

COLLABORATIVE MANUFACTURING:

**New Supplier Relations in the Automobile Industry and the
Redefinition of the Industrial Corporation¹**

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I. Introduction

Systems suppliers, partnering, co-development, just-in-time -- top managers in the automobile industry have again found a cluster of words which excite their visionary passions, while line managers despair of understanding what their superiors mean, let alone what they want. And there is reason enough for confusion. Everyone agrees in principle that it is folly to squeeze subcontractors to the point where they can no longer afford to raise their productivity through investments. Efforts to encourage cut-throat competition among suppliers are out; "partnering" is in -- although purchasing agents do often have a menacing way of pronouncing that word. But with that meager, almost commonsense conclusion the consensus ends. Understandings vary as much within most North American or West German companies as within their national industries as a whole. The goal of reordering supplier relations is sometimes to cut costs by finding an outside vendor who can furnish a particular part or perform a certain operation more cheaply than in-house arrangements allow. Sometimes it is to go further and simplify logistics by asking a supplier to assemble relatively simple parts previously provided by separate subcontractors into a single subassembly, and deliver them just in time. Sometimes the goal is to do all that, but require as well that the supplier participate in the design of a whole system: a complex subassembly often

based on sophisticated product or process technologies which the final assembler could not master on short notice. Given these diverse intentions, line managers have warrant to treat discussion of new supplier relations as another in the seemingly endless succession of fads which make humoring the boss a precondition for getting some serious work done.

Taking Fads Seriously

But this time, we claim, the fad is the forerunner of a redefinition of the organizing principles of automobile production more thoroughgoing and radical than even many of its proponents suspect. Firms are drifting, we argue, willy nilly and for reasons they seldom articulate systematically away from the modest interpretation of new supplier relations as cost cutting for the benefits of an essentially self-sufficient manufacturer. They are drifting towards a disconcerting view in which the design and production of an automobile requires collaboration of many specialized firms, none of which could complete or even organize the task alone. At the limit -- and that limit is already being approached by at least one major producer -- the car company would become a kind of higher order design house and marketing agency. Its chief function would be to coordinate the work of other design houses (the systems suppliers), assemble the subassemblies, and distribute the final product. To learn with whom and under what conditions to collaborate, the collaborative manufacturer will have to build elaborate, overlapping institutions for monitoring technological change and market developments. Apart from final assembly, most of its own manufacturing will be as much a form of research and development as a means of adding value to the final product. To build those

institutions it will be necessary to train a new kind of manager. In the limiting case, the traditional original equipment manufacturer would become at best a primus inter pares, at worst a "value-added remarketer" or "systems house": the computer industry's unlovely names for firms which buy components from sophisticated specialists and combine them in ways that respond to the needs of particular markets.

Yet just as we are confident that the fad is not just a fad and that there is a drift towards collaborative manufacturing, so too are we confident that most firms will be able to establish a competitive position well before they reach the limiting case. For the next decade at least, most car companies will quite probably look more like their present selves than the alternative model we will present. But that is small comfort for those who take comfort in continuity. If our analysis is correct, the changes required to reach this middle position will put new and potentially unbearable strains on the complex alliances among managerial groups and between them and labor unions which have emerged out of the turmoil of the last decade and a half.

The Structure of the Argument

We begin by arguing that car makers are being pushed and pulled towards an understanding of themselves as systems integrators: pushed by the need to spread rapidly rising development costs among their suppliers, pulled by the almost irresistible offers of new systems suppliers who are willing to take losses on current contracts in order to establish a long-term relation of mutual dependence with their best customers. Once knowledge begins to flow in particular ways from the supplier to the final assembler, we claim, the line dividing the fundamentally self-sufficient producer from the collaborative manufacturer is crossed, and the auto maker must adjust its internal

organization accordingly.

When that happens, we argue in section three, the corporation's chief problem becomes creating an organization which can learn enough to select and monitor its collaborators. One way it can do this is by adapting what we call the systems integrator model. In this model the main reason to manufacture any particular thing is to learn how to make it better than anyone else, or to understand enough about it to know who would be the best manufacturer. In the second, specialized consortia model, the firm exposes in-house suppliers to the discipline of the market and assigns them areas of specialization. Despite their continuing formal ties to the parent company, they are eventually supposed to behave in a way indistinguishable from the ensemble of independent firms clustered around the final assembler in the first model.

It will not be easy to construct either of these two models or any hybrid of them, and section four discusses three of the principle obstacles. One is the widespread alliance between managers and trade unions. These groups have common interests in defending something like the current self-conception of the auto maker as an all but self-sufficient manufacturer. A company approaches collaborative manufacturing threatens the traditional identities of these groups, and their counterstrategies can endanger the progress of the corporation. A second obstacle is a lack of proven suppliers capable of providing the required system. Firms that recognize the need for such suppliers may nonetheless settle for a second-best modification of traditional practices rather than run the risks of association with well meaning but untried partners. The third obstacle, the organizational legacy of previous corporate structures, is in some ways a cumulative result of the first two. In some companies successive strategic choices have created internal alliances and subcontracting relations which make it particularly hard to win consensus for comprehensive reorganization, and hard

to help create the necessary supplier network where it does not already exist -- or make use of it where it does.

