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The Parts of Your Vehicle

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The Parts of Your Vehicle

In an operation like ours, the suppliers will make you or break you.¹

Motor vehicle producers are among the world’s most recognizable brands. Thanks to elaborate marketing, nameplates like Ford, Toyota, and Volkswagen are familiar to consumers around the world. Consumers are attracted to the ruggedness of Ford, the reliability of Toyota, or the style of Volkswagen. Yet the driving experience—comfort, performance, and reliability—primarily is not set by the company whose name is on the dashboard, but by the hundreds of suppliers of the vehicle’s parts.

Think about the radio in the center console of your vehicle. A vehicle is put together from hundreds of components like the radio. These components range from pistons and cylinders to door handles and steering wheels. And a radio, in turn, consists of many individual parts, such as knobs and wires and sensors, not to mention nuts and bolts and screws. Disaggregating a vehicle in this fashion reveals a highly complex supply chain involving thousands of parts and almost as many individual companies.

The motor vehicle industry is composed of two types of manufacturers: assemblers and parts makers. First, a handful of assemblers, usually referred to in this book as carmakers, put together vehicles at several dozen final assembly plants in the United States. Second, several thousand parts makers, usually referred to in this book as suppliers, produce the roughly 15,000 parts that go into the vehicles (Australia Department for Environment and Heritage 2002).

Until the late twentieth century, U.S. carmakers produced most of their own parts themselves and dominated the suppliers of the parts that they did purchase (see Chapter 2). In the twenty-first century, responsibility for making many parts has been passed to independently owned suppliers. Several thousand companies, employing more than 670,000 workers, produce several hundred billion dollars worth of parts every year for new vehicles assembled in the United States.
“The motor vehicle supplier sector has become the backbone of the motor vehicle assembly industry, employing . . . substantially more than the number of people employed by the assemblers” (Hill, Menk, and Szakaly 2007). About 186,000 workers were employed in U.S. final assembly plants in 2007, compared to approximately 673,000 in parts supplier plants (Table 1.1). The true ratio of parts to assembly employment was even higher than three to one because more than one-fourth of the parts purchased in 2006 came from overseas factories, and those workers were not included in the comparison.

The total value of all of the parts delivered by Tier 1 suppliers to final assembly plants averaged $13,600 per vehicle in 2006, compared to $11,100 in 2000, an increase of 22.5 percent over six years (Merrill Lynch 2007). In comparison, the average expenditure on a new car increased only 10.0 percent during that period, from $20,600 in 2000 to $22,650 in 2006 (Ward’s Automotive Group 2007).

**PRINCIPAL OBJECTIVES OF THE BOOK**

The motor vehicle parts industry has been changing geographically as well as functionally. This book analyzes the linkages between changes in the auto industry’s geography and structure. It raises the level of understanding of how the industry is organized by providing analysis at a much richer level of detail than has been provided in previous studies.

This book has two major purposes. The first is to describe the key characteristics of parts suppliers, which account for the largest and increasing share of the value added in manufacturing motor vehicles. The analysis relies heavily on data collected concerning several thousand parts plants in the United States, Canada, and Mexico. The second principal purpose is to describe the changing geography of U.S. motor vehicle production at local, regional, national, and international scales. The book explains that these spatial changes have resulted from changing relationships between carmakers and their suppliers.

An industry that was once heavily clustered in Michigan has been dispersing to other states, as well as to other countries. In the mid-twentieth century, three-quarters of all parts were made in or near Michigan;
in the twenty-first century, only one-quarter come from there. Between 2000 and 2007 alone, Michigan’s employment in the motor vehicle parts industry fell by 43 percent, from 227,000 to 129,000. Yet, at a regional scale, the U.S. motor vehicle industry is still heavily clustered, in a region—known as Auto Alley—that lies in a north–south corridor between the Great Lakes and the Gulf of Mexico.

Parts are made by two kinds of companies, original equipment manufacturers (OEMs) and aftermarket suppliers. Original equipment manufacturers make parts for new vehicles, and aftermarket suppliers make replacement parts for older vehicles. Original equipment accounts for about 70 percent of total parts sales and the aftermarket about 30 percent (Office of Aerospace and Automotive Industries 2007). The distinction between the two groups is not always clear-cut because more than one-third of the 100 largest OEM suppliers also rank among the 100 largest aftermarket suppliers, but for the most part, the two sectors of the motor vehicle industry remain distinct (Automotive Aftermarket Suppliers Association 2007; Automotive News 2007a).

This book is concerned with OEM suppliers, which have varying characteristics. Some of them are multibillion-dollar enterprises, whereas others are very small. Some have been around for more than a century, whereas others were created in the twenty-first century. Some are family owned, and others are controlled by venture capital.
What nearly all parts makers share in the eyes of the motorist is invisibility. If consumers like a vehicle, the carmaker gets the credit. If it is disliked, the carmaker is blamed. Even auto industry insiders know little about most of the parts makers. Numerous histories have been written about carmakers, as well as about their founders and leaders. A search of any good-sized library or online retailer will turn up hundreds of books just on Henry Ford and the Ford Motor Co. A similar search will reveal that little if anything has been written about the vast majority of the parts companies discussed in this book.

