

**COMPONENT MANUFACTURING:
CREATING AN ADVANCED MANUFACTURING SECTOR**

PROPOSAL TO THE

ALFRED P. SLOAN FOUNDATION

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EXECUTIVE SUMMARY

The Advanced Manufacturing Project (AMP) is a research consortium dedicated to investigating the determinants and possible policy supports of improved performance in manufacturing, in what we take to be its key swing sector — component manufacturing. Firms in this sector fabricate and/or assemble molded, forged, formed, and machined goods made of metal and plastic, principally for sale to other manufacturers. The sector stands at the base of such industries as automobiles and other transportation equipment; industrial, farm, and construction machinery; electrical appliances; and, to a lesser but increasing extent, such electronic equipment as medical instruments. Because of the sector's critical position within American manufacturing, the strategic choices of firms in this sector will have a huge impact on the future of U.S. manufacturing generally.

We wish to understand the determinants of performance for a variety of stakeholders: productivity, profits, wages, technical advance, and environmental sustainability. There is enormous variation in these outcomes across firms in this sector. There is also enormous variation in the production recipes these firms use; their practices with respect to inventory and quality management, capital intensity, employee involvement and training differ greatly even when supplying similar products to similar customers.

We believe that a key determinant of these practices is firms' relationships with their typically much larger customers, the Original Equipment Manufacturers (OEMs). At present, component manufacturing firms face contradictory pressures from the OEMs to both lower costs and improve quality, delivery, and product-design capabilities. Such customer demands generally—but not always—come without much support for the investment and restructuring necessary to achieve these goals, much less for increasing suppliers' profit margins or passing some benefits of improved performance to the often better-trained, more involved workforces that help produce it.

We are interested in understanding how different types of outcomes, production recipes, and supplier/customer relations interact — and seeing what sorts of industrial practices or public policies can help improve the performance of the sector. Given component manufacturing's concentration in the upper Midwest, our location there, and our research experience on industrial restructuring, we believe the AMP consortium — which joins scholars from Ohio, Illinois, Wisconsin, and Michigan — is uniquely positioned to find answers to these important questions.

INTRODUCTION

This proposal has four parts. First, we indicate the strategic importance of our target sector for manufacturing generally, and how it coheres as a distinctive industry sector. Second, we outline some recent changes affecting firms in this sector, describe the variety of their responses. Third, we describe our key research questions, methods, and proposed initial deliverables. Fourth, we describe the membership and governance of the consortium.

COMPONENT MANUFACTURING'S IMPORTANCE AND COHERENCE

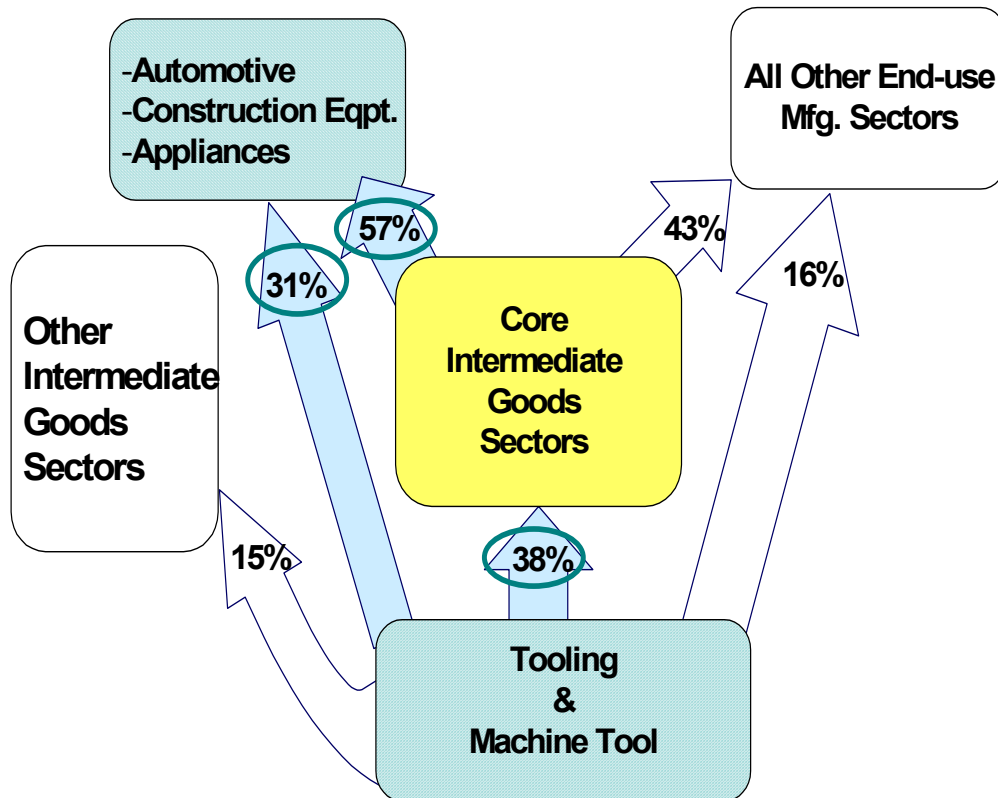
Component manufacturing is a critical industry sector in the U.S.. The character of its member firms, their concentration, and coherence as a group facing common problems recommend it for study.

