterized by the inability of local businesses to generate enough volume to meet the demand of lead firms. The country's unfavorable economies of scale ensure a less competitive position than Thailand, the main regional production hub in ASEAN. In interviews, officials at one lead firm said it was 70% more expensive to produce a car in the Philippines than in Thailand.

2. Comparatively small market for new motor vehicles: While annual motor vehicle sales in the Philippines have been on an upward trajectory, the country still ranks well below regional peers including Indonesia, Malaysia, and Thailand (see Table 15). Even if the market meets the CAMPI projections of 500,000 annual sales of motor vehicles by 2020, demand will still likely remain lower, making the country an unlikely candidate for investments by global lead firms. Without further expansion in assembly capabilities, there is risk there will not be sufficient demand for suppliers to increase their capacity—motor vehicle production is capital intensive and requires annual production volumes of 50,000-150,000 per plant to be profitable, which is a prominent reason why small market countries such as the Philippines have difficulty supporting a robust supply chain.

Table 15. Sales of Motor Vehicles in ASEAN Countries by Year, 2011-2015

Country	2011	2012	2013	2014	2015	Growth Rate from 2011-2015
Indonesia	894,164	1,116,212	1,229,901	1,208,019	1,013,291	13%
Thailand	794,081	1,436,335	1,330,672	881,832	799,632	1%
Malaysia	600,123	627,753	655,793	666,465	666,674	11%
Philippines	141,616	156,654	181,738	234,747	288,609	104%
Vietnam	109,660	80,453	98,649	133,588	209,267	91%

Source: AAF, 2011-15.

3. Low to moderate support for R&D activities: Interviews with industry stakeholders indicated there were low levels of government support for R&D and minimal collaboration between universities and companies for research initiatives. Other studies have observed similar trends (Ofreneo, 2016; Tereso & James, 2013). In addition to having some of the lowest R&D spending relative to GDP in the region (see Table 16), the Philippines had 78 researchers per 1 million people in 2007, the most recent year that data was available (World Bank, 2014). By comparison, Singapore, Japan and Korea all had at least 4,600 researchers per 1 million people, and countries such as Malaysia (364) and Thailand (315) also had more researchers per capita than the Philippines.

Table 16. Public and Private R&D Spending as Percentage of GDP, 2004-2013

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
China	1.22%	1.32%	1.38%	1.38%	1.46%	1.68%	1.73%	1.79%	1.93%	2.01%
India	0.74%	0.81%	0.80%	0.79%	0.84%	0.82%	0.80%	0.82%	—	—
Japan	3.13%	3.31%	3.41%	3.46%	3.47%	3.36%	3.25%	3.38%	3.34%	3.47%
Korea	2.53%	2.63%	2.83%	3.00%	3.12%	3.29%	3.47%	3.74%	4.03%	4.15%
Malaysia	0.60%	—	0.61%	—	0.79%	1.01%	1.07%	1.06%	1.12%	—
Philippines	***0.13%***	***0.11%***	**—**	***0.11%***	**—**	**—**	**—**	**—**	**—**	**—**
Singapore	2.10%	2.16%	2.13%	2.34%	2.62%	2.16%	2.01%	2.15%	2.00%	—
Thailand	0.26%	0.23%	0.25%	0.21%	—	0.25%	—	0.39%	—	—
Vietnam	—	—	—	—	—	—	—	0.19%	—	—

Source: World Bank, 2014. (—) indicates no data for that particular year. R&D activities are defined as basic research, applied research, and experimental development.

4.6. Potential Upgrading Trajectories

Although the Philippines does not actively participate in many segments of the automotive GVC, it has demonstrated considerable upgrading over the last two decades in niche areas, especially in the wire harness segment of the chain. This section outlines potential opportunities for future upgrading, concentrating on the country's demonstrated strengths.

1. **Product and process upgrading to increase wire harness exports:** The Philippines is a major producer of wire harnesses for global markets, with the fourth largest export total in 2014, the presence of leading firms and some backward linkages into wire and coatings. This is a major advantage that presents opportunities for the country moving forward.

