An Anatomy of Change and Transition: The Automobile Industry of Southeast Michigan

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ABSTRACT. At one time Southeastern Michigan was characterized by a rapid decline in manufacturing jobs and was labeled a typical rust-belt region over-dependent upon one sector of industrial production. By the end of this century in almost twenty years the region has become a center of high-tech activity, an area of increasing employment in manufacturing, and an example of a revitalized and restructured industry. The root of this transformation is found in the way the industry was restructured in order to confront its problems and, among other things, in the way it increasingly relied on a more flexible structure of engineering and production led in part by smaller and independent businesses. But this transformation has also meant a significant change in the kinds of work performed and the skill sets needed, and the need to revise how workers are to receive education and training to ensure a workforce able to address the workplace of the future.

1. Introduction

It was fashionable to describe Southeast Michigan[2] as a decaying rust belt Midwest region rapidly being eclipsed in economic significance by the new Sunbelt cities of the West and South. The intensification of international competition particularly by the Japanese automakers; the introduction of new computer based technologies; the emergence of new financial incentives for firms to relocate; the fear of unions, and other factors were cited as reasons for the economic decline of the region. Indeed, in 1982, when there were over 250,000 Michigan autoworkers on lay-off, it was fashionable to believe that the Midwest didn't matter as a significant part of the America's growing "new" economy.

Less than two decades later there is an entirely different picture. New automobile investment has recentralized in the Midwest and in Michigan (Table I). Data on new assembly plants indicated a net gain in assembly plants in the Midwest and the South. Many of them are in Michigan. In Southeast Michigan communities within Macomb County, actual jobs in manufacturing have almost doubled since 1982 and are now higher than in 1979 when domestic auto sales were at their highest level. Moreover, entire new areas of technical activity in auto body design and tool fixture design have emerged in Southeast Michigan that now employ thousands of people in well-paying work, most of it performed in offices as opposed to plants.

The structure of the automobile industry was exemplified by large, vertically integrated operations that were, in many cases, virtually self-contained production facilities from the processing of raw materials to the production of a completed product. When it was necessary to get parts or supplies from others, the industry developed a fairly large and entrenched system of suppliers to serve their needs. As we will show below, this system of a few major players became replaced by more flexible large firms and many more responsive and innovative smaller firms enabling the industry to react more effectively to market forces.

What has happened? Why has the auto industry rebounded in the United States in essentially the same region that was written off twenty years ago?

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TABLE I
Location of auto industry distribution of auto assembly plants over time by region

	Status of Plant			
	Open in 1979	Closed 1979–1999	Opened 1979–1999	Open in 1999
Midwest	27	9	14	32
Southeast	6	1	8	13
West	14	8	4	10
Northeast	9	4	9	5
Total	56	22	26	60
I-65/I75 corridor	27	8	18	37
Other	29	14	8	23

Source: Chicago Federal Reserve Boar, 1999.

What factors negated this process of decline? Perhaps more importantly, does regional clustering, in the age of informational technology and the Internet, still matter?

This paper will argue that the "reconstituted" auto industry within Southeast Michigan is very different from a generation ago. There is greater reliance on highly technical skilled work on the one hand, and administrative and coordination work on the other. The shift has been away from manufacturing centers that provide goods and towards administrative and technical centers of work that design, build prototypes, make dies, fixtures and machine tools, and assemble automobiles – which make Southeast Michigan the hub of a global industry. Regional activities and clustering still matter, but they are now in an international context. Finally, our paper will discuss how the changes within the region have particular impact on one vital institution within the region: the educational and training infrastructure.

The paper is divided into three sections. The first section is a historical discussion of the industry's evolution within the region. In the second section we offer some recent occupational data as well as some survey data of automobile executives that supports our arguments. Finally, in the third section, we discuss the implications of these regional changes for education and training institutions.

2. The auto industry in the age of mass production

The United States automobile industry is the largest industry in the American economy. After application of assembly techniques mastered by Henry Ford and other auto pioneers, the industry concentrated in Southeast Michigan. From the outset, the auto industry developed not in the City of Detroit and migrated outward, but always as an industry across the region. Auto manufacturer Ransom Olds, developer of the first assembly line (which was later adopted by Henry Ford) started his work at the REO plant in Lansing. William Durant, founder of General Motors, was a businessperson from Flint. Thus, from inception, the auto industry always developed regionally in Southeast Michigan's industrial towns and cities. (For a discussion of early auto history see Zunz, 1978; Babson, 1994.)