Consider, for example, the best-selling car in the United States in 2007, the Toyota Camry. Two-thirds of the value of the Camry was added not by Toyota but by independent suppliers. The motor vehicle industry’s principal newspaper, Automotive News, depicted some of Toyota’s several hundred Camry suppliers (Figure 1.1). Several were Japanese-owned companies with close historical links to Toyota, such as the wire harness supplier Yazaki and the spring supplier NHK. But consumers attracted to a Japanese car with a well-earned reputation for high quality may be surprised to see how few of the parts were actually made in Japan or by Japanese companies.

The parts in a 2007 Camry represent a veritable United Nations of ownership, including British-based shaft supplier GKN, Canadian-based hinge supplier Cosma (now Magna), German-based ABS brake supplier Robert Bosch, and Swedish-based airbag supplier Autoliv. Venerable U.S.-owned corporations were major contributors as well, including hose supplier Dana, valve supplier Eaton, interior supplier Lear, and paint supplier PPG. Other parts makers highlighted in Figure 1.1 are themselves multinational joint ventures, such as American–Japanese exhaust supplier Arvin Sango and seat supplier Trim Masters, and German–Japanese sealing supplier Freudenberg-NOK.

The suppliers mentioned in the two previous paragraphs all are ranked among the largest in the motor vehicle industry, each with annual sales in the billions of dollars. Other Camry suppliers are more modestly sized, generating revenues only in the tens of millions of dollars, for example, stabilizer bar supplier Brewer Automotive Components, headrest supplier Gill, and oil filler cap supplier Miniature Precision.

When the Ford F-150, the best-selling truck model in the United States, was redesigned in 2004, it too had a mix of large and small domestic- and foreign-owned suppliers (Figure 1.2). Although the F-150
was a truck made by a U.S.-owned company and the Camry a car made by a Japanese-owned company, the two models had some of the same suppliers. Not only did the “Japanese” Camry and the “American” F-150 share leading U.S.-owned suppliers such as Dana, Dura, and Lear, they both had brakes and lights supplied by leading German suppliers Robert Bosch and Osram Sylvania, respectively.

Suppliers to these two best-selling vehicles differed in two key aspects. The leading F-150 supplier by far, Visteon Corp., was not a major Camry supplier. Among Visteon’s many contributions to the F-150 were alternators, antitheft devices, axles, fuel tanks, headlamps,
instrument panels, pumps, radiators, sound systems, and windshields. In 2004, Visteon was the second-largest parts maker in North America, with $11 billion in sales for new vehicles. Visteon was not the F-150’s leading supplier by accident. Until 2000, when it was spun off as an independent company, Visteon was Ford Motor Company’s parts-making operation.

The other major difference concerns geography. The F-150 was put together at arguably the most venerable assembly plant in the country, Ford’s Rouge complex in Dearborn, Michigan. At its height of importance between the two world wars, the Rouge complex employed more
than 100,000 workers in more than 100 buildings. Raw materials famously arrived at one end and finished vehicles rolled out at the other. Ford’s twenty-first-century Rouge assembly plant bears little physical resemblance to the mid-twentieth-century version. A display in the Rouge visitor center illustrates how much the complex had changed. Yet the plant continued to be a major reason why Michigan was still the leading car-producing state in the early twenty-first century.

Meanwhile, 300 miles south, Toyota was assembling most of its Camrys in Georgetown, Kentucky, previously best known for a small
college that hosted the Cincinnati Bengals preseason camp. Toyota de-
liberately chose to build a campus with nearly 10,000 employees in
a small town with little tradition in the motor vehicle industry. Ironi-
cally, Toyota’s current Georgetown complex comes closer to the orga-
nizational spirit of the mid-twentieth-century Rouge than does Ford’s
twenty-first-century assembly plant on the Rouge site.

Where vehicles are assembled affects where parts are made. Some
parts are made right next door to the assembly plants, and some are
made on the other side of the world. In the context of just-in-time pro-
duction, however, we show that most parts are made within a several-
hundred-mile radius of the assembly plant in which they are used. Thus,
most of the F-150 parts are made within several hundred miles of the
Rouge, and most of the Camry parts are made within several hundred
miles of Georgetown.

DATA FOR THIS BOOK

The first challenge in writing about parts suppliers is actually find-
ing them. Other empirical studies have relied on government summary
data and interviews with selected industry officials and observers (e.g.,
Cooney 2005; Cooney and Yacobucci 2005; Dyer 2000; Office of Aero-
space and Automotive Industries 2007; Van Biesebroeck 2006).

This study’s database, in contrast, has been built by aggregating
observations from several thousand individual parts plants in the United
States, Canada, and Mexico. A large number of variables have been
collected for every factory operated by the 150 largest North American
suppliers, as well as more than a thousand smaller companies. Together,
these plants account for the overwhelming majority of parts production
in North America, probably well over 90 percent.

One hundred percent coverage cannot be claimed for the database.
Information may be incorrect for particular plants, and some plants un-
doubtedly have been missed altogether. But this is by far the most com-
prehensive and detailed compilation of data on parts suppliers in North
America, making it possible to identify trends and draw conclusions at
a higher level of detail than is possible with summary data.2
Government Data Sources

The primary government data source is the U.S. Census of Manufactures, collected every five years, including 1997 and 2002. The Census of Manufactures provides information about both the value of shipments originating from manufacturing establishments and the value added at manufacturing establishments in each sector of the economy. The census also provides information on employees, payroll, production workers, wages, cost of materials, and capital expenditures.