We believe, however, that these obstacles are not generally insurmountable, and that in anticipation of the changes to come it is worthwhile to discuss the characteristic problems which will face managers and trade unions in the new model corporation, and to speculate on some possible solutions. We argue in the conclusion, therefore, that the blurred boundary between the inside and the outside of the corporation will require a redefinition of both parties' identities. Here too, important themes have been anticipated by faddish debate. But, to repeat, here too if we are right the reality is likely to leave even the fad mongers speechless.

2. Development Costs and the Drift Towards Collaborative Manufacturing

The most revolutionary changes often begin as modest efforts to improve existing arrangements or as unwanted but temporarily expedient deviations from them. Just-in-time delivery, and the other innovations, which came to define Japanese manufacturing practice began in these ways. The same, we strongly suspect, will be the case with collaborative manufacturing. No major car producer has set out to create a radically new corporate structure. But given the rapidly rising development costs which result from shorter product life cycles and more rapid technological change many apparently circumscribed responses to immediate and apparently limited problems touch off a sequence of self-reinforcing decisions regarding supplier relations which together undermine precisely that which they were individually meant to buttress: the autonomy of the corporation.

A few of these sequences seem to be particularly common, and they will do to illustrate the drift of decision making. Take first car makers which aim to improve operations by lowering the cost of current production. An obvious first step is to review the costs of all components and determine which of those currently made in house ought to be bought from outside vendors. But if, as a result of this review, the firm finds itself dealing with an increased number of vendors, then the savings achieved through out-sourcing are at least partially offset by the increased costs of administering the more complex supplier system. The obvious answer is to reduce the number of suppliers by making them responsible for combining discrete components (which they may obtain from their subcontractors) into subassemblies or modules.

Once key supporters have responsibility for delivering subassemblies, however, it seems natural to give them the authority to modify the components

of those subassemblies in any way which reduces their cost or improves their performance, provided of course they still meet the customer's specifications. But no doubt there will be some highly beneficial modifications which require a (slight) revision of the original design. The customer begins to accept these as well, not only that, the example is infections. Purchasing agents begin to wonder whether additional (slight) modifications in the original design might not make it possible to subcontract groups of other components as subassemblies. There is no natural stopping point in this chain reaction of decisions; and if the process goes far enough, the design engineers begin to conceive of the car as a system of systems, each of which might be manufactured by an independent producer. Suddenly it seems as plausible to question as to assume the definition of a car company as the designer and manufacturer of virtually all that is essential to the construction of a car.

Consider next the case of car companies that look to new supplier relations as a means of solving apparently short-term design problems. A firm that must respond rapidly to new market demands or has been forced to lay-off part of its engineering staff may simply have to turn to suppliers for help in designing new products. The creation of the Chrysler K-car after massive layoffs in that company is a case in point. Alternatively, firms may have to go to outside suppliers for help in designing new technologies with origins outside the auto industry into their cars. Subassemblies based on engineering plastics or microelectronics are obvious examples. But here too there is no stopping point. Microelectronics can be, and in some more expensive cars already is, used to control the operation of the engine, the brakes, the suspension, and -- through the use of control area networks (CAN) which makes information generated in each such system available to the others -- the relation among them. Plastics are already being used for interior panels and gas tanks. If recycling problems

can be solved, they might be used for skins as well. And this is to say nothing of innovations in process technologies which loosen existing design constraints (for, say, continually stressed springs), and which are often so embedded in the particularities of the supplier which develops them that they are much harder for the customer to reproduce than many product innovations. Who is the car manufacturer if all complex systems in the car and even the links among them are designed in substantial measure by suppliers?

High-level managers at companies as diverse as VW, Mercedes-Benz, FIAT, Ford and BMW, we found, were well aware of the sources of drift and in most cases uncertain of what to make of them. One common, provisional response is to simultaneously note and limit the increased collaboration with suppliers by distinguishing systems (such as the motor and power train) which the company must make if it is to retain its competitive identity and advantage, and those it can make, but might well subcontract to suppliers with independent design capacities. But often this distinction would dissolve in discussion. If we asked two or more managers seated at the same table whether a particular subassembly might not in the near future be designed and produced outside the company, they frequently disagreed and said that their differences would be resolved by a committee whose very purpose was to settle such disputes. In principle, they then typically added, anything could be designed and produced outside; and what appeared at any moment as an immutable list of "must" and "can" components was really nothing more than the current, revisable, collective judgement regarding which components it was opportune to make. But final product alike, what defines the identity of and gives internal structure to a car company which may not find it opportune to design fully or manufacture any particular part of a car, even the most important? The emerging processual view of the "can" - "must" distinction -- the view that it is

a sequence of committee decisions rather than a fixed list -- is an admission of the potentially radical consequences of the new supplier relations which is admissible precisely because it depicts those consequences as controllable by familiar means.

The Push and Pull of Constraint and Opportunity

Even though such sequences of decisions appear natural to many managers -- including many who felt threatened by them -- they are not. If cost-cutting led naturally to delegation of design responsibility to suppliers and delegation of some design responsibility naturally led to delegation of more, it is hard to see why collaborative manufacturing did not become a matter of fact a long time ago.

