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JOHNSON CONTROLS, INC.—AUTOMOTIVE SYSTEMS GROUP

THE GEORGETOWN, KENTUCKY PLANT

Philip Beckwith, plant manager at the Georgetown, Kentucky plant of the Automotive Systems Group of Johnson Controls, Inc., was pleased as he described business there in February 1992:

> *We are becoming a world-class manufacturer using American workers here in rural Kentucky to compete successfully in the auto supply business. We make metal frames for automobile seats and assemble complete seating systems on a Just-in-Time basis. Our plant motto is "Quality People Make Quality Products," and we believe it and live it. We are just as dedicated to the company's overall goal of "Exceeding Customers' Expectations," even when the customer is Toyota, maybe the best manufacturing company—and the most demanding customer—in the world.*

THE AUTO SUPPLY INDUSTRIES IN THE UNITED STATES AND JAPAN[1]

Automobile manufacturing in the early 1990s continued its long-held position as the largest industry in the world in terms of sales. (See Exhibit 1 for sales information.) Supplying the automobile manufacturers with component systems and parts was itself a major industry.

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1 This section draws heavily on the work of Banri Asanuma, especially as reported in his "Japanese Manufacturer-Supplier Relationships in International Perspective: The Automobile Case," Chapter 7 in Paul Sheard, editor, *International Adjustment and the Japanese Economy* (St. Leonard's, NSW, Australia; Allen & Unwin, 1992). See also the results of the MIT International Motor Vehicle Program as reported in James P. Womack, Daniel T. Jones and Daniel Roos, *The Machine that Changed the World* (New York: Rawson Associates, 1990), especially Chapter 6. John McMillan presents an interesting, managerially oriented summary of the relevant theoretical and empirical research on supplier relations in "Managing Suppliers: Incentive Systems in Japanese and U.S. Industry," *California Management Review* **32** (1990) 38–55. For an earlier discussion of the auto supply industry, see "Note on Supplying the Automobile Industry," Harvard Business School case 9-378-219 (Boston: Harvard Business School, 1978, revised 1981).

Prepared by Paul Milgrom and John Roberts as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. Research for this case was supported by Booz, Allen & Hamilton and the National Science Foundation.

The average car had more than 10,000 parts, each of which needed to be designed and manufactured, either by the auto manufacturer itself or by outside suppliers. A variety of approaches to the problem of acquiring parts and components had been used in the industry. Henry Ford at the time of World War I had chosen an extreme solution to this make/buy problem, integrating back vertically to the point where Ford Motor Company controlled its own steel mills and iron mines. At General Motors in the 1920s, Alfred Sloan continued the vertically integrated approach but set up separate supply divisions to make parts and components for the final assembly operations. Both firms, and Ford in particular, later reduced the extent of vertical integration. Toyota and the other Japanese manufacturers, in contrast, had always relied much more on outside sup-pliers. Table I indicates the differences across automobile manufacturers in the extent of in-house procurement in 1985 as measured by the ratio of in-house production costs to total production costs.[2] Another indicator of the difference is sales per employee, which were almost six times as great at Toyota in 1991 as at GM.[3]

Table I: Vertical Integration in the Auto Industry, 1985

Firm	In-house Production
General Motors	70%
Ford	50
Chrysler	30
Toyota	30
Nissan	30
Honda	30
Mazda	26

The extreme differences revealed in Table I between the largest American firm, General Motors, on the one hand, and Toyota and the other Japanese manufacturers on the other were in fact reflective of fundamentally different approaches traditionally taken in the United States and Japan to the problems of organizing parts and component supply. By 1990, these differences had narrowed as the U.S. industry[4] moved to adapt and adopt elements of Japanese practice, but they were still important.

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[2]2 Quoted by Nicolaj Siggelkow, "Supplier Management in the Automobile Industry," honors thesis, Department of Economics, Stanford University, 1993, page 24, as derived from Helmut Demes, "Die pyramidenförmige Struktur der japanischen Automobilindustrie und die Zusammerarbeit zwischen Endherstellern und Zulieferern," in N. Altman and D. Sauer, *Systemische Rationalisierung und Zulieferindustrie* (Frankfort: 1989).

3 Yoshiro Miwa, "Organizations, Networks, and Network Organizations," Discussion Paper 93-F-6, Research Institute for the Japanese Economy, Faculty of Economics, University of Tokyo, June 1993.

4 There was essentially free trade between the United States and Canada in motor vehicles and parts, creating a single market at the producer level (but not for consumers because of licensing and taxes). Plants in Canada produced parts to be used in assembly plants in the U.S. and vice versa, and each of the Big Three made complete vehicles in each country for ultimate sale in both. Nevertheless, the auto companies were U.S. corporations, with the Canadian operations as subsidiaries, and the same was the case with many of the parts suppliers. Thus, it is not a great misrepresentation to speak of the "U.S. industry."

Cross-National Differences

Numbers of Suppliers: The traditional pattern in the U.S. auto industry was one of relatively high vertical integration by the motor vehicle manufacturers (called "Original Equipment Manufacturers"—OEMs) combined with procurement from a very large number of parts suppliers, including some that received orders only intermittently. Even in 1986, after moves had begun to reduce the numbers of suppliers, some 5,500 firms supplied 80% of GM's purchases of parts and components for its North American vehicle production. Including marginal suppliers of parts as well as suppliers of raw materials, machine tools, services and the like raised the number to 35,000. The other members of the U.S. "Big Three" had moved further toward concentrated purchasing, however. At Ford, the number of parts and components suppliers for North American production in 1986 was 2,500, and at Chrysler it was 2,000. Some 150 of Ford's parts suppliers represented 60% of the dollar volume of its purchases, while 300 of Chrysler's suppliers accounted for 90% of its parts purchases.

In contrast, Toyota purchased over 90% of the value of the parts and components it acquired in Japan in 1986 from the 172 members of the *kyohokai*, the association of its major suppliers. Even adding in the suppliers of tools, equipment and construction services (organized in a separate association called the *eihokai*) brought the total to only 224 firms. In the same period, Nissan bought 55% of its parts (by value) from the 54 Nissan subsidiaries, related companies and small-to-medium sized firms in its *takarakai* association. Another 35% was purchased from the well-established firms selling to multiple automobile manufacturers who were members of the *shohokai* association. Mazda similarly had relatively few suppliers, although it relied more on firms that also served other manufacturers than did its larger rivals.