Motor vehicle assembly operations are allocated to North American Industrial Classification System (NAICS) code 3361. NAICS 3361 is divided into three six-digit codes: NAICS 336111 for automobile manufacturing (i.e., final assembly), NAICS 336112 for light truck manufacturing, and NAICS 336120 for heavy truck manufacturing. The value of parts delivered to automobile and light truck final assembly plants in the United States was $156.2 billion according to the 2002 census (Table 1.2).

The manufacture of many motor vehicle parts is assigned to NAICS 3363, which is divided into eight six-digit codes: engines, electrical, steering & suspension, brakes, transmissions, fabrics & seats, metal stampings, and other. We also include NAICS 336211, motor vehicle

<table>
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<th>NAICS, Parts</th>
<th>Shipments from suppliers ($, billions)</th>
<th>Received by assemblers ($, billions)</th>
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<tr>
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<td>336310, 336350, Powertrain</td>
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<td>42.9</td>
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<td>336390, Other</td>
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<td>6.6</td>
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<tr>
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<tr>
<td>—, Total value of parts</td>
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<td>156.2</td>
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</tbody>
</table>

SOURCE: U.S. Census Bureau, 2002 Census of Manufactures.
bodies, in our definition of motor vehicle parts. The value of shipments for NAICS codes 3363 and 336211, motor vehicle parts and motor vehicle bodies, in 2002 was $211.3 billion. The six-digit NAICS codes are subdivided into more detailed eight- and 10-digit codes. For example, transmissions (NAICS 336350) is divided into transmissions for new vehicles (NAICS 33635011), transmissions for heavy trucks and buses (NAICS 33635012), transmission parts (NAICS 33635013), axles (NAICS 33635014), and other drivetrain parts (NAICS 33635015). NAICS 33635015 in turn is divided into seven 10-digit codes, such as clutches (NAICS 3363501522) and drive shafts (NAICS 3363501528).

The large discrepancy between the value of deliveries and the value of shipments, as well as the large size of “other” categories, points to three serious limitations of NAICS data. First, shipments include both original equipment and aftermarket sales. As mentioned earlier in this chapter, an estimated 30 percent of shipments go to the aftermarket, although precise figures are not available from the census and percentages are likely to vary among NAICS codes. Second, deliveries include both domestic-made and foreign-made parts. As discussed in more detail in Chapter 13, at the time of the 2002 census, roughly one-fourth of parts arriving at U.S. assembly plants were produced in other countries.

The third critical limitation, affecting both shipments and deliveries, is that some key parts, including tires, glass, and paint, have been placed in NAICS codes other than 3363 if their primary customers are outside the motor vehicle industry. Consequently, it is not possible, using census data, to break out values on the shipments of these parts to vehicle assembly plants.

This Study’s Database

Rather than relying predominantly on aggregated government data, research for this book included creating a database of several thousand parts plants by name and address. The starting point for the plant-level database was information acquired from ELM International, Inc., a Michigan-based vendor of information about automotive suppliers.3

Although it was not designed with research applications in mind, the ELM International database purports to offer exhaustive coverage, with 4,268 plant-level records in 2006, covering the United States, Canada, and Mexico. Additional records are continuously added. Informa-
tion about individual plants includes name, address, products made at the plant, names of customers, number of employees, and name of the union if present.

We made five types of substantial revisions to the ELM International database. First, the names of companies and unions were corrected to reflect the many mergers, acquisitions, and other changes affecting the industry in recent years.

The second revision concerned employment level. Plants shown by ELM International to have more than 2,000 employees were checked either by phone or a review of the company Web site. Employment figures reported in the ELM International database for 2006 averaged about one-fourth higher than the field-checked employment figures. Consequently, employment figures based on ELM International data were not used in this study unless they were found to be in substantial agreement with other sources.

We also added plants that should have been included by ELM International to the database and removed others that had closed. Every plant operated in the United States in 2006 by the 150 largest parts suppliers, according to Automotive News (2007a), was identified, representing a total of approximately 1,600 plants. There was a net of 335 plants added to the ELM International database, approximately a 20 percent increase.

Fourth, we collected additional information about the 4,268 plants in the database beyond that provided by ELM International. The age of the plant and the nationality of the owner were found for most of the plants through contacting the companies or reviewing state industrial directories, press reports, and trade associations (e.g., the Japan Auto Parts Industries Association). The latitude and longitude of each plant location was geocoded to facilitate mapping of plant distributions, which was especially important for the geographic analysis found throughout this book.

The final significant revision was to identify one primary type of part for each of the 4,268 plants. The ELM International database listed up to 13 distinct parts being made at a particular plant; only 1,551 plants had only 1 parts code, 37 had at least 10 parts codes, and 4 plants had the maximum 13. The mean number of parts codes per plant was about 2.4. For this book, we assigned each plant one of six codes: chassis, electronic, exterior, interior, generic, and powertrain.
The principal limitation of the database that could not be overcome concerned the customers for each plant. The database showed the names of the carmakers to which the parts were ultimately attached, but it rarely listed the name of the immediate customer, which in many cases would be another supplier. In other words, most suppliers of seat parts, for example, reported their customer to be a carmaker even though the seat parts were actually shipped to a seat assembler.