The reasons it did not have to do with the economic environment in which auto firms operated during most of the post war period. As long as markets were expanding and products and production technologies changing in well defined ways at a slow pace, firms had strong incentives to keep most production under their direct control. If production runs were long, the costs of designing subassemblies, and of building product specific equipment to produce them could easily be amortized. The assembler thus captured the value added in the subassembly operation, protected its proprietary technologies and designs, and assured itself of reliable supplies of key components at predictable prices and quality standards regardless of external market fluctuations. Bureaucratic supervision of a captive supplier was a sure way to avoid dependence on the manufacturer of crucial product-specific components. Naturally, standard parts and specialized components in excess of what could be produced in dedicated facilities were always purchased on the open market. But under stable conditions hierarchical control of parts production through vertical integration

was for efficiency reasons the preferred solution to the problem of coordinating parts production with automobile design and assembly.⁵

To understand why things are drifting away from this pattern now, it is necessary to consider the dynamic of development costs and suppliers' reaction to them. Together, we believe, these forces are respectively pushing and pulling the major manufacturers down a path which for them consists of almost disconnected short-term decision.

The push comes from the need to reduce development costs and time. Although it is hard to quantify the extent of the change (and even harder to explain it), there is wide agreement that markets have become more fragmented and product life-cycles shorter in the automobile as in other industries. More and more models have to be introduced in shorter and shorter times; and insofar as the physical investment goods required for final assembly are becoming increasingly flexible (and hence largely reusable for successive product generations), not only are development costs rising absolutely, but they are rising as a fraction of total production costs as well⁶. The shorter the product cycle, moreover, the greater the penalty for being late to market. The explosion of retailers selling slightly dated "off price" garments in the US at discounts up to 50% is one indication of the cost to manufacturers of tardiness. The incessant financial reductions and other special sales programs by which the automobile industry currently tries to reduce inventory of slow selling models suggests an analogous trend. Hence by any comprehensive accounting measure, development costs can only be reduced by reducing development times as well.

Collaboration with independent systems suppliers as against captive parts producers addresses both aspects of the problem at once. By their very nature such suppliers share the cost of development: It is their independent design

capacity, after all, which defines them. In the ideal case, moreover, the systems supplier is working on related projects for firms in the same, or, better still, other industries. This means, first, that its automobile customer(s) benefit from the supplier's collateral experiences and pay a smaller share of the firm's overhead. Second, and at least as important, the more diversified the supplier becomes, the less dependent it becomes for survival on the good fortune of any automobile company which in turn has come to depend on it. Thus the company can reduce its business with the supplier in bad times without jeopardizing a now indispensable source of expertise, thereby reducing the burdens of what would otherwise amount to a kind of quasi-ownership.

Collaboration with a systems supplier reduces development times because a project can often be finished more quickly if execution begins before conception is complete than if tasks are completed serially. A classic example is the cheap Hollywood picture. Shooting of such films often starts before the screenplay is finished. The assumption is that each day's work on the set will help advance the story line for the next. In automobile production this means that the original equipment manufacturer gives a rough sketch of a system to a supplier, then modifies the overall design of the car based on the latter's suggestions -- and then submits a more refined description of the system to the supplier for further modification. (FIAT's director of industrial policy actually refers to the firm as a film director in this sense.) This method reduces development costs as well because problems of conception and execution are linked. Solutions to the one kind suggest solutions to the other, so the expenses of resolving the joint problem are less than those of solving either component in isolation. Given such general and complementary advantages to close collaboration with suppliers in the current environment, it is easier to understand why any move in this direction "naturally" suggests a further one.

But for those automobile producers who are not so moved, there is always the pull of all but irresistible offers of collaboration by the (would be) systems suppliers. What is sauce for the goose is sauce for the gander. The car makers' opportunity to spread the costs of development is the suppliers' opportunity to increase their autonomy in the market by creating or expanding their design capacities. Auto producers who do not solicit the help of systems suppliers are therefore likely to be solicited by them -- or face competition from other auto firms which have succeeded in redistributing development and production costs.

As automobile-industry watchers know, this war of position is extraordinarily complex, with suppliers second-guessing one another and the car companies and vice-versa. All seem aware of the drift of developments. But given the incremental character of the car makers' decisions and the risks associated with the assumption of design responsibilities, suppliers can only make haste slowly. If they are too aggressive in expanding their capacities through, say, mergers with complementary firms, they may offer products which for reasons we will take up later, the car companies prefer to build themselves. If they are too timid, their competitors will beat them to the punch and establish privileged relations with major customers, relegating the over cautious to the second tier of subcontractors.

To further complicate matters, there are important regional differences between Western Europe, North America, and Japan. In Western Europe the major suppliers appear to be the most independent and self-confidently expansive. Some, like Robert Bosch, are bigger and more technologically sophisticated than almost all their customers. (It was Bosch, of course, which developed the anti-skid brake, partly in collaboration in Mercedes-Benz). And the presence of potential -- some say actual -- monopolists such as Bosch gives

the car companies strong incentives to encourage the creation of other systems suppliers as competitors. Siemens-Auto, Alfred Teves, and VDO, which compete directly with Bosch, benefit greatly from such considerations.

In North America and particularly the United States, on the other hand, the long tradition of squeezing suppliers to the subsistence minimum through competitive bidding the retention of very substantial captive component-production facilities, and the tradition of radically separating conception from execution of tasks in all aspects of corporate activity means that suppliers are neither as capable of assuming design responsibilities, nor major producers so willing to relinquish them as in Western Europe. In Japan, as we will have occasion to note again, the situation is intermediate, though (much) closer to the European than the U.S. pole.