- This is a relatively large sector, and traditionally a relatively prosperous one.¹ In 1997, it claimed close to 2 million employees, or more than 10 percent of U.S. manufacturing employment. Payroll per employee within the sector is 120 percent of the overall U.S. average (albeit falling in recent years), making these jobs well worth keeping. Especially for the Midwest region in which it is concentrated, this sector has a big impact on living standards more generally. About 80% of the employees in the sector are not college educated (compared to 70% for the nation as a whole). Because of its above-average wages, the sector has offered an important path to a “middle class” life, particularly for African Americans.
- The sector's health is critical to the success of U.S. manufacturing generally. As Figure 1 (see next page) indicates, component manufacturing stands at the intersection of multiple manufacturing supply chains, and at the base of such key manufacturing sectors as the machinery, appliance, and transportation sectors. For the larger OEMs in these and other sectors to flourish, they need high-quality, responsive components producers.

¹ The following statistics are for SIC codes 308 (plastic products), 346 (forgings and stampings), 359 (pistons, valves, small motors), and 3714 (motor vehicle parts). These SIC's are illustrative rather than definitive of the sector we want to study. The data come from the US Bureau of the Census, *County Business Patterns* and 1992 input-output tables.

Figure 1: A Key Swing Sector

Estimated Sales - Weighted Connections Among the Sectors in Key Upper Midwest Supply Chains



- Particularly in the sector’s traditional Midwest base, firms are having problems responding to these challenges. While good productivity data are not readily available for the sector,² a study of one part of it — auto suppliers — revealed stagnation in productivity growth in the 1980s-90s, despite robust productivity growth at their customer auto assemblers³. The component manufacturing sector’s performance looks particularly bad when compared to sectors such as computers, semiconductors, and telecommunications equipment, where annual productivity growth has been in double digits. There is also evidence that the weakness of the component manufacturing

² Our project would work to remedy this situation.

³ Okamoto, Yumiko, “Multinationals, Production Efficiency, and Spillover Effects: The Case of the US Auto Industry,” *Weltwirtschaftliches Archiv*, 135 (2): 241-260, 1999.

sector has been holding back the performance of their OEM customers. For example, one-third of the U.S./Japanese differential in lead time and engineering hours in autos, both unfavorable to the U.S., has been traced to differences in the performance of their respective suppliers. Also, U.S. auto suppliers were found to have 2-3 times the defect rate of their Japanese counterparts⁴. While these gaps have narrowed in recent years, they have not gone away. Also, poor supplier firm ability to modify products and processes makes it harder for them to take advantage of new product markets, even as consumer demand in such traditional markets as autos and appliances approaches saturation.

Component manufacturing is thus a big, key, and troubled industry sector. It is also one whose geographic concentration, similarity in firm size and capacity, and dense professional organization suggest the existence of common industry needs, and of receptivity to proposals for meeting those needs.

- The sector is heavily concentrated geographically, with 45 percent of total sectoral employment in the Great Lakes states of Wisconsin, Illinois, Indiana, Michigan, and Ohio (as against 36 percent of U.S. manufacturing generally). The adjacent parts of the sector's supply chain are also heavily concentrated in those states. Its key customers in appliances, construction equipment, and auto have 38 percent of their total employment there; and a key supplier to the sector, tooling and machine tools, has 49 percent of its employment there.
- In contrast to the OEMs they serve, most of these firms are small-to-medium enterprises (SMEs), with fewer than 500 employees. In part because of their small size and limited capacity, they are more deeply anchored in their regions, and more dependent on surrounding regional institutions (e.g., the local technical colleges, area infrastructure, economic development assistance programs, or regional modernization services). The NIST Manufacturing Technology Centers (MTCs) in Illinois, Indiana, Michigan, Ohio, and Wisconsin serve several thousand of the sector's member firms each year.
- Component manufacturing firms have dense and overlapping professional organizations, and (when they are organized) heavy overlap in union membership. While less dense than in other countries,⁵ the sector is characterized by substantial

⁴ Clark, Kim, and Takahiro Fujimoto, *Product Development Performance*. Boston: Harvard Business School Press; Cusumano, Michael and Akira Takeishi, "Supplier Relations and Management: A Survey of Japanese, Japanese Transplant, and U.S. Auto Plants," *Strategic Management Journal* 12 (8): 563-588, 1991.

⁵ Other nations also see these industries as related. In Germany an umbrella association called the "Arbeitsgemeinschaft Zulieferindustrie" was founded in 1993. It consists of the industries listed above plus rubber producers and hot-end metal manufacturers. The organization encourages cooperation among its members and public policies that enhance their technological capacity. They have drawn up general conditions for behavior that are meant to govern their own behavior vis a vis OEMs. The association is working to establish a European association of similar composition.

activity by national trade associations. In metalforming, approximately 700 firms, 520 of them in the Great Lakes states, are members of the Precision Metalforming Association (PMA). PMA, based in suburban Cleveland, boasts a broad array of activities and publishes a monthly magazine with deep coverage of technical issues in stamping, roll-forming, and other forming technologies. In plastics processing, 900 firms are members of the Society of the Plastics Industry (SPI) in Washington, DC. The Chicago-based Midwest group is the nation's most active. In machining (including tooling), more than 1400 firms are part of the National Tooling and Machining Association (NTMA), headquartered in the Maryland suburbs of DC, but with some two-thirds of members in our region. In heat-treating, more than 200 shops are members of the Jacksonville, FL-based Metal Treating Institute. A newly formed organization, the Original Equipment Suppliers Association, seeks to advance the interests of the automotive original equipment suppliers. Most unionized firms in the sector have workers represented by just a few unions: The United Auto Workers, International Association of Machinists, and the United Steel Workers.