The early automobile industry established the paradigm for the mass production period of the early 20th century. These original plants were established near a body of water (for steam power and shipping of raw materials) or railroad lines. They were often clustered together so that parts could be transferred quickly from one plant to another. The traditional economic argument of realizing economies of scale in the auto industry prevailed, and firms realized cost savings through clustering of all processes within a single area.

The standard for efficient auto production was the Dearborn Rouge plant facility built by Henry

Ford from 1917–1920. This was a vertically integrated facility that produced steel, glass, and other raw materials; then performed all the stamping, forging and other fabrication operations; and, finally, assembled the vehicle. This "industrial city" at its height employed over 110,000 workers and performed 70% of all industrial operations for the company. While General Motors (GM) complexes in Flint, Pontiac, Lansing, and Detroit did not rival the size of Ford's Rouge operations, they were also self-contained units which performed the many diverse operations of auto production (engine production, metal stamping and auto assembly) at the same complex.

Not all auto production was performed by the large automakers-normally referred to as the original equipment manufactures (OEM's). Often, new technical innovations for the automobile, such as the universal joint (the gear that transmits power from the engine to the wheels) were patented and supplied by large auto suppliers such as Henry Dana from Toledo. Sometimes skilled items such as die making, heat treating and machine tool production were performed in smaller shops and supplied to the OEM's. Most of these activities grew up in close geographical proximity to the auto produces and there were very tight supplier/OEM relationships from the beginning of the industry. However, the conventional wisdom governing the auto industry "economies of scale" which means bigger is better and more efficient. Even the spread of unionization in the 1930s did not change the strategy of the automakers to build large facilities, which often dominated the communities in which they were located.

In the 1930s there were attempts made by General Motors and Ford Motor to decentralize their domestic assembly operations closer to their markets. Both automakers opened plants in Kansas City, St. Louis, Atlanta, and Los Angles. They continued to produce parts in Southeast Michigan and use railroad transportation to ship them to assembly plants. Thus, transportation costs of the finished products to their final markets would be lower, but the technical design and part making capacity remained centralized in Southeastern Michigan.

After World War II, the impact of three important new construction and technical innovations began to alter location decisions for the auto plants. First, development of the Federal Interstate highway system permitting trucks delivery of parts and products. This meant auto plant need not be located near railroad lines. This development encouraged more decentralization of facilities and development of more auto suppliers to the OEMs as long as they could bring their parts to the plant loading docks. Truck delivery and highway development also inspired the second major change – the evolution of auto production from multi-storied facilities in urban centers to sprawling one-story plants located in suburban and rural areas.

In the pre-World War II period, to utilize efficiently the limited land next to railroad crossings, most auto facilities were constructed as multiple storied buildings that "built the car" from the top floor downward. Once freed from being close to railroad lines, the newer facilities were much larger, with all equipment and parts on one floor. The prototype was the construction of the Warren Tank Plant in 1942. This enormous one story plant was designed by the famous Detroit industrial architect Albert Kahn and became the model for mass production facilities in the world. The one story building gave the OEM's greater flexibility as assembly lines could be modified and altered with greater ease and plant expansions could be done undertaken at more speed and less cost.

They also encouraged development of plants not in self-contained complexes but in individual sites. This began the decentralization of auto production facilities. Most importantly, the large amounts of land required were unlikely to be found inside cities. Thus, development of new facilities encouraged large amounts of suburban economic development. The standard process was to build the plant in a "semi-rural area" and then construct housing for workers around the facility. This development encouraged the growth of suburban areas in Macomb, Oakland, and Western Wayne Counties as the first older auto facilities in Detroit were closed and re-opened in the suburbs. It is important to understand that this phenomenon of industrial regionalization was initiated even before the mass construction of housing subdivisions that characterized the sub-urbanization of the 1950s.

The third innovation was the growing use of machinery to replace human labor in the produc-

tion process. These machines in the auto industry were often called "transfer line equipment." They moved metal from one process to another and often controlled the actual machining of the parts themselves. These machines were able to link stamping operations with one another, machine the engine and transmission parts, and transport parts in the forging and foundry processes. All these activities served to eliminate thousands of jobs in the industry. It also resulted in the development of large numbers of smaller machine tool and design firms that specialized in making this equipment. For the first time in the auto industry, the automation of many processes was eliminating the jobs of the production workers. As the reliance on large integrated facilities waned smaller scale businesses began to take a more important role in providing the knowledge and innovation within automobile production. This trend would be one of the foundations of the restructuring to come.