Key findings of the database included:

- **Number of plants:** 3,179 plants were located in the United States, plus 416 in Canada and 673 in Mexico (see Figure 1.3).
- **Type of owner:** 3 percent of the U.S. parts plants were owned by carmakers; 42 percent by the 150 largest suppliers, each with annual North American original equipment sales of more than $200 million; and 55 percent by 1,000 other suppliers.
- **Plant size:** Median plant employment was 220, mean was 350, and 6 percent had more than 1,000 employees.
- **Nationality of owner:** 77 percent were owned by companies with U.S. headquarters and 23 percent by companies with foreign headquarters.
- **Date of opening:** 55 percent were opened before 1980 and 45 percent between 1980 and 2006.
- **Location:** 25 percent were located in Michigan, 36 percent in other Great Lakes states, 28 percent in the South, and 11 percent in the rest of the country.
- **Union:** 85 percent of the plants reported on their union status: 30 percent had a union and 70 percent did not.
- **Type of part:** 22 percent of plants made parts for the powertrain, including the engine and transmission; 19 percent of plants made parts for the chassis, including tires, wheels, brakes, steering, and suspension; 15 percent of plants made parts for the exterior, including bodies, bumpers, glass, and paint; 14 percent of plants made parts for the interior, including seats, instrument panels, doors, headliners, and carpeting; 15 percent of plants made parts for the electronic systems, including engine management, passenger convenience, and safety; and 16 percent of plants made generic parts, including bearings, brackets, and hinges.
Compared with supplier studies by the U.S. Census Bureau, the Center for Automotive Research (CAR), and Merrill Lynch, this study has found a smaller percentage of powertrain plants and a larger percentage of chassis plants (Table 1.3). The difference can most likely be attributed to differences in allocating parts among systems. For example, should the axle be considered part of the powertrain or part of the chassis?

**BOOK OUTLINE**

The book is divided into four sections, based on impacts of changing carmaker–supplier relationships at various geographic scales:

- Part I: The motor vehicle industry’s traditional core region cen-
tered on southeastern Michigan and adjacent Midwest states near the southern Great Lakes. Which parts are still being made in the industry’s traditional home and why?

- Part II: Local-scale connections between carmakers and their suppliers. Which parts are being made very close to their customer—a final assembly plant—and how are the rest of the parts being moved from supplier to customer?

- Part III: Clustering of motor vehicle production at the regional scale, known as Auto Alley. Why have most suppliers located in Auto Alley, and what factors account for choice of location within Auto Alley?

- Part IV: International shifts in production of parts for the U.S. motor vehicle industry. What is the magnitude and rate of growth of the outsourcing of parts to other countries, and which of the many parts in a motor vehicle are the ones being sourced overseas?

### CARMAKER–SUPPLIER RELATIONS

Manufacture of original equipment parts constitutes an intermediate step in the process of producing motor vehicles. As a result, the

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<th>System</th>
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<th>CAR Merrill Lynch</th>
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NOTE: Columns may not sum to 100 due to rounding.
fortunes of the producers of the parts depend to a large extent on their ultimate customers, the carmakers. A book on motor vehicle parts suppliers therefore must acknowledge the perspective of carmakers. In this section, we briefly review changes in the role of parts makers from the carmaker’s perspective, as well as the literature on relationships between carmakers and parts suppliers.

The “Big 3” carmakers (GM, Ford, and Chrysler) dominated twentieth-century production, but they entered the twenty-first century on very shaky ground. Their U.S. market share plunged from 95 percent in the mid-twentieth century to 75 percent in the late twentieth century to 50 percent in the first decade of the twenty-first century. Ford and GM faced their most serious financial challenges since the Great Depression, and Chrysler was first sold to German carmaker Daimler-Benz, then to private equity firm Cerberus. Reflecting the declining market share, the “Big 3” were more accurately known in the twenty-first century as the “Detroit 3.”

As the Detroit 3 struggled, Japanese-based companies led by Toyota were raking in record profits and market share. Foreign-owned carmakers accounted for more than one-third of motor vehicle production in the United States during the first decade of the twenty-first century (Andrea 2007). Toyota passed Ford as the world’s second-largest producer in 2004 and GM as the world’s largest producer in 2007 (Child 2008). When it overtook GM, Toyota became the first non-American company to lead world production since the nineteenth century.

Toyota’s success was based on its distinctive production system that efficiently turned out vehicles nearly free of defects. The Toyota Production System has many key elements, and often underappreciated among them is a distinctive relationship between the carmaker and its suppliers. “At least part of Toyota’s success is because of its harmonious relationship with supplier companies.”

In a fiercely cutthroat market, the relationship with suppliers has become a key source of competitive advantage for some carmakers. As Toyota passed Ford and then GM as the world’s largest carmaker, favorable supplier relations contributed to its success. “The automaker thinks it can gain a competitive advantage in North America if suppliers are satisfied by their relationship with the automaker” (Chappell 2005b).
Benefits of Good Carmaker–Supplier Relations

Researchers have been especially interested in documenting and explaining the competitive advantage accruing to carmakers as a result of good supplier relations. The seminal study *The Machine That Changed the World* by the International Motor Vehicle Program based at the Massachusetts Institute of Technology introduced many in the U.S. auto industry to the successes of Japanese-inspired lean production, including the different relationships between carmakers and suppliers as compared with the U.S. model (Womack, Jones, and Roos 1990).