   Motor vehicles have long production cycles; as a result, demand for simpler wire harnesses with high labor content will be very long lived, even as segments of the market change with extreme rapidity. However, the sector is also characterized by pressure from lead firms to their suppliers to provide more technologically sophisticated wire harnesses at lower cost to support the greater interplay between electronics hardware and software.[38] These and other developments will require exporters to undertake both product and process upgrading to maintain competitiveness.

   Strengthening backward linkages in wire harness production may also play a role. While rubber, plastic parts and copper can generally be sourced in the domestic market, backward linkages with electronics and the electrical industries account for 70% of imports from the sector's exporters. Table 17 below lists the top import categories of wire harness exporters in the Philippines in 2014—most are electrical switches and connectors, while copper parts do not make the list. Additionally, aluminum has been identified as an important raw material for the industry moving forward (Beecham, 2015)—the metal allows for the development of lighter wire harnesses, which is a priority considering how much wiring is required with the increased electrical content in vehicles.

[38] Examples include the increased use of multiplexing—having wires and cable carry more than one signal at a time.

Table 17. Top 10 Imports, by Value, of Philippines Wire Harness Exporters, 2014

HS Code	HS Description	Share of Imports	Import Value (US$, million)	No. of Firms Importing in 2014
853690	Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits (e.g, connectors, junction boxes, etc.)	33.1%	150.9	8
854449	Other electric conductors, for a voltage not exceeding 80 V, not fitted with connectors	15.6%	70.8	6
854720	Insulating fittings for electrical machines, appliances or equipment, of plastics	12.1%	54.9	6
853890	Other parts suitable for use solely or principally with the apparatus of heading No. 85.35, 85.36 or 85.37	5.0%	22.9	5
740710	Bars, rods and profiles, of refined copper	4.6%	20.8	1
854441	Other electric conductors, for a voltage not exceeding 80 V, fitted with connectors	4.5%	20.5	5
980690	Other commodities, temporarily imported or exported	3.6%	16.5	5
401699	Other articles of vulcanized rubber other than hard rubber	2.7%	12.3	4
391990	Self-adhesive plates, sheets, film, foil, tape, strip and other flat shapes, of plastics other than in rolls	2.5%	11.3	3
740819	Wire, of refined copper, n.e.s.	2.4%	11.0	1
Top 10		**86.1%**	**391.8**	**9**
Electrical Equipment Components		**70.3%**	**320.0**	

Source: PSA, 2015. The share of imports reflects total imports accounting for 1% or more of 9 of the top 10 wire harness exporters total import value in 2014 ($455 million).

2. **Functional upgrading into R&D for wire harnesses:** All of the investments in EPZs to perform R&D related to the automotive industry have occurred within the last decade. Although the Philippines still does not support R&D activities in a systematic way, the country's base of engineers, its strong workforce, its entrenched network of Japanese lead firms such as Toyota, Honda, and Mitsubishi, and its demonstrated history of success in the information technology services sectors offers promise for future expansion.

   The R&D investments by wire harness producers could be instructive. With the automotive industry moving toward electric vehicles and autonomous driving, demand for wires is projected to increase an additional 10% by 2020 with the potential for higher gains over the medium term as electronic signals are transmitted in greater frequency. However, leading manufacturers such as Yazaki report that space and weight constraints have placed an emphasis on R&D activities in order to maintain competitiveness. Yazaki and other firms are investigating a range of innovative approaches, from multiplexing to wireless communications between different sub-assemblies (Greimel, 2016).

3. **Chain upgrading into aerospace wire harnesses:** The Philippines has the potential opportunity to upgrade into the electrical systems of the aerospace industry by leveraging its automotive wire harness experience. Electrical systems are closely related to the two systems in which the country is already participating—interiors and flight controls. Mexico, the world's largest exporter of wire harnesses, has been a pioneer in leveraging its

capabilities in automotive wire harnesses to enter the aerospace value chain. This could be fruitful area for Filipino firms to explore, given that a single A380 aircraft has approximately 500 kilometers of wires. Another chain upgrading trajectory is electronic hardware—with wire for automotive applications becoming lighter and finer in order to save weight and accommodate lower voltage, there is increasing overlap with the wiring used in electronics.