STRATEGIC CHOICES IN A NEW ENVIRONMENT

This is a time of major transformation in the sector, largely driven by shifting demands from its customers. As we discuss below, these demands pose several dilemmas for component manufacturers.

In the past twenty-five years OEMs have come to face new competitive challenges and opportunities — most prominently increased global competition, increasingly volatile and fragmented markets, and shifting technology mixes. OEMs from Europe, Asia, and America now compete against each other more directly, as national markets are less protected than in the past. Globalization provides opportunities in input markets however, since OEMs now have access to suppliers from around the world. OEMs are finding that their customers often seek products tailored to them (rather than being satisfied with a generic version), and brand loyalty has fallen greatly. While the core technologies relied on by OEMs (largely steel and mechanical engineering) remained stable for decades, their production processes are now being revolutionized by technologies developed in other parts of the economy, such as new materials and electronics. For example, cars now contain plastics, aluminum, electronics, ceramics, and software — technologies that are capital-intensive, shared with other industries, evolving quickly, and requiring diverse management styles.

OEMs have often responded to this new environment by focusing on their ‘core competencies’, and by outsourcing areas not deemed to be part of the core. Relations with their outside suppliers can be governed either by competitive bidding, or by partnership.

Sometimes the result for their suppliers is simply increased price pressure, and reduced OEM commitment. In some important cases, however, OEMs have become more interested in cooperative and enduring relations with key suppliers. In order to meet consumer demands for greater variety of products, for example, OEMs are in some cases moving toward obtaining components in larger chunks (for example, an entire automotive instrument panel, instead of separate gauges, wiring, and dash) — something that often requires suppliers to develop new

competencies. As OEMs look to suppliers to keep them abreast of emerging technologies, they have an interest in those suppliers developing niches of technical expertise, even at the cost of working with their competitors.⁶ All over the advanced industrial world, OEMs are establishing partnerships with suppliers to upgrade the latter's capabilities. Despite their growing global networks, OEMs remain tied in the medium term to their regional supplier base, including the second and third tier suppliers. The upgrading is intended to improve these suppliers' parts, which account for a rising share of defective parts and warranty charges in industries such as motor vehicles⁷.

For component manufacturers, these changes in OEM behavior yield both risks and opportunities. They are subject to stiff price competition, even as they are asked to act cooperatively with firms up and down the supply chain. In some cases, however, their increasing strategic importance to OEMs gives them greater bargaining leverage with those customers. If suppliers are successful in developing lucrative niches of distinctive competence, they may also be able to diversify their customer base.

The key question for these firms is how to develop the capability to do advanced manufacturing without going broke. Making the transition from essentially commodity component manufacturing to the continuously innovative production that characterizes advanced manufacturing takes time, money, and wit. In embarking on this endeavor, the typical component manufacturer faces three large problems:

1. OEM partnership is inconsistent. The first problem is with the OEMs (what we will be calling the "vertical" dimension of the relations we wish to investigate). While they often preach

⁶ The actual extent of outsourcing which is driven by a desire for better technology (as opposed to lower wage and overhead costs) is a matter of dispute, and one of the things we want to more clearly measure.

⁷ Among the most striking examples of these networks are CONSAF, a sub-supplier training consortium established by four large Italian-based OEMs, and Fiat's efforts to create an "automotive technology district" around Turin in collaboration with local polytechnics. Another noteworthy case is Volkswagen's cooperation with the City of Wolfsburg to create Wolfsburg AG, an initiative aimed at providing regional infrastructure for independent automobile design firms. In the United States, six OEMs (Deere, Case, Harley-Davidson, Mercury Marine, Trane, and Ariens) are collaborating with the Wisconsin Manufacturing Extension Partnership and the state technical college system in a training consortium aimed at improving the skills, quality, and performance of their small and medium-sized suppliers. Similarly, Ford has contracted with CAMP (Cleveland's Manufacturing Technology Center) to provide training in quality improvement and inventory reduction to its northeast Ohio suppliers.

Some of these efforts involve collaboration with unions as well. Within union ranks, there is an increasing belief that support for supply chain upgrading, alongside enhanced training for workers within OEMs, is necessary for securing a voice in industrial restructuring and preserving high-wage union jobs. For example, the Wisconsin Regional Training Partnership, a labor-management consortium of metalworking OEMs and their suppliers dedicated to training and modernization, now has 60 member firms, with a collective workforce of 60,000 employees in the Milwaukee metropolitan area. UAW Region 1A in the Detroit area sparked the formation of the Labor-Management Council for Economic Renewal, a 10-year old partnership of 55 firms and their unions that provides training on topics such as safety and continuous improvement.

the gospel of collaborative relations with their suppliers, they often live it, like many other gospels, only on the weekend. There is also the problem that different OEMs, even when individually helpful to their key suppliers, want things from them that are sufficiently different that it is difficult to organize production in ways that satisfy them all.