Research on changing relations between carmakers and their suppliers has emanated from two types of scholars. Analysts in nonacademic settings have measured the magnitude of the parts industry and have documented the enhanced role of suppliers in the production process. Academic researchers have emphasized the underlying meaning and significance of changing carmaker–supplier relations and the comparative advantage that accrues to some carmakers through enhanced supplier relations.

Most of the recent studies on the motor vehicle parts sector have come from analysts in nonacademic settings. Researchers are based in three types of organizations: auto industry specialists, financial services firms, and government agencies. Described below are some of the studies that industry specialists have released to the public.

The CAR Economics and Business Group has addressed changing relationships between carmakers and suppliers in numerous studies. CAR researchers have estimated the total number of jobs generated by the auto industry in the United States and in selected states (Hill 2005; Hill, Menk, and Szakaly 2007), the future size of union membership and the Detroit 3 workforce (McAlinden 2007), and a “stay/go” index to forecast the likelihood that production of particular types of parts will abandon Michigan (McAlinden 2006).

DesRosiers Automotive Consultants has estimated the magnitude of the supplier sector in North America and the likelihood of increased overseas outsourcing (DesRosiers 2005, 2006). The firm is Canadian based, so it breaks out U.S. and Canadian data.

The Original Equipment Suppliers Association (OESA), representing the perspective of the leading parts makers in North America, has documented the difficulties faced by suppliers, especially in the context
of the global economy. OESA has also described the increasing role of equity investment firms in the parts supplier industry (De Koker 2006; Motor & Equipment Manufacturers Association 2007; Original Equipment Suppliers Association 2006).

CSM Worldwide has specialized in forecasting future demand for vehicles and parts, with a worldwide focus (Robinet 2005). Roland Berger Strategy Consultants has also concentrated on future worldwide trends in demand for different parts, especially in view of technology changes (Maj, Benecchi, and van Acker 2004). The McKinsey Global Institute within McKinsey & Company has documented productivity improvements in the motor vehicle industry (Baily et al. 2005). IRN, a Michigan-based consultancy, focuses on auto supplier issues (Korth 2007).

Studies on the motor vehicle parts sector have also been produced by agencies of the federal government. The U.S. Department of Commerce Office of Aerospace and Automotive Industries publishes an annual assessment of the parts industry. Reports on aspects of the auto industry of particular interest to Members of Congress are published by the Congressional Research Service (Cooney 2005). The Government of Canada has also commissioned studies of its automotive market (Van Biesebroeck 2006).

Analysts based in financial services firms have been primarily concerned with the financial challenges facing motor vehicle suppliers as a result of changing relations with carmakers (see, for example, Steinmetz 2006). Merrill Lynch has monitored the supplier sector with an eye to recommending companies for investment (Merrill Lynch 2007); the firm has also looked at future energy technology (Merrill Lynch 2006).

**Elements of Changing Carmaker–Supplier Relations**

The shift from parts and components to modules and systems has fundamentally changed the role of parts suppliers in the development and production of cars. Analysts agree on the following basic dimensions of change (Wasti and Liker 1999).
**Fewer parts and more modules**

What goes into a vehicle can be sorted into the following hierarchy:

- Parts are typically small, individual pieces of metal, rubber, or plastic stamped, cut, or molded into distinctive shapes, such as knobs and levers.

- Components are several parts put together into recognizable features, such as radios and seat covers.

- Modules are several components combined to make functional portions of a motor vehicle, such as instrument panels and seats.

- Systems are groups of components that are linked by function into major units of motor vehicles, such as interiors and engines.

In the past at their final assembly plants, carmakers gathered together thousands of individual parts and components purchased either from independent suppliers or made by their own parts divisions. Now, suppliers are being asked to deliver large modules and systems ready to be installed on the final assembly line. “A modular system is composed of subsystems (or modules) that are designed independently but still function as an integrated whole” (Dyer 2000, p. 171). Modularization was described by GM vice president Bob Lutz as “like the definition of a Lego set” (Mackintosh 2004).

“What was once a highly vertically integrated industry has become ever more dependent on supplier companies to fulfill increasingly complex piece and module design and production” (Hill, Menk, and Szakaly 2007, p. 9). As a result, some analysts speculate that “[m]odularization may remove the nameplate assembler from directly manufacturing much of the product; it becomes rather the marketer, coordinator and distributor of the final vehicle” (Cooney and Yacobucci 2005, p. 41).

SupplierBusiness.com (2004) described the difference between a module and a system this way: “[T]he different parts of a safety system or a braking and traction control system are located in separate areas of the vehicle and incorporated into several different modules, but they will have been designed to work together as a complete system . . . [M]odules are being designed as complex units, which incorporate multiple functions. Examples of modules include seats, doors, cockpits, front-ends and suspension corner modules. Each of these can include components from two or more major vehicle systems.”
A parts producer stated the difference more flippantly: “Two parts bolted together is a module. Three parts bolted together is a system.”

**Larger contracts to fewer suppliers**

Instead of buying from thousands of suppliers, carmakers are offering large contracts to only a handful of suppliers, which are consolidating into fewer larger firms and driving smaller firms out of the industry.