4. **Product and functional upgrading into automotive electronics:** Recent developments suggest meaningful collaboration between major actors in the two industries is emerging (Wright, 2016). The evolving landscape toward explicit partnerships and the increasing electronics content of vehicles provide opportunities for the Philippines, which has a number of firms such as Continental Temic, Fujitsu, and IMI that have expertise in both electronics and automotive GVCs.

   The outputs of such firms generally fit the profile of goods where the country has competitive advantages—smaller, lighter products that do not incur excessive transport costs but that nonetheless require technical knowledge and cost-competitive labor to assemble. Many of these companies reported during interviews that sales were increasing rapidly. The Philippines is well-positioned to take advantage since many of the electronic radar, chassis, wheel, and braking sensors that are in high demand are already being produced in the country—one company indicated that it planned on doubling its physical size and workforce in the next 3-5 years. Moreover, Asia-Pacific is expected to be the dynamic growth market moving forward, further increasing the Philippines' strategic value in these firms' supply chains.

5. **Chain entry into batteries for e-vehicles:** The Philippines could possibly position itself to enter e-vehicle value chain by producing batteries for lead firms targeting Chinese consumers. As part of a US$500 million project it launched in 2012 to develop energy-efficient tricycles and motorcycles in the country, the Asian Development Bank (ADB) identified the creation of a lithium-ion battery supply chain in the Philippines as one of its targeted outcomes. Lithium-ion cells are the preferred source of power for BEVs and PHEVs because of their sizeable energy density (Voelcker, 2015). Additionally, the government has included batteries for e-vehicles as part of its 2014 Investment Priorities Plan, which provides tax holidays and other financial incentives for investors.

   There are two firms already working toward establishing a presence in this niche; Talino EV is an American company that produces batteries for e-vehicle—according to its company website, it has expanded to the Philippines to take advantage of the opportunities afforded by the ADB program. Pangea Motors announced in 2014 it was building a manufacturing facility in Golden Mile Business Park in Cavite to produce rechargeable batteries and components for assemble 10,000 electric vehicles. Pangea's strategy is for Pasang Masda to help replace the country's famous "Jeepney" fleet that is used informally for public transportation (PEZA, 2015; Magkilat, 2014).

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6. Appendix

Table A-1. CKD vs. CBU Sales in the Philippines, 1990-2011

Year	Total Sales	CKD Sales	CBU Imports	CKD% of Sales	CBU% of Sales
1990	57,865	—	—	—	—
1991	47,949	47,008	941	98	2
1992	60,360	58,899	1,461	98	2
1993	83,811	82,202	1,609	98	2
1994	103,471	99,346	4,125	96	4
1995	128,162	127,016	1,146	99	1
1996	162,095	137,365	24,730	85	15
1997	144,435	120,488	23,947	83	17
1998	80,231	67,903	12,328	85	15
1999	74,414	64,635	9,779	87	13
2000	74,000	70,851	3,149	96	4
2001	76,670	65,202	11,468	85	15
2002	85,587	74,734	10,853	87	13
2003	92,336	85,388	6,948	92	8
2004	88,068	58,822	29,246	67	33
2005	97,063	58,566	38,497	60	40
2006	99,541	56,050	43,491	56	44
2007	117,903	61,128	56,775	52	48
2008	124,449	61,513	62,936	49	51
2009	132,444	64,498	67,946	49	51
2010	170,267	74,984	95,283	44	56
2011	165,193	67,742	97,451	41	59

Source: DTI, 2014.