3. Human capital needs

The technology and work organization changes in the industry, however, did not alter skill requirements of front line production workers very much. Through the late 1970s the firms maintained traditional assessment and selection processes to hire production workers. In essence, they were looking for the ideal model established by Frederick Taylor fifty years ago: poorly educated individuals who were willing to follow orders and leave their brains at the plant gate entrance. The majority of automobile workers were unskilled or semi-skilled – which meant they were trained on the job to perform certain operations. About 10% of the hourly workforce received a more systematic education and training through the skilled trades agreements adopted in the union-management-initiated system.

Engineers and other white-collar workers were expected to provide the technological expertise necessary for the industry. These individuals were increasingly expected to have college backgrounds. However, many were still recruited from supplier firms because they "knew the industry" i.e. had concrete experiences with auto production. Many were attracted to the car industry because of the leading edge of mechanical engineering – these were the "car guys" who lived for the development of new models and concepts as part of American culture. As the industry developed in size and sophistication, however, there developed engineering programs at universities and colleges, which prepared individuals for technical careers in the automobile industry. Professional organizations such as the Society for Automotive Engineers (SAE) and the Society for Mechanical Engineers (SME) developed into major organizations supporting the technical development within the industry, attracting thousands of members to their annual meetings held in Detroit. Through the 1990s the attraction of working in the automobile industry made it relatively easy to attract individuals to the professional ranks.

Attracting non-college-trained individuals to the automobile industry was rarely seen as a difficult task. Despite the physical difficulty of the work, and the erratic work schedules, the assumption was that high wages and fringe benefits of a union contract (medical benefits, pension, etc.) Would attract a sufficient number of people to work in the plant. Their education and training would then be conducted within the industry. Since the organization of work was very hierarchical, the idea of using local decisions or developing worker input into the system was rarely present. Collective bargaining agreements solidified this labor management system. Unlike the European model, these were all private agreements negotiated at the bargaining table between the company and the union in which the state or government played little role in the development of the system. These agreements were often the product of particular issues within the union to achieve some mobility for workers from production jobs into skilled trades.

Two striking exceptions to this pattern were the development of the Henry Ford Trade School within Ford Motor Company and of the General Motors Institute in Flint. The Ford Trade School was organized and run by the company to train skilled trades people and was aimed at young men, many who had not completed high school. However, unlike the traditional apprenticeship system, not only were technical subjects taught, but also the students learned all aspects of running a small manufacturing enterprise. When they left the school many formed their own companies[3] that

produced the dies and machine tools for use by the industry. Even though Ford closed the school in 1952, alumni are still found working in the auto industry.

GM operated the General Motors Institute to insure that its plant engineers assimilated direct manufacturing experience with the industrial practices of the firm while they mastered technical concepts. Students, many already GM employees, were accepted into a rigorous engineering program which required them to spend summers within a work experience at a GM facility. At the job, they would apply their theoretical knowledge to the actual process of manufacturing. The GM Institute was a forerunner of many cooperative education programs that are now in many community colleges and universities. In 1982, General Motors ended its formal relationship with GMI, and in 1998 it became Kettering University. But the practice of cooperative education continues at the institution.

In this initial period, clustering of the auto industry within Southeast Michigan realized traditional orders of efficiency and effectiveness of any large-scale mass production industry (Porter, 1998, pp. 197–288). The industry was established within a region that had considerable skills in metalforming and bending. In addition, the carriage-making skills provided the necessary complement to these mechanical skills. Thus, there were technical skills available that could be shared and developed within the industry. In addition, there was access to large numbers of unskilled workers who would be able to perform the mass production work under the classical work rules of Frederick Taylor. The population of the region continued to expand – providing the industry with large numbers of unskilled workers – first through migration from Europe, and after World War I, the exodus of Afro-Americans from Southern Black Belt areas. The clustering of the plants meant that layoffs from one factory could result in workers finding jobs in other plants very quickly. Rapid labor force as the result of the brutal conditions was considered part of the mass production enterprise.

Education and training of these hourly workers played little role in the early automobile industry as a competitive advantage issue. Most of the required training of the hourly workforce would be easily accomplished within the facilities. Even the education of apprentices and skilled trades workers was conducted inside the shops, in part because of a fear of unionization. The few technical and engineering employees in the auto industry tended to be self-taught individuals who entered the field from other professional fields. They learned their skills through trial and error of the industry. There were university-based engineers who tended to dominate all technical decision-making. The assumption of the engineers was they were the source of all technical knowledge in the industry. Because of the enormously quick growth of the industry into a major part of the American economy, there was relatively little priority given to education and training of the workforce, in comparison to other factors which might generate productivity and greater profits.