It is easy to define a boundary between the world of the essentially self-sufficient car maker and the world of collaborative manufacturing. But it is hard to know when any particular firm, let alone a national industry as a whole, crosses it. Collaborative manufacturing begins when the flow of knowledge from key suppliers to the customer is such that the latter could not in reasonable time teach itself what its subcontractors are currently teaching it. That knowledge could be technical in the narrow sense; but it might as well be, and typically is, an indissoluble mixture of process, design, and technological expertise. Whether or not any major firm has crossed that line, many have begun to reorganize themselves to limit the risks to which they would be exposed if they do. These organizational countermeasures are the theme of the next section.

3. Systems Integrators and Specialization Consortia: The New Car Company

We present two alternative models of the corporation once it has crossed

the boundary into collaborative manufacturing. The first is the systems integrator, of which BMW may well become the prototype. The other model is a specialization consortium. We argue that this form of organization could emerge from General Motors' efforts to restructure its components divisions.

Both of the models represent extrapolations from current developments at these companies. To that extent they are exaggerations of trends that could well prove to be reversible. On the other hand it is plain from our discussions with the managers in these companies that they would easily recognize the outcomes we describe as possible futures for their respective companies.

BMW as Systems Integrator:

Of the companies we encountered, BMW has moved most decisively towards collaborative manufacturing. Figures on vertical integration vary considerably, even when they seem to be using the same standard of measure. But it seems certain that somewhere between fifty-five and seventy-five percent of the total production costs at BMW comes from outsourced parts. People in purchasing tell us that over eighty percent of the parts purchased involve important collaborative work with a specialist sub-contractor which supplies BMW with know how and design. No single part of their automobile is, in principle, inappropriate for outsourcing. Workshops in BMW's plants are being made increasingly autonomous and obligated to prove their production efficiency according to market standards.

Growing emphasis on collaboration has turned in-house manufacturing at BMW increasingly into a strategic learning process. Manufacturing is seen less as a source of value added than as a way of exploring the boundaries of new technologies or of maintaining the capacity to evaluate and encourage the effort of suppliers investigating areas not covered by the assemblers direct

expertise. Without this practical know how across a range of development and production areas, the firm would be incapable of directing to its own ends the inflows of know how and information that it receives. At the same time, mastery of specific technologies and manufacturing processes allows the firm to avoid its worst fear: becoming dependent on its suppliers. The idea is to establish a system in which the firm continuously learns from its suppliers without becoming intolerably vulnerable to them.

These shifts in the firm's relation to production have been accompanied by corresponding changes in corporate organization. This has been done by erecting distinct but overlapping institutions into a scanning system which continuously identifies and deploys new technologies and appropriate suppliers according to shifts in market tastes and technical possibilities. All issues concerning the location of production inside or outside the firm, for example, are made within a special committee (a Bezugsartenkreis) that brings representatives of engineering, purchasing and controlling together. Over half of the purchasing department's staff have double degrees in economics and engineering and representatives of the purchasing department participate in development and planning of the automobile from the very earliest conceptual stages.

The company has created three subsidiaries which concentrate on specialized or technologically advanced forms of motor vehicle development and production: The BMW Motor Sport Group (**ZS Motorsport GmbH**), The Advanced Engineering Design Group (**ZT Technik GmbH**), and the Motorcycle Group (**ZX**). Each of these subsidiaries, especially the first two, concentrate on pushing the boundaries of motor vehicle engineering and design. Finally, the firm engages systematically in joint ventures or participates financially in companies with its own venture capital fund. Four areas are regarded with special interest:

new production materials, new production technologies (eg participation with Cecigram in France), electronics (participation in Leowe Opta), and venture capital participations in companies doing mostly basic research in a variety of fields.

The effects of this system on the performance and organizational identity of the company are remarkable. Above all, the new structure makes possible radical reductions in development time. This is proven by the introduction of the new **Z1** sports car. Construction of this car was an experimental effort to shorten the company's current eight-year model-development cycle. The new engineering subsidiary, **ZT Technik GmbH**, did the engineering and BMW sub-contracted out modules -- world wide -- to firms that did the final design and development of the automobile. Within two years, the company was producing a limited edition of the car at the rate of roughly 17 units per day. BMW believes that it will require another two years before the car can be produced in series. But the project demonstrates that with the new system at BMW is capable of reducing development times to the range -- 43 months -- previously attained exclusively by Japanese producers.

The price of this success has been, predictably enough, a series of conflicts regarding the role of manufacturing in the company. Recently there was a long dispute between purchasing and engineering about whether to stop producing cylinder heads in house. The decision was to keep production inside because BMW did not want to transfer a crucial proprietary casting technology to a supplier. But all parties agreed that it was unlikely that such production would remain in house for long. The fact that a company called the Bavarian Motor Works and with a long, respected tradition of excellence in engine production contemplates such decisions underscores again its commitment to learning as against mastery of particular manufacturing processes or design

capacities.

General Motors as Specialization Consortium:

The alternative to the pure system integrator such as BMW is the specialization cartel consortium that seems to be emerging at General Motors. Here the aim is also to enhance the final assemblers capacity to engage in system integration, but the company is pursuing the goal by different institutional means. General Motors' strategy is to create a set of sub-contractors within the company itself whose behavior mimics that of the independent European sub-contractors clustered around firms such as BMW. Accomplishing this involves radically restructuring relations between the firm and its in-house suppliers.