Table A-2. Auto Companies Located in PEZAs by Segment, Date of Investment

PSIC Industry Classification	Original Investments	Years					
		1985-1989	1990-1994	1995-1999	2000-2004	2005-2009	2010-2015
Chemicals and Chemical Products	1	0	0	1	0	0	0
Electrical Machinery and Apparatus	14	0	2	4	1	1	6
Fabricated Metal Products, Except Machinery and Equipment	28	0	1	6	7	5	9
Motor Vehicles, Trailers and Semi-Trailers	52	2	8	17	13	4	8
Research & Development and Services	9	0	0	0	0	4	5
Rubber and Plastic Products	19	0	3	6	1	3	6
TOTAL	**123**	**2**	**14**	**34**	**21**	**19**	**34**

Source: Authors based on PEZA, 2015.

Table A-3. Philippines Top 10 Export Destinations for Wire Harnesses by Value

Partner	Export Value (USD, millions)				Share of Philippines Exports (%)			
	2007	2010	2012	2014	2007	2010	2012	2014
World	891.6	1,107.2	1,446.5	2,042.0				
Japan	369.7	452.1	583.2	934.0	41.5	40.8	40.3	45.7

USA	350.8	366.0	399.7	480.6	39.3	33.1	27.6	23.5
Canada	73.5	154.2	260.2	294.2	8.2	13.9	18.0	14.4
Mexico	27.4	46.4	34.9	162.3	3.1	4.2	2.4	7.9
Thailand	0.4	14.6	71.1	75.4	0.0	1.3	4.9	3.7
Indonesia	2.8	3.9	3.8	19.1	0.3	0.4	0.3	0.9
Australia	21.4	21.1	31.7	17.4	2.4	1.9	2.2	0.9
Other Asia, nes	3.9	5.3	11.0	17.3	0.4	0.5	0.8	0.8
Rep. of Korea	--	0.0	0.4	12.8	--	0.0	0.0	0.6
Argentina	--	0.0	7.4	8.8	--	0.0	0.5	0.4
Top 10 in 2014	**849.9**	**1,063.7**	**1,403.5**	**2,021.8**	**95.3**	**96.1**	**97.0**	**99.0**
Vietnam	14.3	12.8	15.4	2.1	1.6	1.2	1.1	0.1
China	3.2	21.1	5.7	1.6	0.4	1.9	0.4	0.1
South Africa	11.4	0.7	0.4	0.1	1.3	0.1	0.0	0.0
United Kingdom	6.9	2.5	4.5	3.6	0.8	0.2	0.3	0.2

Source: UNComtrade, HS02 6D, Philippines exports to the world. Retrieved on October 28, 2015.

Table A-4. Upgrading in Laguna Technopark

Period	Types of Investment			Examples of Upgrading Events
	Original	Expansion	New Project	
1993-1995	9	0	1	**PRODUCT:** Yutaka Manufacturing adds catalytic converters to its product mix
1996-2000	6	3	2	**PROCESS:** Yutaka Manufacturing expands to manufacture baffle plates and motorcycle mufflers
				PRODUCT: FCC Philippines begins four-wheel vehicle clutch lining for automobiles
2001-2005	2	5	10	**PROCESS:** Furukawa Electric Autoparts Philippines increase in the production capacity of its production of steering roll connectors
				PRODUCT: Honda Parts Manufacturing adds assembly of motor vehicles
2006-2010	3	1	9	**FUNCTIONAL:** F-tech R&D Philippines becomes the first automotive R&D firm within Laguna Technopark. F-tech's clients include Honda, Toyota, Nissan, and Mitsubishi.
2011-2015	2	7	9	**CHAIN:** Applied Machining Corporation, originally a manufacturer of applied metal parts for autos, adds CNC capabilities for aerospace in 2013.
				CHAIN/FUNCTIONAL: FRP Philippines Corp. progresses from originally making fiberglass-reinforced parts (FRP) for toilets to walls for sea walls to FRP parts for autos to recycling fluorescent lamp crushing for inputs

Source: Authors based on PEZA, 2015.