“Productivity improvements and the declining market share of domestic OEMs have led to considerable consolidation among motor vehicle parts suppliers” (Hill, Menk, and Szakaly 2007, p. 10). “Since the early 1990s . . . the largest 20–30 suppliers in the industry have taken on a much larger role in the areas of design, production, and foreign investment, shifting the balance of power in some small measure away from lead firms towards suppliers” (Sturgeon, Van Biesebroeck, and Gereffi 2007, p. 3). As a result, “[w]hile the total number of vehicles produced in North America grew by 40 percent between 1991 and 2005—from 11.6 million to 16.3 million—the combined sales of the largest 150 suppliers in North America almost tripled over the same time period . . .” (Hill, Menk, and Szakaly 2007, p. 24).

**Longer relationships between suppliers and carmakers**

Instead of awarding contracts annually to the lowest price bidders, carmakers are developing long-term relationships with suppliers, at least for the several-year life of specific vehicle models, if not longer.

“The continued efforts by original equipment manufacturers (OEMs) to reduce costs has led to an ever-increasing amount of manufacturing, sub-assembly, and R&D work being shifted to suppliers . . . The supplier companies design, engineer and manufacture the vast majority of the parts that go into a modern-day motor vehicle” (Hill, Menk, and Szakaly 2007, pp. 1, 9). “For niche vehicles or low-volume cars the entire assembly is sometimes turned over to an outside contractor. The practice allows OEMs to assemble vehicles locally without large capital investments or to increase production capacity when their own assembly plants cannot satisfy demand for an unexpectedly successful model” (Van Biesebroeck 2006, p. 210).
**More research and development by suppliers**

Instead of providing detailed specifications, carmakers are giving suppliers responsibility for research and development to design and build innovative modules and systems.

In 2000, suppliers spent $6.6 billion on research and product development, accounting for 36 percent of total automotive-related spending on research and development; this increased to $6.8 billion in 2003, or 40 percent of all research and product development spending (Hill, Menk, and Szakaly 2007). “Most innovations in safety, emissions, and entertainment come from Tier 1 suppliers.”

“Some suppliers are willingly taking on the new responsibilities offered to them by the OEMs, transforming themselves into ‘Tier One-Half systems integrators,’ that engineer and build complete modules (for example, an entire interior, 4-corner suspension sets, or an entire rolling chassis) and assume both product design and development responsibilities and down stream supply chain management functions previously undertaken by the OEMs” (Office of Aerospace and Automotive Industries 2007, p. 6).

**Smaller parts inventory and more just-in-time delivery**

Instead of maintaining a large inventory of parts, carmakers are requiring suppliers to deliver modules and systems on a just-in-time (JIT) basis, often within only a few minutes before needed on the final assembly line.

“Because there is no built up inventory, JIT allows the firms to correct quality problems as they are discovered, and to make running changes in product specifications or volume requirements when needed” (Office of Aerospace and Automotive Industries 2007, p. 5).

**Two Paradigms for Carmaker–Supplier Relations**

Researchers argue that an automaker’s strong relationships to its supply base can be a valuable strategic capability that is difficult and time-consuming for competitors to imitate. According to Jeffrey Dyer (2000, p. 169), “competitive advantage will increasingly be jointly created, and shared, by teams of firms within a value chain.”
Analysts’ perspectives on Japanese carmaker–supplier relations

Japanese carmakers have established constructive partnerships with their suppliers. A key to better supplier relations is trust. The three leading Japanese carmakers, Toyota, Honda, and Nissan, are seen as legitimate semi-insiders by supplier companies (Sako 2004, p. 301): “Suppliers’ trust of (Japanese carmakers) lay in the latter’s competence as teachers, but also in devising a clear set of rules for sharing specific gains from short-term intervention, and for letting suppliers appropriate wider gains from long-term capability enhancement.”

According to Wasti and Liker (1999), positive supplier relationships are achieved by following six steps: 1) understand how suppliers work, 2) turn supplier rivalry into opportunity, 3) supervise vendors, 4) develop supplier technical capabilities, 5) share information intensively but selectively, and 6) conduct joint improvement activities.

From interviews with nearly 100 managers at Honda and Toyota as well as their suppliers, Liker and Choi ([2004]; see also Dyer and Nobeoka [2000]) concluded that these two carmakers “have struck remarkable partnerships with some of the same suppliers that are at loggerheads with the Big Three and have created latter-day keiretsu across Canada, the United States, and Mexico . . . Toyota and Honda have managed to replicate in an alien Western culture the same kind of supplier webs they built in Japan.” (Keiretsu is defined on p. 22.)

It is no coincidence that many of today’s fastest growing and most financially stable suppliers set up shop in the United States at the behest of Japanese carmakers. “For Toyota and Honda, making sure their suppliers earn a profit is a key part of their formula for success. Profitable suppliers are able to develop technologies that give their customers an advantage” (Automotive News 2005a). Japanese carmakers have nursed their suppliers, and suppliers like doing business with them. In addition, supplier networks incorporate a complex system of incentives.

The three leading Japanese carmakers do not have identical supplier relations (Sako 2004). Although all three transfer knowledge to suppliers through a variety of development activities and management control systems, Toyota shares more information with suppliers and has more separation between purchasing and engineering development. “[Each of the three Japanese carmakers] clearly distinguishes between the inner core of suppliers to which processes for ‘capability enhancement’
are taught in a hands-on manner, and the rest, who are mainly given incentives to make improvements through long-term customer commitment. This distinction ensures that tacit knowledge is shared only with the inner core. This inner core ranges from 25 companies at Nissan and 52 at Toyota, and up to 63 at Honda” (Sako 2004, p. 302).