The difficulty with General Motors' old system of components production was that membership in a common corporation often lead to arrangements that sheltered internal suppliers from market competition. Because they had what amounted to guaranteed markets, the in house components supplier would provide the mother company with products that, given a free choice, the latter may not have been willing to purchase.

Turning these rigid and inefficient components divisions into flexible sub-contractors that resemble the European independent suppliers involves a double operation. First, the company has to establish clear measures of performance for each of the internal sub-contractors so that their behavior can be evaluated against a standard provided by external competitors. Generally this means turning the component production facilities into small business units (SBUs) and encouraging them to sell their products on the open market. This helps turn the owners' fixed costs into variable ones.

The second step is to assign each of the small business units an area of

expertise which has an internal integrity such as the provision of a particular system or sub-assembly. The logic is to create a coordinated environment of specialization in which any given unit can gain the flexibility it needs to perform a specific task by cooperating directly with another unit in the same confederation of internal suppliers.

Redrawing the boundaries of the corporation in this way amounts to what European industry has on occasion called specialization cartels: i.e. agreements, often defined and monitored by trade associations, to fix not price but area of specialization in such a way that the better each firm gets at what it does, the more it needs to collaborate with firms in complementary areas. We will call them specialization consortia to avoid any suggestion of shady collusion. In the ideal case, the mutual dependence that results makes such specialization consortia self sustaining. In these systems, sales to the outside market play an important role because what a firm learns from its outside collaborators benefits the other members of the specialization consortium.

It is hard to say how far General Motors has gone in establishing such specialization cartels, but it is clear that much of the logic of reorganization in its independent components divisions thus far is consistent with doing so and was probably motivated explicitly by these considerations as well. Through a staggered series of reorganization and reconsolidation moves, GM has reduced the number of components divisions it now has to ten. Moreover, each of the existing divisions has been reorganized so that it consists of sets of non overlapping specialties.

The new **AC-Rochester** division, formed in September 1981 by merging the former **AC Spark Plugs** and **Rochester Products** divisions, specializes on the parts that govern the flow of air and fluids into and out of the car: e.g.: fuel systems, carburetors, filters, pumps, exhaust systems, e.t.c. **AC-Rochester**

has 5 business units, each of which groups a number of plants with complimentary specialties, just as **AC-Rochester** is itself specialized among GM's existing components divisions. The SBUs in the division sell their expertise and products to Mitsubishi Motors, Daewoo and many other automobile producers. Although the boundaries among the various units are still in flux, a group of managers and trade unionists from the relevant plants were well aware of the company's interest in establishing a system of coordinated specialization.

If this system is extended throughout the rest of General Motors, then the corporation will ultimately assume a new identity. In effect it will begin to play the role of an investment bank or holding company, maintaining an interest in a broad array of specialization consortia. The new GM would thus be a variant of the new BMW: on the one hand a designer, assembler and marketer of automobiles, and on the other an investment bank which coordinates the activities of organizations designed to provide specialized systems and sub assemblies.

Varieties of Specialization Consortia

There is, of course, no reason why such specialization consortia are only or best organized by a single auto assembler. For example, several auto producers can ally to form a holding company which organizes a network of specialized suppliers serving their separate needs as well as those of other customers in the metalworking industry. This is the case of Uddevalla Invest in Sweden, a kind of investment bank where the majority interest is divided among many large Swedish industrial firms and the minority interest is held by the public sector, including one local authority, a municipality to the north of Gothenburg. The firms in the group build prototypes and do engineering consulting for automobile firms, among others. But their central position in the

manufacturing strategy of Swedish industry is perhaps best revealed by the fact that they produce hardware and software which link the large producers to their subcontractors inside and outside the group, while creating the possibility for members of the group to communicate more easily among themselves.

Alternatively, specialization consortia can be created by arranging a number of specialty producers or groups of producers under a single corporate holding company. The role of the corporate "headquarters" in such a system is to allocate capital to the operating units, to provide research and development facilities where these can serve the needs of clusters of operating units, and to coordinate acquisitions and marketing in such a way that the holding improves its capacity to offer complete systems as the demand for these latter increases. Well known American examples include Masco -- the self proclaimed "masters of the mundane" -- and Magna International Inc.⁷ Magna's annual report depicts the corporation as a planetary system in which "executive management" is the sun and the group's "automotive systems corporations" are the planets around each of which orbits a cloud of operating-unit moons.⁸

Japanese producers occupy a position intermediate between these two polar cases of BMW and General Motors.⁹ Their subcontractors were traditionally more independent than those at GM and were encouraged through long term investment to design product and production technologies. At the same time they were never as independent as the independent Europeans auto component producers. But as production runs shorten and the longevity of products decreases, the Japanese are beginning to push their first tier suppliers to a position already occupied by European suppliers. Indeed, some Japanese suppliers, such as Toyota Auto Body, are becoming auto assemblers in their own right. Although we will not pursue the matter here, further investigation may show that the Japanese may prove to be virtuosi at "European" sub-

contracting.

4. Obstacles To Reorganization

Regardless of the power of the forces pushing and pulling OEM's towards a fundamental redefinition of their products and organization, even a cursory survey of the situation within firms and different national markets reveals obstacles to the kind of transformation we have been describing. The most general obstacle to change is the balance of power within the firm.

Reorganization favors some groups over others; and potential losers within both management and labor naturally try to protect themselves by defending existing arrangements. Often there is a marriage of convenience between these two groups, with each entering a defensive alliance for its own reasons.