Table A-5. Supporting Automotive-Specific Stakeholders by Focus Area

English Name	Abbrev.	Type	Members	Geographic Focus	Year Est.
Philippine Automotive Competitiveness Council, Inc.	PACCI	Industry Association		Philippines	
Chamber of Automotive Manufacturers of the	CAMPI	Industry		Philippines	1995

Philippines, Inc.		Association			
Motor Vehicle Parts Manufacturers Association of the Philippines	MVPMAP	Industry Association	101	Philippines	1996
Truck Manufacturers Association	TMA	Industry Association	9	Philippines	
Motorcycle Development Program Participants Association	MDPPA	Industry Association		Philippines	1973
Automotive Body Manufacturers Association of the Philippines	ABMAP	Industry Association		Philippines	
Motorcycle Parts Producers and Exporters Association, Inc.	MCPPEA	Industry Association		Philippines	
Philippine Automotive Federation, Inc.	PAFI	Industry Association		Philippines	
Center for Automotive Technology Corp.	CATC	Industry Association		Philippines	2005
ASEAN Automotive Dialogue		Industry Association		Regional: ASEAN	
ASEAN-METI Economic and Industrial Coordination Committee - Working Group on the Automobile Industry	AMEICC-WGAI	Industry Association		Regional: ASEAN	
ASEAN Consultative Committee on Standards and Quality	ACCSQ	Industry Association		Regional: ASEAN	

Source: PACCI, 2012.

Table A-6. Motor Vehicle HS Codes

VC Stage/ Subassembly	HS Codes (2002)	HS Code Descriptions	VC Sector	Mfg.
Final Products				
Passenger vehicles	87032 87033	87032: Other vehicles, with spark-ignition internal combustion reciprocating piston engine 87033: Other vehicles, with compression-ignition internal combustion piston engine (diesel or semi-diesel)	--	Lead Firms
Subassemblies				
Body system	870600	8706: Chassis fitted with engines, for the motor vehicles of headings 87.01-87.05	Chassis	Lead Firms
Drive train	840733 840734 840820	Reciprocating piston engines used for the propulsion of vehicles of Chapter 87; of a cylinder capacity: > 250 cc ≤ 1,000 cc > 1,000 cc Compression-ignition internal combustion piston engines (diesel or semi-diesel engines); of a kind used for the propulsion of vehicles of Chapter 87	Engine	
Components/Parts				
Body system (suspension)	401110 401211 870831+ 870839+ 870870 870880 870894	401110: New pneumatic tires, of rubber; of a kind used on motor cars 401211: Retreaded tires; of a kind used on motor cars (including station wagons and racing cars) Brakes and servo-brakes and parts thereof; 870831: Mounted brake linings 870839: Other 870870: Road wheels and parts and accessories	Tires Brakes^ Wheels Suspension systems and parts (incl. shock absorbers)	Suppliers