The relative differences in the number of suppliers at the corporate level were replicated at the plant level: On average, a GM plant in the United States had about 800 suppliers (although the newest plants by 1990 had as few as 300, reflecting the move toward Japanese practice), while a typical Toyota plant in Japan had 125, even though it had twice the production capacity.[5]

What Was Purchased: Although Japanese OEMs had smaller numbers of suppliers than Ford or GM, they were also less vertically integrated, buying a much greater fraction of the value of the cars they made from outside vendors. Part of this difference is accounted for by the fact that the Japanese often bought complete systems (e.g., seats, brake systems, transmissions, axles, fuel systems) from outside vendors, while their U.S. counterparts preferred instead to purchase parts or components, typically from multiple vendors (including in-house supply divisions), and to assemble these into complete systems themselves. GM went furthest in this direction and Chrysler least, with Ford in between. This difference in part accounts for the difference in the

5 The data in these last three paragraphs are from Asanuma, *op. cit.*

number of suppliers. GM dealt directly with the thousands of suppliers of individual parts and components. In Japan, the suppliers of a given OEM were organized in a hierarchy, with only the first-level suppliers dealing directly with the core company, the second-level dealing with and supplying parts to the first, and so on. Correspondingly, GM in the mid 1980s had some 6,000 employees working in purchasing, while Toyota had only about 340.[6]

Contracts and Relations: The contracts between the OEMs and their suppliers also differed between the two countries. In Japan, the basic contract for supply of a part, component subsystem, or complete system had a term of one year, but it was automatically renewed unless one or the other party objected. The presumption was that the supplier would actually have the business for the life of the vehicle model (typically four years for passenger cars during the 1980s). There was, however, no presumption that the supplier of a particular part for a particular model would receive the order for that part when the model was redesigned. Indeed, the Japanese auto firms tried to adhere to a "two supplier" policy for any class of part. Although typically only one supplier would be selected to provide a given part for a given model (e.g., headlights for Honda's Acura Integra), different suppliers would be selected to supply the corresponding part for other models made by the same manufacturer, and the multiple suppliers competed for the business on each model at redesign. Nevertheless, there was a shared expectation that the relationship between the auto company and the supplier would be an on-going one, continuing beyond the life of any one model. These expectations were typically met: during the period from 1973 to 1984, only three firms ceased to be members of the Toyota *kyohokai* supplier association, and only 21 firms were added to the group.[7]

The contracts themselves were relational, setting the basis for the firms' working together, rather than being very specific in their terms. Only target quantities were indicated, and the price was not stipulated, although provision was made for prices to be adjusted twice yearly in light of cost or design changes. As well, if the supplier had to make investments in specialized capital equipment to supply the particular component (such as dies for forming metal into the particular shapes and sizes required to produce a unique design), the price could be adjusted over time in response to actual realized volumes to permit the supplier to recapture these costs.

Traditional U.S. practice also involved one-year contracts but, in contrast to the Japanese system, the contracts were not automatically renewed. Indeed, at General Motors, purchasing agents needed special approval from corporate headquarters to renew a contract without another round of competitive bidding, even on an unchanged part. OEM purchasing agents were famous for driving hard bargains, and they were strongly motivated to seek the lowest possible price. In

6 McMillan, *op. cit.*

7 Banri Asanuma, "Manufacturer-Supplier Relationships in Japan and the Concept of Relation-Specific Skill," *Journal of the Japanese and International Economies* 3 (1989), 1–30.

this context, the practice developed of the OEM paying for and retaining ownership of firm- or product-specific capital equipment that the supplier needed to meet the OEM's special requirements, even though this equipment would be located at the supplier's facility and, as in the case of dies, mounted on the supplier's own capital equipment.[8]

Standards and Expectations: Both US and Japanese OEMs set strict standards for suppliers, but here, too, there were differences. In both cases, reliable delivery was crucial: having an assembly line shut down for want of a part was extraordinarily expensive. In the US, this led the OEMs to insist that their suppliers maintain large inventories of both finished goods and inputs. The Japanese, working to a Just-in-Time philosophy, did not impose such requirements, but expected frequent, timely deliveries, often in response to a *kanban*[9], as the parts were needed for assembly.

Quality was critical for both as well, although Japanese notions of acceptable quality were orders of magnitude stricter than was traditional in the US. In the US, very exacting product specifications were typically established at the outset by the OEM and shipments were inspected on delivery. OEMs' purchasing staff also made periodic inspections of supplier facilities and examined suppliers' production and quality control programs and the reliability of their raw materials sources. In the Japanese industry, there was much greater reliance on the suppliers to meet quality standards on their own. Typically, parts were delivered directly to the point on the assembly line where they were used, without any separate inspection by the auto company. Quality problems were to be met by cooperative efforts between the auto maker and the supplier. This was facilitated by the practices of having purchasing personnel from the automotive firm make frequent visits to the supplier's factories, learning the processes and technologies involved and providing technical assistance, of having supplier employees often welcomed into (or even stationed at) the auto maker's facility, and of involving suppliers early in the process of designing and developing a new model. In fact, the Japanese relied heavily on suppliers to design and develop parts, components, and even whole systems, with the auto company only providing performance specifications and approving the final drawings developed by the supplier, rather

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8 A partial exception existed for some sophisticated components or complete systems like transmissions or fuel systems that remained unchanged for extended periods (eight to twelve years) and that required significant specific investments to produce. To the extent that these were procured outside, they were purchased from large, well-established firms (Bendix, TRW, Dana, etc.) under three- to five-year contracts. These contracts allowed adjustment of the price to the realized volumes to permit amortization of the specific investments. Another exception was for suppliers of products with a significant after-market as replacement parts, like glass or tires.

9 In its classic form as developed at Toyota, a *kanban* was simply a piece of paper or card. It carried the name and number of a particular part and a lot size. When more of the part was (about to be) needed at a work station, the kanban would be sent to the supplier of the part, thereby notifying it to provide more.

than setting detailed design and manufacturing specifications and providing the drawings to the supplier. For example, in 1985 over 90% by value of the parts Nissan acquired from outside suppliers were in this "Drawings Approved" category rather than "Drawings Supplied."[10] Moreover, in contrast with U.S. practice, in principle a supplier in the Japanese system retained responsibility for flaws that showed up only after the vehicle was sold, and the supplier could be called upon to compensate the auto maker for the costs of correcting these.

Both the US and Japanese auto companies expected suppliers to make cost data available to them, although the greater familiarity of the Japanese purchasing agents with their suppliers' actual operations may have affected the value of the information provided. Moreover, there was some indication that the Japanese requested more detailed cost information. Beyond this, the American producers traditionally required their suppliers to respond quickly to the rapid and large shifts in production that marked the OEMs' operations as they reacted to changing market conditions. The Japanese attempted to maintain smooth production schedules and to stick to production plans, so that there was less unforeseeable variation in their requirements. However, the variety of different models that they produced and the immense number of product variants that were available with each model[11] placed demands on their suppliers to be sufficiently flexible to provide the demanded variety and required them to deal with the resulting complexity.