4. The restructuring of automobile industry (1979–present)

By 1979 the American automobile industry was comprised of almost one million jobs, 51% in the OEMs and 49% in supplier industries. The industry was at its domestic production high point. However, from 1979 through 1990 the American car industry was to undergo a profound crisis stimulated in large part by the market challenge posed by Japanese production methods. The story of this challenge has been developed in a large number of studies; thus, what is offered is only a quick summary of the most important changes and their impact on regionalization (Keller, 1989).

In the main, the success of the Japanese production techniques – often named lean production – eliminated waste and emphasized coordination and workflow as the principal competitive advantages for firms. While new computer technologies are important, the key of successful Japanese auto production is the ability to execute operations with great precision, fewer mistakes, and more efficiency than other auto firms. All workers add value to the process that is tightly controlled from design to final assembly by using teams of workers. There are three important parts to this approach, which were quickly adopted by the American automakers (Womack et al., 1990).

First was the development of supply chain systems within the firms and other companies. For

the most part, American firms were faced with a dramatic need to decentralize their parts-making operations and to develop new ties with suppliers. This meant that cost, which was the main variable used by the industry to determine its suppliers, might be less important than technical ability, quality, just-in-time delivery, and other variables. It was during this period that American companies began to develop supplier programs and systems to bring suppliers into a close working relationship with their production schedules. Some of the rewards of institutions like the Ford Trade School and the General Motors Institute manifest themselves during this period.

As the result, two important developments occurred. First, both as a response to the loss of market share (Japanese imported automobiles captured over 25% of the US market in passenger cars) and the movement toward lean production, the OEMs began significant downsizing and closing of their unproductive facilities. These tended to be older and to be in Southeast Michigan areas. By 1982, over 250,000 autoworkers in Michigan had lost their jobs. At Ford Motor Company, 1/3 of the hourly workforce experienced indefinite layoff sometime between 1979 and 1984. Many of these closed facilities were located in the urban centers or older suburban areas where a significant number of the workforce were Afro-American. The negotiated contracts provided high seniority workers with the ability to "bump" into regional labor pools. This often meant that to maintain working in the auto industry, workers, particularly GM workers, found themselves working in plants hundreds of miles away from their homes, forcing them to commute to work. The "gypsy auto worker phenomena" became an important issue within some facilities (Halberstam, 1986).

Downsizing of the traditional OEM's meant that non-union auto suppliers began to experience significant growth. Many of these were located in non-union southern and rural areas, near highways, so that their delivery of just-in-time parts was within 18–24 hours of the assembly plants. Some significant suppliers emerged, primarily non-union, to continue the parts operations. These firms often located within Southeast Michigan, but they did not pay the wages and benefits of the unionized industry. The trend to continually separate part making from assembly operations, and to pay different wages for these activities continues today, as both GM and Ford have spun off their parts-making operations into new separate companies (Delphi and Visteon, respectively).

The second major trend has been the development of computer-based technologies and work organization techniques within the American auto industry. In almost all plants, some form of work teams developed, local collective bargaining contracts changed, and there has been a renewed call for education and training. In the early 1980s, jointly funded education and training funds were established in all three major automobile companies. These funds were originally designed to aid displaced workers in finding other employment. However, as the auto industry recovered, they were used more often for educational and training programs in new vehicle launches and development of quality and team skills. They also brought training providers (usually locally owned and managed smaller firms) and educational institutions into the plants for the first time and encouraged development of the major belief in the significance of formal education past high school for all hourly workers within the auto industry.

The use of the computer-based technologies was also important in changing the balance of control and power within the plants. Much of the new machinery required a considerable amount of skilled labor to maintain and use – which neither management nor the rank-and-file understood. In a real sense, this elevated skilled workers within the plants to important positions because they were the only people who knew how to run the machinery. The significance of skilled trades workers in the OEM plants increased during the period. It also created a greater need for a variety of technical workers with programming skills who were able to organize and implement the technologies on the factory floor. Thus, even within the electrical skilled trades, computer-based skills became significant for future development. In many larger facilities, skilled trades were 15% of the remaining workforce.

Finally, the automakers recognized that the Japanese advantage was the ability to more quickly move from concept to actual assembly of new models, meeting market needs faster than

their American competitors. Again, this advantage was less a result of modern technology and more the outcome of organizational innovations in the design and engineering processes. To increase the speed at which they could bring products to market, American automakers implemented concurrent engineering strategies (where design and engineering functions are mixed together), simplification of internal parts, and quick plant startups. The product design and process design industries became significant new competitive edges for firms. There were billions of dollars of corporate investment into these processes creating thousands of technical jobs all located in an office environment. All these advances emphasized the significance of coordination and alignment of functions within the organizations. It also revealed enormous inefficiencies in the competing internal organizations – too many models and far too many parts. The goal was to produce cars that sell and control for market share, not try to expand beyond capabilities.