2. *Rivalry undercuts accumulation of investment capital.* The second problem is with competitors (what we will be calling the “horizontal” dimension). Even a firm embarking on the advanced manufacturing path typically relies partly on low-end goods or services to fill its factories. A highly competitive market means lower profits to invest in transition. And inevitably, some of the investments made on the transition may not pay off. The example of training is classic. A firm that assiduously trains its workers faces the cost of losing them to higher-paying rivals, who are able to pay more precisely because they do not incur such training costs themselves.

3. *Firms and policymakers lack knowledge of best practices.* A third problem in adopting advanced manufacturing practices is the firms’ own lack of knowledge of what works and what doesn’t. In recent years component manufacturers have experimented with all sorts of strategies, such as pressuring their own suppliers to cut prices; “sweating” their own workforces; establishing self-directed work teams, extensive profit-sharing, and greater guarantees of job security; investing in quality training; investing in automated equipment; removing automated equipment; making work more contingent on market forces out of those employees’ control. They have tried these often-contradictory experiments because the “right” recipes are not really known. We know from the work of the Performance Benchmarking Service that high-value added per employee firms that are innovative also tend to pay their workers more than firms that do not, make significantly higher capital investments, and spend more on training. Are these things just correlates, or are they causally related? One striking finding of recent work on human resources policy is that clusters of practices are associated with improved performance in areas such as productivity and quality, yet very few firms adopt “advanced” practices of employee involvement or self-direction in clusters.⁸ Adding interaction with other firms further scrambles the picture. For example, plants that had suggestion systems for workers had more cost reduction if they also had long-term relationships with their customers — but few plants combined the two.⁹

Some results of firms’ experimentation can be seen in manufacturing-intensive regions such as the Great Lakes. There, overall manufacturing output has resumed its climb, average productivity has risen sharply, and employment has stabilized. However, incomes of manufacturing workers have stagnated, and inter-firm variation in productivity in the component manufacturing sector is enormous and growing. Aggregate employment stabilization masks continued decline in cities and their inner-ring suburbs. The outer rings are growing, but firms there almost always offer lower wages to their workforces, and some evidence suggests they

⁸ See the review in Richard Freeman and Joel Rogers, *What Workers Want* (Ithaca: Cornell University Press, 1999).

⁹ Susan Helper, “Complementarity and Cost Reduction,” National Bureau of Economic Research Working Paper 6033, revised April 1999.

have lower productivity. However, the very large number of metropolitan manufacturing firms that are characterized by high wages, high productivity, and distinctive capabilities is also notable. That these firms survive despite the problems of cities and their higher wage costs may mean that they are doing something that, if generalized, could mean higher wages and productivity throughout this important sector (and, potentially, jobs for minorities segregated in the urban core).

So: What exactly is it that they're doing? Why are they doing it? What are the relations with OEMs or competitors that permit them to do it? How can they, and other firms interested in improving their performance, be encouraged through industry or public policy supports? What relevance, if any, is their local institutional environment?

Finding the answers to these questions, we believe, holds to the key to understanding the broad future of U.S. manufacturing, and suggests that employment stabilization with good wages may be a real possibility in this part of the U.S. economy.

RESEARCH QUESTIONS & STRATEGY

As basic as such questions are, they are remarkably understudied. A number of research centers look at the customers or suppliers of component manufacturers, such as autos or machine tools. But we don't know of any other centers that look at the component manufacturers directly. Our project would allow us to focus on issues specific to the small firms that make up this sector, and to look at existing and potential cross-fertilization across the industries they supply.

Research Questions

We assume that a firm's choice of strategy is a function both of its own perceived capacity to meet different market demands, and of the characteristics of the supply chains and the regions in which they are embedded. (We assume these factors interact with each other.) We are interested in performance measures such as productivity (both labor and total factor productivity), quality, new product introduction, firm survival and growth, profits, wages, and emissions reduction. We will investigate the impact on performance of practices (taken both singly and together) which have been suggested to be advances in manufacturing¹⁰ such as: simultaneous engineering, employee involvement, partnership with suppliers, just-in-time production, training in continuous improvement, investment in computers and automated equipment, linkages with universities and technical assistance agencies. We will ask questions such as the following:

What are the strategies of OEMs with regard to their suppliers? We argued above that the strategies of component manufacturers were shaped by those of their customers, and that the latter had changed — with increasing outsourcing, modularization, collaborative relations with

¹⁰ Hence our name, the Advanced Manufacturing Project

suppliers, more competitive bidding, and greater “tiering” of suppliers (with different relations in each tier). It is important to understand the relative weight of those different changes, and what drives them — how much, for example, is driven by technology, and how much is driven simply by cost concerns? ¹¹It is also important to get a better sense from OEMs of the range of relations they have suppliers, how they choose those relations, and what difficulties and opportunities they see in developing them. How much do internal organizational obstacles within OEMs, such as cross-functional conflicts, corporate-subsidary disjunction, staff turnover, and tangled communications lines inhibit the development of collaborative relationships with external suppliers? What are the conditions for overcoming these obstacles? And how can component manufacturers disadvantaged by current OEM-led programs achieve the capabilities needed to sustain participation in such supply chains?