Within management, the division between potential winners and potential losers can lead to the formation of factions whose conflicts can immobilize the firm. Plant managers, for example, are frequently opponents of the new forms of organization. They may fear that their plant's traditional line of product or components will be directly threatened by outsourcing. But they may be more generally concerned that the role of production as a whole within the organization will be devalued by the shift from vertical integration to systems integration. By the same logic, those managers most likely to back a movement toward cooperative manufacturing enthusiastically are those in purchasing departments. These changes make their position in the entire company more central strategically. Managers in planning have a more detached view of the problem than these structurally advantaged and disadvantaged factions, and typically take a more balanced and moderate, though less predictable, position.

The precise balance of power within management is impossible to specify independent of the particular situation in a given company. One thing, however,

is certain: opponents of change cannot be easily eliminated by casting all decisions about outsourcing as easily and objectively solvable problems of cost/benefit analysis. The costs of keeping production in house or not can be estimated with a variety of different measures, and an exaggerated emphasis on any one standard -- short run savings as against, say, learning potential -- can easily encourage other departments to resort to their own accounting magic in defense.

As usual in such situations, it is more likely that opponents of change will be won over when they participate fully and fairly in the company's basic decision-making processes. The obligation to participate in the basic definition of the product and production processes (What are the distinguishing features of the firm's products? What are the crucial technologies for the future competitiveness of the firm?) does not eliminate the insecurity inherent in a reclassification of the company's units. But it does force all participants to justify their positions strategically, and thereby forces traditionalists out from behind the screen of narrow cost calculations.

When such efforts fail and management factions form it is especially likely that the party of tradition will find allies among the representatives of the production workforce. Indeed, trade unions and works councils are likely to be more uniformly mistrustful of the new developments than management. We know, for example, of no counterpart in trade-union organization in the automobile industry to the emergent collaborative manufacturers, at least at the moment. The labor movement's primary concern in the current situation is preserving employment. Most of what we have described as components of a new system of collaborative manufacturing has been interpreted by the labor movement, especially though not exclusively in the United States, as modern-day examples of the auto companies' age-old concern to reduce their costs,

especially their labor costs. The labor movement understands contemporary processes of restructuring almost universally as threats not as opportunities.

There is little room in this interpretation for reflection on how to secure the long-term capacity to maneuver. For example, if manufacturing in house becomes increasingly a form of R&D, it is likely that the jobs that stay in house will be for the highly skilled. By the same logic, many of the less attractive jobs currently done in house will be outsourced. The thrust of labor's current defensive strategy is to produce the opposite outcome: the defense of the status quo protects low-skill jobs currently done in house while subtly encouraging management to confine risky experiments involving new high-skill jobs to outside suppliers -- where the work may remain even after the experiment has succeeded. In the short term labor's current strategy may save jobs. But in the long term it seems improbable that forcing the company to redirect its resources toward the preservation of low value added technologies will strengthen the unions' long-term viability. Yet, for the labor movement to make management's decisions regarding the use of manufacturing as a form of R&D a subject of collective bargaining would involve accepting a fact which the unions do not openly acknowledge: that traditional automobile companies are being fundamentally redefined.

The great danger of "traditionalist" alliance between factions of management and labor is that they succeed just long enough to imperil successful -- and potentially mutually beneficial -- reorganization of the firm. The longer change is blocked, the greater the danger that Young-Turk parties of management will form, sometimes allied with the highly skilled, unthreatened and therefore more "cooperative" parts of the work force. The Young-Turks will proclaim themselves the paladins of efficiency, and do battle with their counterparts in the opposing camp. The resulting conflicts can destroy a

company as surely as politically motivated inaction. And even if the Young Turks are successful in overcoming the opposition, their victories may so embitter the losers that reorganization will constantly be threatened by the vengeful demands of small groups looking for an opportunity to make good their losses or restore their dignity. This is the situation in General Motors and in some ways FIAT as well. But such outcomes are obviously not inevitable; and in the next section we will suggest some ways that a simultaneous reorientation of both management and labor could change the relation and the character of the alliance between them.

Another obstacle to a shift towards collaborative manufacturing concerns the availability of an appropriate base of suppliers. As we have already noted, the possibilities for cooperation with technologically sophisticated suppliers has grown considerably in recent years. Former after market producers are now attempting to become developers; developers are attempting to enhance their capacity to supply systems. Suppliers and manufacturers interested in collaborative strategies are converging. Moreover, the horizon of exchange has been expanded through internationalization.

Nevertheless, it is often difficult for firms to construct exactly the kind of collaborative relations they want and that the logic of collaborative manufacturing would suggest. It is, for example, today a rule of thumb that it is difficult to establish collaborative relations in those parts of production that deal with extremely expensive and specialized machinery or that are sensitive to transportation costs. In both cases a supplier must make significant investments, either by purchasing the specialized equipment or by relocating to solve the transportation problem. The OEM can reduce some of the risks of such investments by guaranteeing the supplier a predictable volume of business, but that comes at the price of limiting its own maneuverability -- the reverse of its

original intentions. No one can know whether the supplier, which itself is breaking new ground, will be able (or want to) live up to the expectations that it has aroused. Both sides are operating under considerable uncertainty. Neither can be absolutely sure of the possibilities and deeper intentions of the other -- and neither, therefore, is willing to take the first step. Dilemmas such as these often result in piecemeal and sometimes contradictory changes in the traditional relations between OEMs and suppliers.