Within the context of the sustained relationships, the Japanese auto companies expected their suppliers to engage in on-going efforts to increase quality and reduce costs. In fact, the auto companies had predetermined goals for price reductions (2% every six months in one instance[12]) and at the semi-annual price negotiations they pushed their suppliers to meet these. The latter generally acceded because they were able to lower their own manufacturing costs at least this quickly through learning effects and conscious cost-improvement efforts. The suppliers were also encouraged to suggest changes in specifications to lower costs or increase quality. When they did so, they were allowed to keep the resultant cost savings for at least one six-month pricing period and perhaps for a year, depending on how much of a role the auto company had had in developing the proposal. Moreover, having developed such an improvement would lead to the supplier's receiving a higher performance rating by the auto manufacturer. A higher rating relative to other suppliers in turn positioned it to receive increased volumes of future business. Other factors in these rankings were technological capabilities (which determined whether the supplier would be allowed to work on a "Drawings Approved" basis), quality, reliability in delivery, cooperativeness, and success in lowering costs.

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10 Yoichi Ohta, "Intercompany Relationship in Japanese Manufacturing Industries," M. Litt. thesis, Oxford University, 1985, as cited by Asanuma, *op. cit.*

11 Asanuma reports that Toyota offered 101,088 different specifications of its Crown model in 1978, versus 322 in 1966.

12 Cited by Asanuma, "Japanese..."

Pricing: Annual competitive bidding for contracts meant that prices in the U.S. were effectively determined as expected cost plus a profit margin, the size of which would depend on competitive pressures. This also meant that cost increases (and especially ones that were industry-wide) were passed on in higher prices. In Japan, initial prices were negotiated during the period after the supplier had been chosen and while the part was being developed. As noted, at the semi-annual price renegotiations the auto companies expected price reductions. However, cost increases resulting from changes in design or increased materials prices would be a basis for a price increase, although the auto companies were very reluctant to grant increases to offset increased labor or energy costs. Nevertheless, econometric investigations[13] have shown that the auto firms absorbed a large fraction of the cost variations experienced by their first-tier suppliers, with a larger fraction being absorbed for smaller and less technologically sophisticated supplier firms and ones that were particularly dependent on the auto manufacturer's business.

Long-term Relations, Supplier Associations and Keiretsu: Although there were examples of long and close relations between the U.S. OEMs and their suppliers, especially the more sophisticated, larger ones, the traditional norm in the U.S. industry was an arm's length market relation between the OEM and each supplier and a competitive relationship among suppliers. In contrast, the ideal in Japan was a cooperative, on-going relationship between the auto firm and its suppliers. This relationship was marked by significant information exchange and close coordination.

In many cases the relationship was cemented by the auto company taking an ownership position in the suppliers, but this was far from universal and often the stakes were relatively small. For example, Toyota in 1981 held equity stakes in only 32 of its suppliers, with a majority holding in only 6; Nissan held stakes in 35 of its suppliers, of which 7 were majority shares; at Honda the numbers were 25 and 4; and Mazda held stakes in 10 of its suppliers and majority positions in 3.[14] Nor were the suppliers necessarily tied to a single auto maker: Although it was rare for a smaller firm to supply both Toyota and Nissan, suppliers of each of these two would also supply the smaller producers. Moreover, 38 of the members of Nissan's *shohokai* (the association of larger firms) also supplied Toyota in 1986.[15]

Supplementing this relationship between the car maker and the supplier were relations among the suppliers. While the suppliers were in competition with one another, they also were

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13 T. Kawasaki and J. McMillan, "The Design of Contracts: Evidence from Japanese Subcontracting," *Journal of the Japanese and International Economies* **1** (1987) and B. Asanuma and T. Kikutani, "Risk Absorption in Japanese Subcontracting: A Microeconometric Study on the Automobile Industry," *Journal of the Japanese and International Economies* **5** (1991).

14 Data from the Automotive Herald Co. Ltd. as quoted in Siggelkow, *op. cit.*

15 Demes, *op. cit.*, as quoted by Siggelkow, *op. cit.*

linked through membership in the auto companies' supplier associations. These were vehicles for information exchange, both between the core firm and its suppliers and among the suppliers themselves, and for technology transfer between the auto firm and suppliers and, at the behest of the core firm, among suppliers as well.

Behind the first tier of suppliers were second-level suppliers who dealt with the first-tier firms, and behind them in turn was another tier supplying them. The numbers of firms increased at each stage, and their average size fell. Nonetheless, these firms tended to think of themselves as linked to the core automobile company. Together, all these firms were sometimes regarded as a vertical *keiretsu*, as distinguished from the horizontal groupings of firms that made up the traditional *keiretsu* like Mitsubishi.

Change in the U.S. Industry in the 1980s: Prior to the severe recession that began in 1980, the U.S. auto industry had shown little interest in methods that had been developed elsewhere, including the Japanese approach to supplier relations, even though by that point the Japanese had gained almost a quarter of the U.S. market and an even larger share of world automobile production. During the 1980s the American motor vehicle industry scrambled to learn from the Japanese manufacturers at the same time that it sought protection from them.

Numerous joint ventures and strategic alliances between U.S. and Japanese car makers emerged as the U.S. firms struggled to understand and implement Japanese product development and manufacturing systems. In their relations with suppliers they sought to reduce the number of suppliers with which they dealt, build longer-term relations with them, shift purchasing patterns away from just buying parts toward acquiring sub-assemblies and complete systems from outside, and involve suppliers earlier in the development process. Ford and Chrysler, each of which faced a financial crisis in the early 1980s, generally made more progress on these efforts than GM.

Faced with the threat of overt protectionist trade barriers, the Japanese adopted "Voluntary Export Restraints" that limited exports of Japanese-made cars to the U.S. These constraints, combined with other political pressures, the effects of the sharp appreciation of the yen beginning in 1985, and a recognized advantage to being nearer their customers, led all the major Japanese automobile manufacturers to invest in assembly plants and production facilities in North America. In many cases, first-tier suppliers followed the auto companies and set up operations to service the transplant automobile factories, but (in part under political pressure again) the auto companies increasingly sought domestic suppliers. Many of these, including Johnson Controls, were already well established in the U.S. auto supply industry.

JOHNSON CONTROLS, INC.

Johnson Controls, Inc. (JCI), a diversified manufacturing firm, was founded in 1885 in Milwaukee, Wisconsin by Professor Warren S. Johnson. By 1991 it had grown to have sales of $4,559 million divided among four business segments: Controls (41%), Automotive (27%), Plastics (17%), and Batteries (15%). It employed 42,000 people worldwide, making 20% of its sales outside the United States, and had net income for 1991 of $95.1 million.