**Analysts’ perspectives on Detroit 3–supplier relations**

In contrast, Sako and Helper surveyed 675 Tier 1 suppliers in the United States and 472 in Japan during the 1990s and found that “[t]he U.S. auto industry has been characterized by decades of adversarial buyer-supplier relations” (Mudambi and Helper 1998, p. 789). They also state that “suppliers to the U.S. automobile industry have little expectation of being treated fairly by their customers” (p. 776). Table 1.4 summarizes the contrast between the two models of supplier relations.

“Experts agree that American corporations, like their Japanese rivals, should build supplier keiretsu: close-knit networks of vendors

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**Table 1.4** Relationships between Suppliers and U.S. and Japanese Carmakers

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Detroit 3&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Japanese 3&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship orientation</td>
<td>Adversarial; focus is on cost and OEMs’ short-term gain</td>
<td>Strategically integrate suppliers into partnership-like relationship</td>
</tr>
<tr>
<td>Open, honest communication</td>
<td>Indifference; incomplete and late information</td>
<td>High level and timely</td>
</tr>
<tr>
<td>Protect confidential information</td>
<td>Little regard for suppliers’ proprietary information or intellectual property</td>
<td>High regard</td>
</tr>
<tr>
<td>Importance of cost vs. quality and technology</td>
<td>By far, primary focus is on cost</td>
<td>Also seek low cost but balance it with quality improvements and technology</td>
</tr>
<tr>
<td>Supplier survival</td>
<td>Little regard</td>
<td>Concern for long-term success and stability</td>
</tr>
</tbody>
</table>

<sup>a</sup> GM, Ford, and Chrysler.

<sup>b</sup> Toyota, Honda, and Nissan.

that continuously learn, improve, and prosper along with their parent companies” (Liker and Choi 2004, p. 106). The key word in the previous sentence is *should*, because the reality is that “current attempts to increase informal commitment and trust are constrained by the existence of adversarial buyer-supplier relations in the past” (Mudambi and Helper 1998, p. 776).

U.S. carmakers have tried going down the path of cooperation. During the early 1990s, for example, Chrysler implemented a more cooperative way of doing business with its suppliers that showed almost immediate improvements in its supplier relationships. In the wake of its merger with Daimler, however, that approach was abandoned in favor of the traditional way of doing business.8

Mudambi and Helper (1998, p. 789) concluded that relationships between U.S. carmakers and suppliers are close even though they are adversarial: “[T]he close but adversarial model represents the current state of buyer-supplier relations in the majority of cases.” U.S. carmakers have created a framework of formal cooperation with their suppliers, but it is accompanied by uncooperative behavior. U.S. carmakers take advantage of the competitive weaknesses of suppliers to reap short-term gain (Mudambi and Helper 1998). Especially damning was the perspective of U.S. suppliers, which were less trusting than Japanese suppliers, except when they had Japanese carmakers as customers (Sako and Helper 1998).

Liker and Choi (2004) show that U.S. carmakers have adopted all of the Japanese-inspired organizational strategies, including slashing the number of suppliers, awarding long-term contracts to the survivors, encouraging Tier 1 suppliers to set up lower-tier networks, ordering systems and modules instead of parts and components, receiving deliveries on a just-in-time basis, and giving suppliers responsibility for quality and costs. “However, while these American companies created supply chains that superficially resembled those of their Japanese competitors, they didn’t alter the fundamental nature of their relationships with suppliers. It wasn’t long into the partnering movement before manufacturers and suppliers were fighting bitterly over the implementation of best practices, like continuous quality improvement and annual price reductions” (Liker and Choi 2004, p. 106).
Carmaker–Supplier Relations: Converging or Diverging?

Helper and Sako (1995) did detect some convergence in the way U.S. and Japanese carmakers work with suppliers.

- **Information disclosure.** The percentage of suppliers reporting an increase in information disclosed by U.S. carmakers rose from 38 percent in 1984 and 50 percent in 1989 to 80 percent in 1993; the percentage of suppliers reporting an increase in information disclosed by Japanese carmakers declined from 80 percent in 1989 to 77 percent in 1993.

- **Joint problem-solving.** The percentage of suppliers reporting that U.S. carmakers helped them match efforts by competing suppliers increased from 32 percent in 1989 to 51 percent in 1993; the percentage of suppliers reporting that Japanese carmakers helped them match competitors declined from 45 percent in 1989 to 40 percent in 1993.

- **Contract length.** Suppliers to U.S. carmakers reported that the average contract increased from 1.2 years in 1984 to 2.3 years in 1989 and 2.4 years in 1993; two-thirds of suppliers to Japanese carmakers reported no time-specific contracts.