Nevertheless, there are many examples of successful relations between suppliers and OEMs founded on the principles of the new model. In most cases, truly collaborative relationships have been established in the production of the technically less sophisticated -- and hence less risky -- components of the automobile: gas tanks, bumpers and seats. Such successes encourage slightly more risky ventures, such as door modules. Transitional risks can be minimized through organizational innovations such as joint ventures or mergers designed to create the capacity to produce modules. In Germany, for example, BMW has discussed setting up a common stamping facility with Audi, to be called Sueddeutsches Presswerk, which they hope will allow them to share the costs of an extremely expensive technology, and thereby allow each to redirect its savings to strategic technologies. The mere fact that the Sueddeutsches Presswerk is under serious discussion indicates the character of changes that can be expected as companies turn increasingly toward collaborative manufacturing.

Finally there are an endless array of company-specific factors that can obstruct efforts to create systems of collaborative manufacturing. FIAT, for example, is having difficulties creating a specialization consortium because of its overwhelmingly dominant position on the Italian market. No matter how it reorganizes its components subsidiaries their principle customer is in the short

run very likely to be FIAT; and this expectation undercuts the drive to the devolution of responsibility implicit in the formal reorganizations.

Volkswagen is another good case in point. Because of its particular history as a large volume producer, long owned by public authorities, and located in a region where it was the sole industrial employer, the company has had to move toward collaborative manufacturing in a halting and often internally contradictory way. A dramatic move toward outsourcing in a monostructural region such as that surrounding the main VW plant at Wolfsburg, would result in very high levels of unemployment in the region. The company would have to contend not only with the potential opposition of its works councils and the high compensation costs provided by German labor law, but with the potential objection of the regional government in Lower Saxony as well.

Consequently, the company must move slowly in the direction of collaborative manufacturing, balancing its need for greater flexibility and outside know how with the reality of its deep investments in human and physical capital. A good example of this dilemma was played out at VW's Passat assembly plant in Emden, which is located in a region with a structure similar to Wolfsburg's. There the company has constructed what is likely the most flexible and highly automated modular chassis assembly system in the world. But in order to implement the technology, the company had to agree with the works council in Emden that jobs lost would be replaced by shifting production from other VW plants into Emden. The result is that the Passat chassis is constructed completely out of modules, but from modules constructed in house in the Emden plant, rather than with ones that are purchased from the outside.

But for every peaceful compromise of this kind there is probably at least one silent stalemate or even open conflict. At the same Emden plant, the disputes between the works council and plant managers over the company's

desire to close down its in house seat production and purchase seat modules from Keiper Recaro has been so intense that the works council ultimately declared that it was impossible to bargain further with the plant management in good faith. VW withdrew the plant manager but has not abandoned plans to sub-contract the production of seat modules.

Finally, the case of Daimler Benz shows that a firm can itself create obstacles to collaborative manufacturing by the character of its investments. Unlike any other major automobile company, Daimler has attempted reduce its exposure to risk in the changing international economy by reducing the proportion of its business that is in automobiles and increasing the proportion that is dependent upon public contracts. Since 1985, the company has acquired four major electronics and defense firms -- MTU, Dornier, AEG and MBB -- and turned itself into the largest arms industry conglomerate in Europe.

Our interviews at Daimler made it clear that the idea that the automobile division could benefit from technological synergies with the newly acquired firms was, to put it tactfully, a secondary consideration. In the short run it is likely that if complementarities exist, they are likely to increase, rather than decrease the degree of vertical integration within Daimler. Whether such increased vertical integration will lead to the formation of specialization consortia or to inefficient deals that shelter the firm's divisions from market discipline is an open question. But even if this latter occurred, in the long run, the larger company will be solidly entrenched in the weapons procurement agendas of the West German and other European governments. Automobile firms that move into collaborative manufacturing have not been able to spread their risks in this way.

5. Management and Labor in Collaborative Manufacturing: Some Speculations on Reform

The chief obstacles to reorganization, we have argued, lie within management and labor in particular companies, and the alliances between them. One step towards overcoming the potentially ruinous opposition within these groups is to understand how in principle management, labor, and the forms of cooperation between them might be reorganized so as to protect what each side regards as its indispensable rights without jeopardizing the firm's capacity for continual reorganization. Of course it is easier to say what must be avoided than what might be done; but reflection on the first problem suggests tentative answers to the second.

For management the minimal reform is clearly to eliminate career patterns which encourage the propensity to defend existing structures, whatever they may be. A manager who has made a career in production, reflexively defends his or her department and career whenever the role of production is questioned. Because he or she knows only the logic and exigencies of that specialty, arguments that consider the potential benefits of reform to other specialties appear implausible and contrived. The narrow identification of departmental and corporate interests as a result of upward progress in a confined specialty is referred to at BMW as the "chimney effect." The firm is well aware that it can only create the kind of meta-corporation -- an organization for reorganizing itself -- which it wants if managers acquire specialized knowledge without also forming paralyzing allegiances to particular ways of doing business.

High-level managers at BMW plan to address this problem by redefining managerial careers so that young managers are not only at home in many parts of the corporation, but also thoroughly familiar with their major suppliers. Here they join what is becoming a broad movement in Sweden, West Germany, Italy, and some parts of the United States. Increasingly, managers "belong to the corporation," rather than any of its parts. They are expected to spend time not

only in different divisions and locales, but also in different specialties and not rarely in different companies -- suppliers, for example. There is in such a system no single path to the top. Indeed, following a single path is probably a route to a second-tier position. Rather, the goal, as one of our interlocutors at BMW put it, is to "formalize informal relations," and thereby create the organizational preconditions for spontaneous coordination among managers who intuit through lone experience what to expect from one another.