The Automotive Systems Group

JCI's Automotive Systems Group (ASG) was the world's largest independent supplier of seating systems to the automobile industry. It designed, engineered and manufactured complete seating systems, including leather, vinyl and cloth seat covers, foam pads, mechanisms, and metal frames for cars, trucks and vans. It also sold these parts and components to the OEMs for their own assembly. Nine out of ten passenger cars made in the United States had seats made by JCI or containing JCI components, and the firm had a major presence in Europe. Its major customers included Chrysler, Ford, General Motors (including Saturn and Opel), Honda, Mitsubishi (through the Diamond-Star joint venture with Chrysler), Nissan, NUMMI, Renault, SEAT, Toyota and Volkswagen. The Automotive Systems Group also designed and manufactured other interior trim components, including headliners, door trim panels, head rests, arm rests and package shelves. Headquartered in Plymouth, Michigan, where it also had a technology center, the Group operated over 50 manufacturing plants and engineering locations in North America and Europe (see Exhibit 2). Its 14,000 employees generated $1.2 billion in sales in 1991.

Within ASG, a Toyota Business Unit dealt with the four Toyota manufacturing operations—three in North America and one in Europe—for which the firm had been selected to supply complete seat assemblies on a Just-in-Time (JIT) basis: Toyota Motor Manufacturing, USA, Inc. (TMM); New United Motor Mfg., Inc. (NUMMI); Toyota Motor Manufacturing, Canada (TMMC); and Toyota Motor Manufacturing, UK Ltd. (TMUK). TMM produced Camry sedans in Georgetown, Kentucky. In early 1992 it was gearing up to add production of a Camry station wagon, which was to be made both with left-hand drive for the North American market and with right-hand drive for export to Japan. It had also announced that it would add a second production line, to come on-stream in 1994, that would almost double its capacity. NUMMI was a Toyota-General Motors joint venture that in 1992 was producing Toyota Corollas, Geo Prizms, and Toyota pickup trucks in a former GM facility in Fremont, California. Toyota managed this plant. TMMC produced Corollas in Cambridge, Ontario. TMUK was scheduled to begin operations in late 1992, producing the Toyota Carina E. The Toyota Business Unit included Manufacturing (with operations at each of the operational facilities in Livermore, California, Georgetown, Kentucky and Orangeville, Ontario), Sales Engineering (also with units in each plant), and Finance functions, and a separate Toyota England unit that was readying the facility in Burton-on-Trent to serve TMUK.

The JCI Georgetown Plant

Georgetown, Kentucky is located in the rolling bluegrass country of Scott County, about 12 miles north of Lexington along Interstate 75. Its population of 12,910 supports 46 churches but no bars—Scott County is "dry." JCI built its Georgetown plant in 1961 as a facility to make metal seat frames. It consists of a single-story, 250,000 sq. ft. building on a 31 acre site south of town. In 1985 Toyota announced that it would locate its first wholly-owned[16] North American plant in Georgetown. It chose a 1,300 acre site near the Interstate, east of the town and about seven miles from the JCI plant. The next year JCI was chosen as the sole supplier of complete seat assemblies for the original model of the Camry to be produced at TMM, and a part of the JCI plant (36,000 sq. ft.) was converted to house an assembly operation. The assembly operation started up regular operations in 1988 in concert with the beginning of production at TMM. When the Camry was redesigned for the 1992 model, JCI Georgetown continued as the sole supplier of seat assemblies. Although the vast majority of the value of the plant's 1991 sales were in supplying TMM's Camry, the bulk of the space in the plant was still devoted to making metal seat frames (see Exhibit 2). The Georgetown plant made these to use in vehicles produced by GM, Chrysler, NUMMI, and TMMC as well as for assembly into seats for TMM.

During a 1992 visit, the two parts of the plant presented a striking contrast. The metal working area featured huge presses stamping sheet metal into shape while bending, cutting, shaping and other metal-working activities went on at dozens of other machines. Sparks flew from resistance, arc and robotic welding machines, and the noise from the machines made people raise their voices to talk. The 320 employees were mostly in their forties or older, many of them having been hired when the plant first opened. Volume in 1991 was 6.5 million frames. The assembly area, which was walled off from the metals plant, was clean, bright and newly painted. It was quiet, and the 154 workers were much younger, most having been recruited in the late 1980s for the new operation. In 1991 they produced the 220,000 complete seat assemblies needed to meet TMM's demand. Despite the contrasts, both parts of the plant were approaching world-class, and the metal-working operation had made immense strides in inventory reduction, productivity, and quality since the mid-80s.

Auto Seat Production

Automobile seats are typically constructed of a steel base that is stamped into a three-dimensional shape, metal back and side frames and control mechanisms, wire springs, shaped foam padding, various plastic control levers and handles, and leather, vinyl or cloth upholstery. Johnson Controls' ASG had the capability of producing essentially all the components that go into a seat, although it sometimes obtained some of these from outside suppliers, particularly when the customer so directed.

16 NUMMI, the Toyota-GM joint venture, was established in 1983.

The metal facility at Georgetown stamped coil steel into the requisite shapes using special dies mounted on large presses; formed metal tubing for the frame; bent the wire for springs; welded everything together; and finished (and, at the customer's option, painted) the resulting frame. The frames were then shipped to seat assembly facilities, including the one in the Georgetown plant serving TMM.

In assembly, the foam padding was positioned on the frame, a cut and sewn seat cover was positioned over the frame and pad (a process known as "skinning out") and secured in place, the control mechanisms were connected, and the finished seats were given final inspection. All this was done on a standard moving assembly line: seats moved by the stationary workers who each did their prescribed tasks in order using fairly simple tools. None of this was very high-tech, but quality was crucial—an uncomfortable seat means an unhappy driver, and even such small things as the direction in which the stitching runs can affect comfort.

The metals plant at Georgetown included a common area where the stamping machines formed the steel for all the different customers' seats, dedicated areas for welding each customer's particular products, and a common paint area. The stamping presses were large and expensive, but they were long-lasting and not specialized to any one customer's needs. On the other hand, the expensive dies that fit in them and gave the metal the desired shape were completely specific to the particular seat design for which they were created. Johnson Controls owned the stamping presses, but the dies were the property of the auto companies. The assembly line at Georgetown had been built specifically to serve Toyota, although its design and the basic equipment used in it were not, for the most part, highly specialized to Toyota. With minor exceptions, JCI owned the equipment in this part of the plant. The general pattern, long established in the dealings between the US OEMs and their suppliers, was that physical assets that were useful only in meeting a particular customer's needs were labeled "tooling" and belonged to the OEM, even though they were located at the supplier's factory. General-purpose assets (including ones, like the presses, that were used with several customers' tooling) were called "capital" and were the property of the supplier. This practice differed somewhat from that prevalent in Japan, but, at least in its dealings with JCI, TMM appeared to have adapted to American practice in this regard.