What mix of strategies do component manufacturers choose in response? What proportion of firms compete by designing and manufacturing innovative, high-quality products using skilled, well-paid workers, while minimizing pollution? Are these characteristics tightly associated with one another, or can firms achieve some outcomes (e.g. high quality) without others (e.g. high wages for production workers)?

What policies do successful firms adopt? What policies lead to good performance on the measures listed above? We would want to know in particular about the effects of technology strategy, industrial relations, customer/supplier relations, and linkages with intermediaries such as universities and technical assistance centers. What mechanisms do these firms use to promote learning within and between firms? What incentives do they provide to get people to use them? Which of these policies are key determinants of success, and which are merely correlated with success? For example, we have preliminary evidence that high rates of employee computer use, high percent of design employees, and low turnover all are correlated with high productivity. Must all three policies be adopted for productivity to rise (i.e., are the policies complementary)?

Does the institutional environment matter? Is the decision to adopt a particular production recipe primarily a function of management’s strategy or is it importantly driven by other institutional and locational factors, such as the availability of skilled workers, proximity to specialized suppliers, or the strategies of rival firms? What is the impact on firm strategy of factors such as ownership (family/corporate, public/private, freestanding/subsidiary, domestic/foreign), unionization, and position in the tier structure of the supply chain? What is the impact of unions, local community colleges or other training institutions, state-level manufacturing technology centers, and other intermediary institutions such as trade and professional associations? If these or other institutional supports seem important, what are the conditions of their diffusion? What can the U.S. learn from Western European and Japanese examples of collaborations to improve the capabilities of component suppliers?

What policies — public and private — help firms move toward more profitable roles in the supply chains of traditional industries, or of “new economy” industries such as medical

¹¹ The difference is important in determining a) whether improvements are more likely to be one-shot (as with price reductions given an existing product and process) or on-going (as with an innovation whose possibilities are only gradually realized) and b) how the gains from the improvements are shared.

instruments, computers, or electronic control system? What has been the experience of component manufacturers attempting to move into more demanding and remunerative supplier roles, whether by establishing a solid track record for quality and reliability; taking on additional design, engineering, or logistical functions; or developing proprietary product or process innovations? Do those who have moved enjoy higher profits, productivity, and/or wages?

What determines how productivity gains are shared among a firm's stakeholders? How does this sharing affect the creation of capabilities that generate future productivity gains? Is it feasible or important to erect policy barriers to low-investment strategies, such as living-wage laws, rising safety and environmental standards, or restrictions on local government subsidies to business? Do subsidies such as investment tax credits or technical assistance improve performance in this sector?

Research Strategy

To answer these questions, we propose to use a variety of methodologies. Our general research strategy may be divided into “vertical,” “horizontal,” and “policy” dimensions.

Vertical Dimensions

In the first year of the project we would focus primarily on the vertical dimension, examining the changing governance of supply chains. We would proceed in the following steps:

Identify firms to interview. We would start with groups of OEMs, working backwards to their suppliers, and analyzing the impact of these relationships on both parties. We would work with Manufacturing Technology Centers in Wisconsin, Illinois, Indiana, Ohio, and Michigan to identify appropriate samples of OEMs and suppliers, stratified by end-use sector, involvement in supplier training efforts, etc., whose ranks could then be extended by nominations from participating firms using “snowball” methods. We will be greatly aided in gaining access to these firms by the work of the Performance Benchmarking Service of the Michigan MTC, which is headed by Daniel Luria. This group has already surveyed hundreds of suppliers through the trade associations mentioned in section 1 of this proposal.

Obtain baseline data. All participating suppliers who had not previously done so would be asked to complete a Performance Benchmarking Survey to facilitate comparison with MMTC's national dataset on small and medium-sized manufacturing plants.

Design a common interview protocol. In doing so, we would be able to draw on two similar projects undertaken by consortium members. COWS has recently completed a report on the Wisconsin Supplier Training Consortium, in which the six member OEMs were interviewed about their procurement and supplier development policies, together with 14 participating suppliers nominated by the OEMs. (A particularly successful feature of this research design was that OEMs were asked to suggest suppliers who worked for more than one of the participating companies, enabling component manufacturers to feel more comfortable in providing critical feedback about their customers.) In 1997, REI conducted a study of Northeast Ohio auto

supplier supply chains and pollution prevention efforts, based on structured interviews with 35 firms.

Conduct interviews. We would conduct interviews at about 120 firms and intermediary institutions, with approximately 30 sets of interviews in each state (with northern Indiana included in the Illinois study). Our goal would be to build up an extended profile of individual and collective OEM supply-chain strategies in the region, with explicit attention to their sensitivity to local institutional conditions. We would intend to be opportunistic, following up promising leads or willing participants. We would also modify this regime of interviewing, at least at the margin, if we discovered declining returns to the interviews, and nowhere else to take them. (We doubt this will happen, but expect that such self-critical review and willingness to revise assumptions and depart in new directions, would be part of the AMP style.) Here is a preliminary sketch of whom we would aim to interview.

Institution	Number	Interviews per institution
OEMs	20	2-3 (OEM head of purchasing, plant manager, plant procurement manager)
Suppliers (first, second, and third-tier)	60	3-4 (CM division head or company president, purchasing manager, VP engineering, plant manager, local union head)
Manufacturing services firms (banks, consulting, heat treating, tool/die)	20	1-2 (heads of manufacturing division, sales)
Intermediary institutions (MTC's, trade associations, local govts, national unions)	20	1-2 (researchers, strategists)

Horizontal dimensions

In the second year of the project, we would focus primarily on the horizontal dimension, comparing manufacturing strategy choices across component suppliers. This dimension of the research would be conducted in three overlapping stages:

Analyze interview data. We would try to identify variations in firm strategies and performance in relation to the range of organizational, relational, institutional, and locational characteristics discussed earlier.