The immense cost pressures faced by the Detroit 3 have since pushed the pendulum in the other direction and again made cost the main criterion in supplier selection. First, the Detroit 3 carmakers have been more easily able to source globally, notably from China. As a result, many North American suppliers now have to compete with the “landed costs” of parts produced in China and other low-wage countries. Second, Internet-based technologies have allowed the Detroit 3 to get suppliers to compete on cost more efficiently—and more brutally—than they used to. Confrontational tactics of Detroit 3 purchasers include “beat[ing] down prices with electronic auctions or rebidding work to a competitor. Japanese are equally tough on price but are committed to maintaining supplier continuity” (Chappell 2004a; Sherefkin and Wilson 2003). Consequently, the relations between carmakers and suppliers in America have deteriorated even as the quality of vehicles has improved (Liker and Choi 2004). According to Stallkamp (2005b), “Typically, in any one of the Big Three automakers there might be more than 250 to 300 buyers working at one time, each responsible for man-
aging a small aspect of the parts or services that go into the vehicle.” Isolated from engineering, manufacturing, and marketing people, these buyers have been motivated primarily by the desire to reduce the piece or unit price. A penny per part adds up to big savings for a buyer.

Detroit 3 financial monitors have further increased pressure on suppliers through “open book pricing,” such as auditing quotes and reviewing overhead expenses. “What happens is the big guys, major OEMs, keep putting more and more requirements on the supplier that are non-negotiable. They simply say, ‘This is the way it is going to be done as of this date, and next year we want another 5 percent price reduction.’”

In response, Stallkamp (2005b) suggests that suppliers have engaged in an elaborate game:

The supply base participants quickly figured out that a low quote was the major deciding factor and often bid at cost or even below cost to secure the business. They recovered their profits over time because the development process each of the U.S. companies used was so lengthy and convoluted that each part was changed several times, each time providing a chance for the supplier to increase its price for the design change. Suppliers often padded these design changes, but because the business was based on the initial quote, little was done to move to another supplier because switching would cost time, cause disruption and possibly produce quality issues.

OUTLOOK AND UNCERTAINTIES

“Industry surveys consistently have shown the U.S. component supplier segment to be mistrustful, resentful and rebellious against their Big 3 customers, while favorable to the Japanese transplants such as Toyota and Honda” (Chappell 2005b). One such survey of carmaker–supplier relationships has been conducted annually since 2000 by Planning Perspectives Inc. (PPI). From the responses of more than 200 suppliers, PPI (2005) constructed a Working Relations Index to measure how carmakers treat their suppliers on the basis of 17 business practices. According to a 2007 PPI survey of 308 North American parts makers, including 69 of the 150 largest, Toyota was ranked highest in
fostering positive business relationships, followed by Honda, Nissan, Chrysler, GM, and Ford (PPI 2007; Table 1.5).

Why do supplier relations matter? Because good relationships to the supply base have become a key element of some carmakers’ business strategies. “For the Big 3, the danger is that suppliers may stop offering them their best technology” (Automotive News 2005b). Suppliers say they have reduced spending on research and development for the Detroit 3 and increased it for Japanese carmakers. More mistrustful of Detroit 3 business methods, suppliers have been less willing to share technology with them or invest in their products as compared with Japanese carmakers (Chappell 2004b).

Larry Denton, CEO of Dura Automotive Systems, summarized the situation in Sherefkin and Wilson (2003): “Catalytic converters, ABS, airbags, automatic transmissions, safety belts—those were all innovations that came from the traditional Big 3. We can’t name anything like that that has come in the last five years because if I look at iDrive, advanced diesel engines, hybrids, CVT—where did they come from? There’s something broke here. Innovation isn’t getting through the old domestics . . . Even though we’re all suppliers to all of them, technology is headed in one direction because of the business model, and it needs to be fixed.”

### Table 1.5 Planning Perspectives Inc.’s Working Relations Index 2002–2007

<table>
<thead>
<tr>
<th>Carmaker</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>% change</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota</td>
<td>314</td>
<td>334</td>
<td>399</td>
<td>415</td>
<td>407</td>
<td>415</td>
<td>2.0</td>
<td>32.2</td>
</tr>
<tr>
<td>Honda</td>
<td>297</td>
<td>316</td>
<td>384</td>
<td>375</td>
<td>368</td>
<td>380</td>
<td>3.3</td>
<td>27.9</td>
</tr>
<tr>
<td>Nissan</td>
<td>227</td>
<td>259</td>
<td>294</td>
<td>298</td>
<td>300</td>
<td>289</td>
<td>−3.7</td>
<td>27.3</td>
</tr>
<tr>
<td>Chrysler</td>
<td>175</td>
<td>177</td>
<td>183</td>
<td>196</td>
<td>218</td>
<td>199</td>
<td>−8.7</td>
<td>13.7</td>
</tr>
<tr>
<td>Ford</td>
<td>167</td>
<td>161</td>
<td>160</td>
<td>157</td>
<td>174</td>
<td>162</td>
<td>−6.9</td>
<td>−3.0</td>
</tr>
<tr>
<td>GM</td>
<td>161</td>
<td>156</td>
<td>144</td>
<td>114</td>
<td>131</td>
<td>174</td>
<td>32.8</td>
<td>8.1</td>
</tr>
<tr>
<td>Industry mean</td>
<td>224</td>
<td>234</td>
<td>261</td>
<td>259</td>
<td>266</td>
<td>270</td>
<td>1.3</td>
<td>20.7</td>
</tr>
</tbody>
</table>

NOTE: The index ranks OEMs based on 17 criteria across five broad areas: relationship, communication, help, hindrance, and profit opportunity.
Notes

2. Research for this book also benefited from a dozen strategic interviews with car-makers as well as parts makers, both large and small.
5. The “U.S. Automotive Parts Industry Annual Assessment” is published annually.
8. For an enlightening description of that episode, see Stallkamp (2005a).