VC Stage/ Subassembly	HS Codes (2002)	HS Code Descriptions	VC Sector	Mfg.
		thereof 870880: Suspension systems and parts (incl. shock absorbers) 870894: Steering wheels, columns and boxes	Steering wheel	
Body system (panels)	870710 700711 700721 830230	870710: Bodies (incl. cabs), for motor vehicles of headings 87.01-.05; for the vehicles of heading 87.03 700711: Toughened (tempered) safety glass, of size and shape suitable for use in vehicles, aircraft, spacecraft or vessels 700721: Laminated safety glass… 830230: Other mountings, fittings and similar articles suitable for motor vehicles	Body Panels Windows/ Windshield Metal mountings	
Body system (front & rear end modules)	870810 870891 870892 842139 853910	Parts and accessories of the motor vehicles of headings 87.01-87.05; 870810: Bumpers and parts thereof 870891: Radiators 870892: Silencers and exhaust pipes 842139: Filtering or purifying machinery and apparatus for gases; Intake air filters for internal combustion engines; other 853910: Electric filament or discharge lamps, including sealed beam lamp units and ultra-violet or infra-red lamps; arc-lamps; Sealed beam lamp units	Bumpers Radiators Silencers (mufflers)/exhaust Filters Headlights	
Body system (interior)	940120 870821	940120: Seats of a kind used for motor vehicles 870821: Safety seat belts	Seats Seatbelts^	
	852721[1] 852729[1] 910400	85272: Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles, including apparatus capable of receiving also radio-telephony or radio-telegraphy 910400: Instrument panel clocks and clocks of a similar type for vehicles, aircraft, spacecraft or vessels.	Electronic Instruments: Radios Clocks	
Body system (other)	870829	870829: Parts and accessories of the motor vehicles of headings 87.01-87.05.Other parts and accessories of bodies (including cabs); Other	Other	
Drive train	840991 840999	84099: Parts suitable for use solely or principally with the engines of heading 84.07-08.	Engine parts	
	870840 870850 870860[+] 870893	Parts/accessories of motor vehicles of headings 87.01-05; 870840: Gear boxes 870850: Drive-axles with differential, whether or not provided with other transmission components 870860: Non-driving axles and parts thereof 870893: Other parts/accessories; Clutches & parts thereof	Gear boxes Drive-axles Clutches	
Body System/ Drive train	870899	870899: Parts and accessories of the motor vehicles of headings 87.01-87.05.Other parts and accessories; Other	Other Airbags^	
Electrical Equipment	8507*	8507: Electric accumulators, including separators therefor, whether or not rectangular (including square)	Batteries & parts (accumulators)	

VC Stage/ Subassembly	HS Codes (2002)	HS Code Descriptions	VC Sector	Mfg.
	8511*	8511: Electrical ignition or starting equipment of a kind used for spark-ignition or compression-ignition internal combustion engines (for example, ignition magnetos, magneto-dynamos, ignition coils, sparking plugs and glow plugs, starter motors); generators (for example, dynamos, alternators) and cut-outs of a kind used in conjunction with such engines.	Ignition & parts	
	854430	854430: Ignition wiring sets and other wiring sets of a kind used in vehicles, aircraft or ships	Wire harnesses	
	851220 851230 851240 851290	8512: Electrical lighting or signaling equipment (excl. articles of heading 85.39), windscreen wipers, defrosters and demisters, used for cycles or motor vehicles. NOTE: all of 8512 except 851210 (pertains to bicycles).	Signaling Lighting/visual, sound, windscreen wipers, parts	

Notes: (1) also included in electronics definition; (^) designates safety system component; (*) indicates all 6-digit codes within 4-digit code are included. (+) indicates HS02 is the last year code is used.

Table A-7. Top 10 Exporters of Wire Harnesses (HS Code 854430) in 2014

Company	Firm's Share of Total Exports in HS Code				HS Code Share of Firm's Exports			
	2007	2010	2012	2014	2007	2010	2012	2014
Company #1	27%	27%	26%	22%	95%	100%	100%	100%
Company #2	13%	13%	10%	21%	99%	96%	92%	94%
Company #3	23%	23%	20%	15%	98%	100%	99%	100%
Company #4	24%	22%	21%	14%	98%	99%	99%	97%
Company #5	—	—	12%	8%	—	—	65%	37%
Company #6	0%	0%	1%	7%	—	—	100%	100%
Company #7	0%	0%	0%	5%	—	0%	24%	100%
Company #8	1%	1%	1%	3%	34%	38%	80%	100%
Company #9	0%	0%	0%	2%	—	—	16%	100%
Company #10	0%	0%	1%	2%	—	47%	78%	96%
Top 5 in Given Year	**91%**	**90%**	**90%**	**80%**	—	—	—	—
Top 10 in Given Year	**99%**	**99%**	**98%**	**98%**	—	—	—	—
Distinct Exporters in Year	**102**	**86**	**63**	**40**	—	—	—	—
Distinct Exporters in Year (>$1 million)	**10**	**12**	**15**	**16**	—	—	—	—

Source: PSA, 2015. (—) indicates no trade data for any HS codes in given year. Individual companies are presented in anonymous fashion to protect confidential information