Assembly Production Planning

The assembly operation at JCI Georgetown was tightly coordinated with TMM's operations. A complete seat assembly for a 1992 Camry sedan involved two front bucket seats and a rear bench seat with a split back that could be folded down to allow oversized items to project from the trunk into the rear seating area. The seats were produced in eleven variants that differed in colors and qualities of fabric and leather and on whether the seat controls were powered. Ensuring that JCI could and would supply the right seat at just the right time involved large amounts of communication between the two plants. In fact, JCI was closely integrated into TMM's production planning system.

TMM planned production over a thirteen-week horizon. Each week, it provided Johnson Controls' assembly operation with pre-notice of planned production over the next quarter. This essentially amounted to a spreadsheet with a row for each of the product variants and thirteen columns representing the coming weeks. The forecasts/plans were updated weekly on a rolling basis. TMM aimed to be within plus-or-minus 10 percent on the forecast production at 13 weeks, although in fact there was rarely even this much variance, and the numbers became even firmer as they got closer in time. Implicit in the plans was a presumption that actual production of the planned total number of each variant would be spread smoothly over the week in question. This leveling of production (*heijunka*) was an integral part of Toyota's philosophy in production planning. JCI in turn used this information to inform its suppliers so that they could plan material releases, production and delivery of the needed components. Actual delivery to JCI was then controlled by a *kanban* system.

On a day-to-day basis, as each auto body left the paint department at TMM and began to move along the assembly lines, TMM's computers sent a message (called a "broadcast") to a computer at the JCI plant. This caused a specification of the seats that were to go into this particular car and a set of bar-coded labels for them to be printed at the start of the JCI seat assembly line. A JCI worker used the specification to pick the requisite parts and components (including the bulky foam pads that were taken directly from a truck backed up to a loading gate that opened directly into the assembly area). He or she then placed the components at the start of the line with the printed labels. TMM balanced its line by sequencing cars with different characteristics one after the other, so consecutive seats demanded from JCI typically differed from one another. The seats were assembled at JCI in the sequence specified by the TMM broadcast, then loaded on the specially designed racks which in turn fit into trucks for delivery. Four hours and twenty minutes after the car left the paint department, when it reached the appropriate point on the TMM line, the seats made for it arrived at the work station, carried by conveyor in special racks in which they were transported. They swung into position and were mounted into the specific car for which they were built.

No unit-by-unit inspection was done by TMM on the seats as they arrived, although the TMM team members on the assembly line might have been in a position to notice any flaws that escaped previous detection and stop the line. The whole operation was done "just-in-time": Essentially neither JCI nor TMM had any inventory of finished seats,[17] and JCI's assembly operation had only a few hours worth of parts and components on hand at any time.

17 JCI did hold a set of each specification of seats that it could substitute when a defect that could not be immediately corrected showed up in final inspection.

Lean Manufacturing at JCI Georgetown

The advantages of "lean manufacturing"[18]—essentially the Toyota Production System (TPS) developed in the 1950s and 1960s under the leadership of Eiji Toyoda and Taiichi Ohno from ideas advanced before World War II by Toyota Motors founder Kiichiro Toyoda—were, by 1992, becoming evident to the North American automobile OEMs and auto parts suppliers. Many firms were moving to adopt its key elements: JIT, *kanban* and drastic reductions in inventories; flexible machinery, quick set-ups and small production runs of a possibly large number of product variants; the careful production planning and line balancing and the adherence to these plans (even in the face of demand variations) that characterized *heijunka*; quality being built in from the start rather than achieved through after-the-fact inspection and rework; constant improvement in quality and cost (*kaizen*); standardized work, which meant that methods were regularized and documented and that tasks were designed to avoid bottlenecks and quality problems; cross-trained, multi-skilled workers organized in teams that can decide themselves how to do their work and are responsible for quality and for a variety of tasks (set-ups and minor repairs, ordering parts, controlling inventories); and a general emphasis on making use of the specific knowledge, initiative, and intelligence of the people actually involved in production. JCI's Georgetown plant had achieved much in this direction.

In the mid 1980s, the Georgetown plant, then exclusively a metal shop making frames, was not an efficient operation, although it was not atypical of American auto industry suppliers. It had as much as 32 days worth of inventory filling large containers all over the facility at any one time. The average stamping run length was 20 days, die changes took 4 to 8 hours, and the presses were in actual use only 40% of the available time. The accent was on volume and trying to keep the machines going, and the percentage of pieces needing rework after completion was high. Workers were told what to do and how to do it, and little was expected of them other than acquiescence to management's directives. Meanwhile, although there was no union, there were 20 different job classifications, each with its own narrowly specified tasks and duties.

By 1985, Johnson Controls' ASG had come to recognize these patterns as inefficiencies and to believe that this situation was not competitively viable in an increasingly global automobile business. It also recognized that Japanese manufacturing methods held a promise of much better performance, especially in inventory control. (The company's experience in supplying NUMMI was part of the basis for this.) The Georgetown plant manager at the time in particular believed that much could be learned from Japan and applied in America. In late 1985, before Toyota had announced its choice of Georgetown as the site for its US facility, he committed to a major effort to change the way the plant functioned. He traveled to Japan to study and also sought advice from people within JCI who were familiar with Japanese methods. More dramati-

18 The phrase was popularized by its use in the writings of the MIT International Motor Vehicle Program.

cally, he hired semi-trailer trucks to haul all the excess inventory (fifty truckloads of it!!!) out of the factory to illustrate the sort of changes that would be required and the possibilities that slashing inventories would open up.

In December 1985, Toyota announced its decision to locate in Georgetown. JCI immediately became a candidate to supply TMM, and TMM began visits to the Georgetown plant. These continued for almost a year, during which JCI was able to demonstrate improvements on each visit. In June 1986, JCI formally bid for the TMM contract, and the bid was accepted in late 1986.

In 1988, during the production ramp-up before TMM (and its suppliers) reached full-scale operations, JCI assembly held an average of 7.5 days of inventory on hand. By February 1989 it was operating smoothly with only 8/10ths of a day's worth. This level was subsequently maintained and often bettered. The inventory reduction in the metals operation was, to industry observers, even more impressive: Despite difficulties in getting coils of steel delivered on a JIT basis, inventory was down from 32 to 5.3 days. The manager of the metals operation explained quite simply that "Inventory is my enemy," and he and his colleagues (both white and blue collar) were constantly looking for ways to eliminate it. Die changes could now be done in less than 30 minutes, rather than the 4 to 8 hours that had previously been required, and sometimes even quicker changes were achieved.[19] This in turn made much shorter press runs feasible. As well, a *kanban* system was instituted and, to the extent possible, JCI's suppliers were organized to supply it on a JIT basis to fit with its new orientation.