Analyze existing data. The MMTC's Performance Benchmarking Survey dataset would be mined for evidence on these questions by comparing several groups of component firms using

common materials and processes (such as metalforming, machining, and plastic injection molding), but differing in their production “recipes” on indicators such as wages, value-added, capital per employee, use of teamwork, and other “advanced” practices.

Design a new survey. Building on the results of the first two stages of the research, we would design and administer a survey of industrial component manufacturers, enabling us to situate our findings more precisely in a broader national and regional context. Again, we would base our questionnaire design on experience gained in previous projects, such as Luria’s Performance Benchmarking surveys, which have been carried out for several years, and Helper’s international surveys of automotive suppliers.

Policy dimensions

The third, policy dimension of the research will be conducted concurrently with the other two. We would consistently seek to draw out the implications of our research, so we can inform the actions of firms, governments, and intermediaries. In addition to our US interviews, we would examine some promising European experiments in collaborative supplier development mentioned above, benchmarking them with their Midwest counterparts such as the Wisconsin STC in pursuit of opportunities for mutual learning and exchange of good practice.¹²

Deliverables

Deliverables to be generated by the project will include multiple (we imagine at least 10) working papers and (we imagine at least 5) journal articles, and a final project report. Already, we have been approached by the editors of *Industry and Innovation* (Carfax Publishers), on whose International Editorial Advisory Committee Jonathan Zeitlin serves, to prepare a special issue. We would establish and maintain an active web site, both for communication among team members and for dissemination of results. We would hold at least one conference to present our research to stakeholders from the industry and its supporting institutions, get feedback, and gather support for implementing recommendations.

THE AMP CONSORTIUM

The above research agenda is too ambitious for any single scholar or even group of scholars at a single institution to accomplish alone. We therefore propose to establish a collaborative research consortium comprising the six scholars from four Midwest institutions who are submitting this proposal, each of whom would serve as co-principal investigators.

¹² These transatlantic comparisons would be undertaken jointly by Gary Herrigel and Jonathan Zeitlin with European scholars such as Volker Wittke of SOFI, Peer Hull Kristensen of the Institute for Organization and the Sociology of Work at Copenhagen Business School, and a group of researchers at the Institute of Sociology at the University of Turin, including Aldo Enrietti, Massimo Follis, and Angelo Pichierri.

Governance of the project would be fully joint, with equal weight in decision-making accorded to each of the four institutions represented by these principals. During the initial Sloan grant, fiscal administration for the consortium would be located at Case Western Reserve University, an arrangement which will be reviewed at the end of this period.

This consortium brings together a group of prominent scholars based in four major manufacturing states, with extensive experience of industrial research within and beyond the Midwest, and a complementary mix of qualitative and quantitative skills (see attached biographical statements). Key additional assets include access to a formidable store of existing data, much of it generated by the participants themselves, and exceptional access to firms in the region, built up from years of helping them solve concrete problems in manufacturing modernization. Each of the participants is familiar with the others' work; many of us have collaborated before. The research agenda outlined above represents the outcome of meetings among members of the group over the past two years.

Each of the participants brings to the consortium resources that will enrich the project. Some of these, such as colleagues, data bases, graduate student assistants, and administrative staff, are drawn from their home institutions (see institutional profiles in the appendix). Others involve closely related research grants and projects, or external commitments of matching funding for the work of the consortium. The consortium already has in place a solid industrial constituency with an active interest in its research. Key supporters are the Manufacturing Technology Centers in Ohio, Michigan, and Wisconsin, which themselves have close ties to business, labor, and state/local government. Other prominent intermediary institutions which have expressed interest and support for the consortium's research include the National Association of Purchasing Managers (NAPM) and the National Initiative for Supply Chain Integration (NISCI), a consortium of prominent US-based OEMs. We already have commitments of financial and in-kind support from many of these institutions.

Following are brief biographies of the principal investigators. Appendix I contains profiles of the institutions participating in the consortium. Appendix II contains information about our proposed budget, and a time line.

Principal Investigators

Susan Helper (BA Oberlin College, PhD Harvard) is Associate Professor of Economics at the Weatherhead School of Management, Case Western Reserve University. The focus of her research has been the impacts on innovation and bargaining power of firms' choices between market and collaborative forms of supplier/customer and labor/management relations. Much of this research has been conducted in the auto industry; she has been a research associate of MIT's International Motor Vehicle Program since 1986, and of its French counterpart (GERPISA) since 1993. With Mari Sako (Oxford), she has conducted surveys of auto suppliers in North America, Europe, and Japan. Current projects include (with John Paul MacDuffie (Wharton)) a study of the impact of electronic commerce on the supplier relations in the auto industry, and (with Jorge Carrillo (El Colegio de la Frontera Norte)) an investigation of the mixes of production recipes chosen by maquiladoras in Mexico. Her work has been published in such journals as *American Economic Review*, *Strategic Management Journal*, *Sloan Management Review*, and *Business*

History Review. From 1997-99, she was co-coordinator of the Sloan Foundation/National Bureau of Economic Research Project on Industrial Technology and Productivity, where she organized conferences and plant tours to teach field research techniques to economists.