This new openness across division and corporate boundaries changes the manager's identity. He or she is expected to be loyal to the work group or corporation, but it is hard to say precisely what either is. Conversely, the corporation owes him or her its loyalty, but it is hard to say for what. The ambiguity of these relations brings to mind Groucho Marx's observation that he would not want to be a member of any club that would want him for a member. If it is to succeed in breaking down the allegiances that lead to "chimney effects" without destroying the solidarity and capacity for (organized) spontaneous cooperation which is a precondition for collaborative manufacturing, the new corporation will have to become the kind of club which Groucho Marx would always consider joining.

In principle the problems of labor-organization reform are analogous. Here too it is necessary to create the possibility for permanent restructuring by reducing organization attachments to a particular division of labor within and among firms. The problem of creating intra-firm flexibility is of course more severe in Great Britain and the United States with their traditions of narrow job classifications and detailed work rules than in the rest of Western Europe and Japan. But unions in basic industries such as autos in all these areas are rooted in the plant or corporation; and the blurring of the boundaries among firms and even industries creates problems for them all. Seat-module producers employ,

for example, garment or textile workers, whereas seats in an auto plant are built by auto workers.

The obvious answer is to begin to reconstruct union organizations in ways that correspond to the new industrial structures. The possibilities are numerous but complex, and their mutual relations unclear. A regional or national consortium might, for example, bargain collectively with the specialization consortium of a GM-type car maker subject to general rules governing the auto or metalworking industry as a whole. Alternatively, such a consortium might demand that a BMW-type collaborative manufacturer form one or several associations with its suppliers (and their subcontractors) to negotiate the terms of employment. To make matters still more complex, the more national trade unions take responsibility for coordinating very general industry-wide rules within the general legislation setting national employment standards, the more they begin to look like and compete with traditional political parties -- thus raising another set of vexing problems regarding the reorganization of labor.

But first things first. Whatever the similarities between labor's dilemma and management's, there is this fundamental difference. Top management can in the end fire "traditionalist" executives, and hire Young Turk replacements. Union officials can only stay in office if they win the electoral support of their current members. If they sacrifice or even jeopardize the interests of the current members in the name of a reform program that may win them the support of wage earners in other skill categories, firms, regions, and industries, they stand a good chance of losing their jobs -- and perhaps betraying the trust and sense of obligation that give meaning to their working lives. Local union officials at General Motors are perhaps the world experts in this problem, but it is very familiar to their colleagues in West Germany, Italy and France as well.

It is hard to see how there can be a transition to a new system of manufacturing in the heavily unionized basic industries such as automobiles without explicit debate about new forms of labor-management organization and cooperation. But it is fatuous to think that articulation of a new model will resolve the problem of realizing it. Incremental changes can have revolutionary consequences because they allow decomposition of intractably complex problems into manageable tasks. The drift towards collaborative manufacturing illustrates this possibility. But incremental change can become self blocking precisely because some types of problems are solvable only if certain actions are taken in deliberate concert. The current dilemmas of reform of labor-management relations within the emergent industrial structures illustrate that danger. Restructuring proceeds, and only time will tell whether it is gathering strength as it progresses.

NOTES:

¹This paper appeared in German as "Kooperative Produktion. Neue Formen der Zusammenarbeit zwischen Endfertigern und Zulieferern in der Automobilindustrie und die Neuordnung der Firma" in Hans Gerhard Mendius and Ulrike Wendeling-Schroeder, Hrsg., Zulieferer im Netz. Neustrukturierung der Logistik am Beispiel der Automobilzulieferung, (Koeln: Bund-Verlag, 1990) pages 203-227. The paper is based on extensive interviews conducted in the first part of 1989 with managers and trade unionists in the automobile and automotive components industries in Italy, West Germany and the United States. The authors would like to thank Richard Locke, Dan Luria, Toshihiro Nishiguchi and the SOFI Institute at the University of Goettingen in Goettingen West Germany. Conventional disclaimers apply.

² MIT

³ University of Goettingen

⁴ University of Chicago

⁵on this see Oliver B. Williamson, Markets and Hierarchies, (New York: Free Press, 1975)

⁶ see generally on the organization of development work in the automobile industry the excellent study by Kim B. Clark "Project Scope and Project Performance", Harvard Business School Working Paper, no. 88-069, 1988

⁷ For a description of Mascos strategy in this are, see Dennis L. Marler, "The Post-Japanese Model of Automotive Component Supply: Selected North American Case Studies", IMVP International Policy Forum, May 1989

⁸ Magna International Inc., 1988 Annual Report p. 49

⁹For the development of the Japanese subcontracting system, see Toshiro Nishiguchi, "Competing Systems of Automotive Supply: An Examination of the Japanese 'Clustered Control' Model and the 'Alps' Model", paper prepared for the First Policy Forum, MIT International Motor Vehicle Program, Niagara-on-the-Lake, Canada, 5 May 1987, pp. 10-12. See also Masayoshi Ikeda, "An International Comparison of Subcontracting Systems in the Automotive Components Manufacturing Industry", paper presented at the same conference.