The changes involved other dimensions as well. Employee involvement teams were developed, with employees being paid for the time spent on these; training was increased; and standardized work methods were instituted. Work cells in which a single employee controlled several machines were set up in the metals operation, and the bolts holding the machines to the floor were removed. Beckwith explained the significance of this:

> *You can tell just about everything important about how a plant is run by whether the machines are bolted to the floor or not. If they are, then management and the engineers think they know how to do everything best, and the workers are just supposed to serve the machines. It's a whole different story if the workers are free to move the machines to where they think they can do their jobs best. Of course, it's sometimes a little embarrassing when I take someone on a plant tour and point to a machine that isn't there any more!*

19 Other US firms at this time were achieving such reductions in die-change times, but very often only by making immense capital investments in new presses. Strikingly, the reduction at JCI Georgetown was achieved almost without any outlay of funds. The key steps were to ensure that the proper dies could always be easily found, that they were positioned ready for placement before the preceding run was completed, that the task of correctly placing the dies was simplified, and that the connections of the dies to the presses were standardized.

In fact, the workers were constantly increasing the density of the machine layout, putting the machines closer together than management would ever have suggested. They understood the gains that could come from reducing wasted steps and packing more money-making equipment into the available space, and on their own initiative they were realizing these gains.

The goal of building quality into the products the first time was actively and successfully pursued in both the metal and assembly operations, and the Toyota system of encouraging the assembly workers to stop the line whenever a problem developed was installed. Consequently, rework in metals was drastically reduced, while the rework area at the end of the assembly line involved only a single worker, and he was not always engaged in this task. The system of visual control of processes was instituted, and visual evidence concerning the state of every important activity was prominently posted in the plant. As well, a highly successful employee suggestion program had been organized and the resulting ideas were being implemented. Photographs mounted near the lunch room showed teams that had developed *kaizens* and been given bonuses for them, and a nearby board showed budgeted goals for cost reduction and the progress of various units and functions in meeting these goals.

By 1992, morale was high, and employment was secure and expanding. So successful was the transformation that the Georgetown plant was the only vendor to have won TMM supplier awards in each of the four years of TMM's operation, and it was determined to make winning these awards an annual event. Moreover, it was a member of the Showcase Supplier group, a set of four firms that Toyota used to illustrate the advantages of the Toyota Production System to other (potential and current) suppliers. Although originally Johnson Controls Georgetown had adopted the Toyota Production System out of a sense of necessity, by 1992 it had thoroughly embraced it and made it its own.

The new methods and efficiencies at Georgetown also allowed JCI to do a better job serving the other customers of its metals operation. However, realizing the full benefits of the Toyota Production system required the commitment of the OEM to the level production schedules of *heijunka*, and there was as yet little sign that the American automobile manufacturers that Georgetown served were prepared to abandon making last-minute adjustments in production plans to respond to demand changes. Thus, to the extent that they had adopted elements of lean manufacturing, they did so in the context of holding reserves of inventory to protect against fluctuations.

Relations with TMM

The relations between Johnson Controls Georgetown and Toyota Motor Manufacturing were quite different in many respects from those that had been traditional between North American automobile manufacturers and their suppliers. Toyota selected JCI as its sole seat supplier for the initial (1988) model of Camry to be produced at TMM on the basis of an evaluation of its price, quality, dependability, perceived willingness to adapt to Toyota's needs

and ways, and perceived ability to improve. Several other firms were considered at that time. This selection of JCI represented a major decision on TMM's part because Toyota operated on the basis of long-term commitments to its suppliers. Once selected, the shared expectation was that JCI would have the business as long as the basic model design remained in production and that, unless it sharply failed to meet Toyota's expectations, it would continue to supply seats even when the model was redesigned. No detailed contract was signed between TMM and JCI, however. The assumption was that that relationship was to be a long-term, on-going one in which the two firms would work together for their mutual benefit and would seek to deal cooperatively with problems and potential conflicts as they arose.

Once JCI and the other 130 parts and components suppliers to TMM were selected, Toyota worked with them to help them meet its stringent standards. TMM organized the Blue Grass Automotive Manufacturers' Association, with 20 select TMM suppliers (including JCI) as members, as a vehicle through which to teach the Toyota Production System and to provide training and consulting. Toyota also provided direct technical support to those of its suppliers who were willing to accept it. JCI was among these, and members of the technical support group in TMM's purchasing department worked closely with the people at JCI Georgetown to implement the TPS and to learn about and improve the JCI production, control and management processes. In this way, the TMM people came to be well informed about the technology, methods and costs at JCI.

The determination of pricing within the on-going relationship between JCI and TMM was based on a cost-variance approach that was standard at Toyota, although again the implementation differed somewhat from common practice in the Japanese industry. The basic idea was that the price at any point would be calculated from JCI's original bid, adjusted for product changes. Cost changes resulting from engineering design changes were the basis for immediate adjustments. As well, annual price reviews allowed for adjustments in response to input cost changes. Toyota's fundamental approach was that the prices it would pay its suppliers were given by the competitive alternatives, and if they wanted to make profits, they would have to bring their costs down. In particular, it was not a matter of price being determined as costs plus profit, as was so often the case in other manufacturers' supplier relationships.

Initially Toyota simply provided Johnson Controls with the detailed drawings and specifications for the seats it was to supply, even though JCI was quite involved in the design process with others of its customers. JCI was encouraged, however, to suggest design modifications to Toyota through engineering change requests to improve manufacturability, reduce costs, or increase quality. Some of these changes were accepted immediately, and some were delayed to await a major seat redesign. As expected, Toyota totally redesigned the Camry for the 1992 model year, and the seat design and specifications changed as well. While there was very little carry-over of parts or components from one design to the next, the basic concept was unchanged, so that previously accumulated know-how could be carried forward. JCI had an increased

involvement in design at this stage, particularly in providing feedback on manufacturing feasibility. Johnson Controls did receive the order to supply the new seats, and the anticipation was that its role in design would grow further with Toyota's support and help.

In 1991 Toyota began preparing to produce a new Camry station wagon at TMM, beginning in March 1992. This project represented a major step for the company, because the wagons were to be produced only in Kentucky. (Previously, all models had always been produced in a Japanese plant as well.) While the wagon's front seats were to be the same as in the sedan, the rear seat involved a completely different design. Moreover, the number of different seat varieties would grow immensely with the introduction of the wagon, from the 11 involved in producing the sedan to 77 different specifications for the two models together by the end of 1992, and to more than 100 after another year.