Gary Herrigel (BA Wesleyan University, PhD MIT) is Associate Professor of Political Science and the College, University of Chicago. His fields of interest include: modern industry; comparative industrial policy; economic geography; German, Japanese and US history, politics, economy; historical political economy; social theory; business history and organization. Among Herrigel's recent publications are: *Industrial Constructions: The Sources of German Industrial Power* (Cambridge, 1996); "Americanization, Market Order and Democracy: The Restructuring of Steel industries in Germany and Japan after the Second World War", in: Jonathan Zeitlin and Gary Herrigel, eds, *Americanization and its Limits: Reworking American Technology and Management in Post-War Europe and Japan* (Oxford, 2000); "Large Firms and Industrial Districts in Europe: De-Regionalization, Re-Regionalization and the Transformation of Manufacturing Flexibility" in John Dunning, ed., *Regions, Globalization and the Knowledge Based Economy* (Oxford, 2000); and "Governance of Small and Medium Sized Firm Manufacturing in Germany: Transformation of the Machine Tool Industry in the 20th century" in *Enterprises et Histoire*, May 1999. His current research interests include: a comparative book project on the differing social and political locations and consequent adjustment trajectories of the steel industry in the United States, Germany and Japan; and a collaborative project with Volker Wittke of the SOFI Institute in Göttingen, Germany, on the effect of multinational manufacturing investment on industrial districts in central Europe and the United States.

Daniel Luria (BA University of Rochester, MA University of Michigan, PhD University of Massachusetts) is Vice-President, Strategy & Measurement at the Michigan Manufacturing Technology Center (MMTC) (formerly, the Industrial Technology Institute). The MMTC is one of the 78 member centers of NIST's Manufacturing Extension Partnership. Since 1991 the MMTC has worked with more than 1000 small and medium-sized Michigan manufacturers in the areas of benchmarking, quality systems, cycle time reduction, cost estimation, and business planning. Luria directs the MMTC's Performance Benchmarking Service (PBS). Since 1992, PBS has produced more than 6500 customized benchmarking reports for 3300 companies across North America. A frequent author and commentator on U.S. manufacturing performance, he has co-authored three books; published articles in the *Harvard Business Review*, *Challenge*, *Research Policy*, and the *International Review of Applied Economics*; and been interviewed on NBC Nightly News and PBS's McNeil-Lehrer Newshour. Prior to joining the MMTC in 1984, Luria spent eight years as an industry analyst in the UAW Research Department.

Joel Rogers (BA Yale College; JD Yale Law School; MA & PhD Princeton University) is the John D. MacArthur Professor of Law, Political Science, and Sociology at the University of Wisconsin-Madison. He is also founder and director of the Center on Wisconsin Strategy (COWS), a research and policy institute and demonstration project incubator dedicated to promoting "high-road" — high-productivity, high-wage, low-waste — economic development. He has for years worked closely with business and labor, in Wisconsin and nationally, toward that end. Rogers has written widely on American politics and public policy, political theory, and U.S. and comparative industrial relations. His most recent books are (with Richard B. Freeman) *What Workers Want* (Cornell, 1999), (with Daniel D. Luria) *Metro Futures: Economic Solutions*

for the Cities and their Suburbs (Beacon, 1999) and (with Ruy Teixeira) *America's Forgotten Majority: Why the White Working Class Still Matters* (Basic, 2000). A contributing editor of *The Nation* and *Boston Review*, and a MacArthur Foundation Fellow, he was identified by *Newsweek* as one of the 100 Americans most likely to affect U.S. politics and culture in the 21st century.

Richard Shatten (BA Harvard College, MBA Harvard Business School) is Ameritech Professor for the Practice of Regional Economics at the Weatherhead School of Management, Case Western Reserve University, where he also directs the Center for Regional Economic Issues (REI), a partnership with community leadership to support the development and application of regional economic policy. Prior to joining the university he was Executive Director of the Mandel Philanthropic Program, advising a private family's foundation activities. There, he helped develop leadership education programs and neighborhood renewal strategies.

And prior to that he was Executive Director of Cleveland Tomorrow — a committee of the chief executive officers of Cleveland's largest corporations organized to pursue projects that are fundamental to the region's long term economic vitality. Under Mr. Shatten's tenure the organization played a leading role in Cleveland's turnaround. It initiated programs including neighborhood housing renewal, labor-management cooperation, manufacturing technology transfer, venture capital formation, business incubation, and a succession of downtown projects including a Rock and Roll Hall of Fame, baseball stadium, basketball arena, housing development, a lakefront park, a science center, and historic theater district renewal. Mr. Shatten lectures and writes about civic leadership systems and their impact on regional economic advantage. He teaches nonprofit entrepreneurship and studies regional economic development and leadership for nonprofit organizations.