JCI was asked to make the prototype seats for the wagon and received a purchase order for this work. During February 1992 TMM began making several station wagons a day on a pre-production basis. These were interspersed among the sedans on the assembly line. The intent was two-fold. First was to learn about any problems with the design and its manufacture and to correct these before actual production began. The second was to familiarize the TMM production teams with the tasks involved in building the new model, to have them learn to deal with a greater variety of products, and to establish any changes in the standardized work that the wagon would require. JCI made the seats for these pre-production units on the same basis, delivering them to the TMM line as part of its regular JIT shipments.

Reflective of the nature of the relation between TMM and JCI, this pre-production activity went on with no formal contract from TMM for JCI to provide the seats for the production version of the station wagon. Two weeks before the actual production was to begin, JCI had no purchase order, and no formal assurance that it would actually get the business. There had not even been an agreement on the price it would be paid for the seats if it did get the order. Yet the JCI managers were not concerned about the apparent uncertainty. Receiving an order for the prototype from Toyota carried an implicit commitment of getting the production work as well, provided no disasters occurred, and the JCI managers trusted Toyota. They also seemed relaxed about the explosion in complexity that producing the seven-fold increase in the number of product variants would bring. They knew it would strain them, but they had faith in their systems and their people.

Exhibit 1

World Production By Region, 1980, 1985, and 1990 (Thousands of units)

{PRIVATE }		1980			1985			1990	
	Cars	Trucks & Buses	Total	Cars	Trucks & Buses	Total	Cars	Trucks & Buses	Total
Total N. America	7,567	2,306	9,873	9,524	4,482	14,006	7,764	4,862	12,626
Canada	847	526	1,373	1,091	846	1,937	1,085	831	1,916
Mexico	303	187	490	247	151	398	598	222	820
United States	6,417	1,593	8,010	8,186	3,485	11,671	6,081	3,809	9,890
Total Europe	12,789	2,550	15,429	5,366	642	6,008	16,135	2,969	19,104
France	2,939	440	3,379	2,632	385	3,017	3,295	474	3,769
Italy	1,445	165	1,610	1,389	184	1,573	1,875	246	2,121
Spain	1,104	77	1,181	1,345	73	1,418	1,679	380	2,059
U.K.	924	389	1,313	1,048	266	1,314	1,296	270	1,566
U.S.S.R.	1,327	872	2,199	1,300	NA	1,300	1,189	945	2,134
West Germany	3,521	358	3,879	4,167	279	4,446	4,661	316	4,977
Other	1,529	249	1,778	1,834	235	2,069	2,140	338	2,478
Total Asia/ Pacific	7,095	4,345	11,440	8,737	5,211	13,948	11,685	4,277	15,962
Japan	7,038	4,004	11,042	7,647	4,624	12,271	9,948	3,538	13,486
Korea	57	66	123	265	114	379	987	335	1,322
Other	670	275	275	825	473	1,298	750	404	404
Latin America	1,388	304	1,692	951	282	1,233	831	281	1,112
Africa	277	128	405	204	101	305	213	124	337

1980 data: *World Automotive Market*, 1982, published by Automobile International, New York.
1985 data: *World Automotive Market*, 1987.
1990 data: *World Automotive Market*, 1992-93.

Top 25 Manufacturers Ranked by 1990 Worldwide Production (thousands)

{PRIVATE }1990		Total	Passenger Cars	Commercial Vehicles
Company (Base Country)				
1. General Motors (USA)		7,145	5,208	1,936
2. Ford (USA)		5,535	3,704	1,832
3. Toyota (Japan)		4,671	3,800	871
4. Nissan (Japan)		3,065	2,349	716
5. Volkswagen (Germany)		3,012	2,874	139
6. Peugeot-Citroen (France)		2,701	2,459	242
7. Fiat (Italy)		2,069	1,805	264
8. Renault (France)		1,988	1,666	322
9. Honda (Japan)		1,925	1,765	160
10. Chrysler (USA)		1,813	859	954
11. Mazda (Japan)		1,607	1302	305
12. Mitsubishi (Japan)		1,372	870	503
13. Suzuki (Japan)		843	512	331
14. Daimler-Benz (Germany)		815	574	241
15. VAZ (USSR)		736	736	0
16. Hyundai (Korea)		703	585	118
17. Daihatsu (Japan)		636	373	263
18. Isuzu (Japan)		598	202	395
19. Rover Group (UK)		528	465	63
20. Fuji-Subaru (Japan)		352	352	197
21. BMW (Germany)		500	500	0
22. Volvo (Sweden)		378	378	62
23. Kia (S. Korea)		222	222	174
24. Alfa Romeo (Italy)		224	224	0
25. FSM (Poland)		207	204	0

Source: MVMA Motor Vehicle Facts and Figures, 1992. Published by the Motor Vehicles Manufacturers Association of the United States, Inc., Detroit, Michigan.

Top 25 Manufacturers Ranked by 1985 Worldwide Production (thousands)

{PRIVATE }1985		Total	Passenger Cars	Commercial Vehicles
Company (Base Country)				
1. General Motors (USA)		6,425	4,887	1,538
2. Toyota (Japan)		3,665	2,569	1,096
3. Ford (USA)		2,853	1,636	1,217
4. Nissan (Japan)		2,537	1,865	672
5. Volkswagen (Germany)		1,815	1,735	81
6. VAZ (USSR)		1,660	785	875
7. Renault (France)		1,537	1,323	214
8. Chrysler (USA)		1,480	1,266	214
9. Peugeot-Citroen (France)		1,478	1,309	169
10. Fiat (Italy)		1,346	1,203	143
11. Honda (Japan)		1,120	956	164
12. Mazda (Japan)		1,193	815	379
13. Mitsubishi (Japan)		1,152	571	582
14. Suzuki (Japan)		781	236	546
15. Daimler-Benz (Germany)		669	538	131
16. Isuzu (Japan)		587	213	374
17. Fuji-Subaru (Japan)		584	260	325
18. Daihatsu (Japan)		579	161	417
19. Rover Group (UK)		555	465	90
20. BMW (Germany)		431	431	0
21. American Motors (USA)		346	110	236
22. Volvo (Sweden)		324	289	35
23. Seat (Spain)		320	305	15
24. Polski (Poland)		259	259	0
25. Hyundai (Korea)		241	226	15

Source: World Motor Vehicle Data, 1987. Published by the MVMA, Detroit, MI.