Jonathan Zeitlin (BA Harvard College, MA Cambridge University, PhD Warwick University) is Professor of History, Sociology, and Industrial Relations, and Director of the European Union Center at the University of Wisconsin-Madison. Zeitlin's research interests and numerous publications range widely over current and historical developments in business organization, industrial relations, technology, skill formation, and public policy in Europe, the United States, and Japan. Among his recent works are: (with Gary Herrigel) *Americanization and Its Limits: Reworking US Technology and Management in Postwar Europe and Japan* (Oxford, 2000), (with Charles Sabel) *World of Possibilities: Flexibility and Mass Production in Western Industrialization* (Cambridge, 1997), and (with Steven Tolliday) *Between Fordism and Flexibility: The Automobile Industry and Its Workers* (Berg, 1992). A faculty associate at the Center on Wisconsin Strategy since 1992, Zeitlin has also worked as a consultant on industrial and training policy for the International Labour Organization, the United Nations Industrial Development Organization, and the Greater London Council. He has received fellowships and research awards from the Guggenheim Foundation, the German Marshall Fund, the European University Institute, the British Economic and Social Research Council, the British Academy, and the Marshall Aid Commemoration Committee of the Association of Commonwealth Universities.

APPENDIX I: PARTICIPATING INSTITUTIONS

Center for Regional Economic Issues (Susan Helper and Richard Shatten)

The Center for Regional Economic Issues (REI) was established by the Weatherhead School of Management in 1986. The Center provides a knowledge base that supports the understanding and revitalization of the regional economies. REI fosters partnerships between researchers and policymakers for the benefit of both academic institutions and the region. REI's primary focus is on regions because that is an important point of origination for long term economic prosperity. Historically, cities were the primary focus of much of American life and they were the ultimate anchors of national and international commerce. Over time the economies of cities have stretched well beyond their municipal lines spreading into adjacent counties and states. Now, regional progress is beyond the control of any single city. Good regional economic performance requires the cooperation of many diverse institutions, including governments and an array of civic and business coalitions and foundations. REI aims to provide a clearer understanding of trends and opportunities to build coalitions to enhance regional economic advantage. The Center comprises full time research staff as well as faculty associates. The Center's full time staff includes a director, associate director, research manager, programmer, grants administrator, and secretary. The Center supports faculty associates working on supply chain, regional innovation system, entrepreneurship, knowledge management, and organization of civic systems. Funding partners include Ameritech, the State of Ohio, U.S. Economic Development Administration, IMVP, NBER, Brookings, the Cleveland Advanced Manufacturing Program and other foundations and development groups and regional civic leadership organizations.

The University of Chicago (Gary Herrigel)

In addition to his own research expertise in the area, Herrigel brings two institutional resources to the consortium. First, he can supply a group of graduate students at the University of Chicago interested in doing in-depth research on the problem of supply chains and industrial adjustment in the US and other advanced industrial states. Currently, two students are writing comparative dissertations on various aspects of this problem, while several others are developing relevant projects at the masters and dissertation proposal levels. Second, Herrigel has very close ties with the SOFI Institute in Göttingen Germany. He has already received a grant from the TransCoop Foundation in support of a collaborative project with Volker Wittke of SOFI to analyze the changing character of manufacturing supplier relations and their impact on industrial regions in Germany and the United States. The SOFI institute is a valuable resource for the Consortium's project. It has a number of staff researchers who are working on dissertations of direct relevance to the concerns of the Advanced Manufacturing Project consortium. Indeed, they have extensive contacts in the US Midwest, in particular with Motorola and with many German owned OEM's and component suppliers active in the US, such as Daimler Chrysler, Robert Bosch, and Thyssen Budd.

Michigan Manufacturing Technology Center (Daniel Luria)

The Michigan Manufacturing Technology Center (MMTC) is a not-for-profit consulting and training company headquartered in Ann Arbor, and with regional affiliates in Grand Rapids, Traverse City, Saginaw, and Marquette. Affiliated with the Manufacturing Extension Partnership program of the National Institute of Standards and Technology, the MMTC assesses and consults with Michigan manufacturers with fewer than 500 employees. Its staff has a particular focus on suppliers to the automotive and office furniture industries. Services include ISO/QS/TE compliance training, lean manufacturing, activity-based costing, and environmental management. With a statewide staff of 100, the MMTC is the largest not-for-profit manufacturing consultancy in the state.

Center on Wisconsin Strategy (Joel Rogers and Jonathan Zeitlin)

The Center on Wisconsin Strategy (COWS) is a research and policy institute, and demonstration project incubator, dedicated to promoting high-road economic development. In its joining of academic expertise with practical social experiment, it has often been described as “the Wisconsin Idea in action.” And as with previous incarnations of that idea, one of its aims is to model policy change in Wisconsin, evaluate it, and then export what works nationally. Its work has been decisive in reshaping the AFL-CIO’s strategy on pensions, economic development, training, and a host of other matters, and is now getting institutionalized in the Department of Labor’s embrace of sectoral strategies of labor market administration of the sort that COWS modeled first in Milwaukee. COWS has an annual budget of about \$1M, supplied from the University, national and area foundations, government grants, and fees for technical services. COWS employs some 20 people, including senior researchers and graduate students, and enjoys substantial additional in-kind contributions from affiliated faculty at the UW-Madison. Its program is also tightly coordinated with the Economic Sociology Program at UW, one of the largest such PhD programs in the country. Along with its research expertise and capacity, COWS brings to the consortium a wealth of experience working with area manufacturers and other stakeholders in high-performance manufacturing — including labor unions, community groups, and government officials.