Top 25 Manufacturers Ranked by 1980 Worldwide Production (Thousands)

{PRIVATE }1980		Total	Passenger Cars	Commercial Vehicles
Company (Base Country)				
1. General Motors (USA)		7,162	6,106	1,056
2. Ford (USA)		4,359	3,204	1,155
3. Toyota (Japan)		3,521	2,444	1,077
4. Nissan (Japan)		3,052	2,086	966
5. Volkswagen (Germany)		2,427	2,255	172
6. All Models (USSR)		2,199	1,327	872
7. Renault (France)		1,859	1,859	0
8. Peugeot-Citroen (France)		1,529	1,347	182
9. Fiat (Italy)		1,368	1,258	110
10. Mitsubishi (Japan)		1,187	732	455
11. Mazda (Japan)		1,174	782	392
12. Chrysler (USA)		1,043	800	243
13. Honda (Japan)		983	872	111
14. Daimler-Benz (Germany)		700	410	290
15. Rover Group (UK)		535	399	136
16. Isuzu (Japan)		473	107	366
17. Suzuki (Japan)		468	87	381
18. Daihatsu (Japan)		433	157	276
19. Fuji-Subaru (Japan)		428	204	224
20. BMW (Germany)		341	341	0
21. Volvo (Sweden)		310	296	14
22. Seat (Spain)		297	297	0
23. Audi (Germany)		285	285	0
24. American Motors (U.S.)		252	252	0
25. Alfa Romeo (Italy)		229	226	3

Source: Automobile International's 1981 World Automotive Market. Published by Johnston International, New York. American Motors—World Motor Vehicle Production, MVMA, Detroit, 1982.

Exhibit 2

JOHNSON CONTROLS, INC.
AUTOMOTIVE SYSTEMS GROUP

Frame and Mechanisms Facilities

Cadiz, KY
Georgetown, KY
Vincennes, IN
Athens, TN
Lexington, TN
Linden, TN
Telford, U.K.
Leigh-on-Sea, U.K.
Alagon, Spain
Friedensdorf, Germany
Niedereisenhausen, Germany

Foam Facilities

Saline, MI (Lab/Engineering)
Whitmore Lake, MI
Jefferson City, MO
Greenfield, OH
Pulaski, TN
Tillsonburg, Ontario
Jaurez, Mexico
Silloth, U.K.
Espeikamp, Germany

Cut and Sew Operations

Stockton, CA
Greencastle, IN
Lewisburg, TN
Harrodsburg, KY
Maysville, KY
Plymouth, MI
Washington, U.K.
Barcelona, Spain
Martorell, Spain
Geel, Belgium
Rosny-sur-Seine, France

Headliner/Interior Trim

Modesto, CA
Bardstown, KY
Murfreesboro, TN
Ann Arbor, MI
Telford, U.K.*
Espeikamp, Germany*
Washington, U.K.*

* denotes joint venture/partnership with local firm

Exhibit 2 (cont'd)

JOHNSON CONTROLS, INC.
AUTOMOTIVE SYSTEMS GROUP

Complete Seat Assembly—Europe

Location	Customer
Washington, U.K.*	U.K. OEMs
Geel, Belgium*	Opel
Bochum, Germany*	Opel
Zwickau, Germany*	VW
Aarschot, Belgium*	Renault
Barcelona, Spain*	SEAT
Martorell, Spain*	SEAT
Rosny-sur-Seine, France*	Renault
Mellamare, France*	Renault
Burton-on-Trent, U.K.	Toyota (scheduled 1992 production)

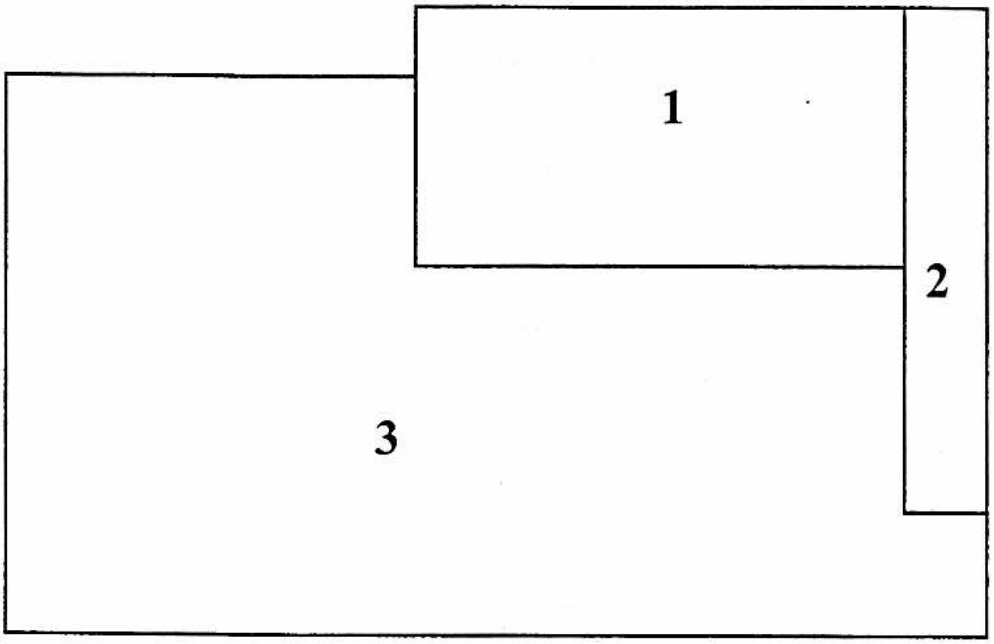
* denotes joint venture/partnership

JIT Complete Seat Assembl—North America

Location	Customer and Location
Belcamp, MD	GM Truck - Baltimore
Edison, NJ	GM Truck - Linden
Georgetown, KY	Toyota - Georgetown
Lerma, Mexico	Chrysler - Toluca
Lewisburg, TN	Saturn - Spring Hill
Livermore, CA	NUMMI - Fremont
Mt. Clemens, MI	Chrysler -Sterling Heights
Murfreesboro, TN	Nissan - Smyrna
Newburgh, NY	GM Passenger Car - Tarrytown
Orangeville, Ontario	Jeep - Brampton
	Toyota - Cambridge
Ossian, NY	GM Truck - Fort Wayne
Shreveport, LA	GM Truck - Shreveport
Shelbyville, KY	Ford - Louisville
St. Mary's, OH	Honda - Marysville
Strongville, OH	Ford - Lorraine, Wayne, Kansas City
Sycamore, IL	Chrysler - Belvidere
Taylor, MI	Jeep - Detroit
Utica, MI	GM Truck - Pontiac West
	GM Passenger Car - Van Nuys, Lordstown

Exhibit 3

JOHNSON CONTROLS AUTOMOTIVE SYSTEMS GROUP
GEORGETOWN PLANT LAYOUT



1. Seat Assembly and Shipping
2. Office and Cafeteria Area
3. Metal Working (Press, Welding and Paint) and Shipping

Total Area: 250,000 Sq. Ft.