These three innovations have had major influence upon the regional development of Southeast Michigan as an automotive center. First, as the auto industry in Southeast Michigan closed plants, communities fought for any forms of new economic growth. Thus, in the 1980s, Michigan, and Detroit specifically, were able to win the development of three new assembly plants, but not without very painful political and economic struggles. Two of these new plants were located in city of Detroit, where the popular African-American mayor Coleman Young[4] fought back fierce attempts from community groups seeking to refuse to give tax abatements and other benefits to the companies in their attempt to save their community rather than have it be the site of a new GM plant (Wylie-Kellarman, 1987). Indeed, as the automotive industry contracted, state and local governments began to actively court any auto investment with tax abatements and a variety of other governmental incentives. For these units, regional economic development was land use, proximity to highways, and tax abatements – few human capital issues were considered in the process. Few economic development practitioners appreciated the huge human capital resources that were needed to develop this new industry.

The second important implication was the development of a "dual" auto industry. This new interest in subcontracting to non-union suppliers, coupled with the general devolution of manufacturing plants from the Midwest along the I-75 and I-69 interstate highway systems, resulted in a bifurcation of auto workers and firms. There was the unionized OEM segment that maintained control over the assembly operations and the vital engine and transmission development, yet all remaining parts making and design were often ceded to smaller, non-union firms. The rate of unionization in these supplier firms dropped from 60% in the late 1970s to less than 23% a decade later. The auto supplier industry was "reinventing" itself in new non-union branch plants in rural Midwest and Southern states (Katz, 2000).

While many of these firms were originally created to be non-union inexpensive makers of parts for the OEM, some began to grow their research and development capabilities so they could produce their own innovations and sell them to the OEM for adaptation within their products. In particular, the development of plastics and plastic component parts was spurred by these producers. The sophisticated technology of the computer controlled "seat industry" was developed through a few major suppliers and then sold to the auto industry. Innovation and development became part of the concerns of major suppliers, which fostered a decentralization of research and development into many of these supplier firms. The research and technical facilities for these companies dotted the landscape of Oakland and Washtenaw Counties in the Detroit Metropolitan area. Twenty-six of the top 30 independent supplier companies (all with sales exceeding $1 billion) constructed technical centers within the region. These centers regular interact with the technical centers of the OEMs and the technical workers from many of the job shops and machine tool builders. In the age of the Internet and advanced communications technology, clustering of these individual skills makes a difference (Luria and Rodgers, 1999, p. 84).

The decentralization of the industry and the investment made by the OEMs in supplier chain systems made clear that there were many new skills needed by the industry. These included management and coordination skills, which became critical to align the various functions of auto pro-

duction. Thus, there were major experiments with new organizations of work, not only on the level of plant teams. These included new partnerships, such as GM purchasing Electronic Data Systems in order to capitalize upon EDS' computer management skills. Perhaps the most important was the development by GM of an entire new car platform and organization structure – Saturn – inside the company. The Saturn Company became distinctive in its commitment to new organization and car development concepts and new dealer relations as well as new technology in the assembly and production of automobiles.

All these developments served to reconstitute the auto industry within Southeast Michigan as the technical and management hub for the organization. Many auto suppliers not only moved their research and development facilities into Southeast Michigan, they also placed their product design and machining tool building into the area to be close to the OEM purchasing departments. The supply chain could be international, but there needed to be significant talent in the management of the process and the coordination of that for the good of the companies. Thus, all three major automakers expanded their technology and administrative capacities at their headquarters. Moreover, as the computer-based technologies became more significant for the industry, these firms began to search more for electrical and computer engineering and information technology backgrounds far more than mechanical engineers, forcing changes in engineering programs and salary structures within the industry. Increasingly expertise was sought from the growing number of IT, design and engineering firms popping up throughout a corridor known as Automation Alley. Furthermore, these smaller firms provided the major producers with reduced labor costs, and they increasingly looked to temporary workers to fill their need for skilled employees in response to contracts from the larger producers (see Gottfried and Fasenfest, 2001 for a discussion of regional employment patterns and contingent labor).

All these changes influenced important shifts in the development of human capital strategies for hourly workforce. There was increasing recognition of the need for education and training in the auto industry as part of all efforts. The apprenticeship system continued to receive support, but there were more needs for education and greater sophistication in the selection processes used by the industry. One lesson from the Japanese that the Americans learned was the need to be far more selective before hiring individual workers. As a result, the OEMs that tended to emphasize workers who possess the necessary "soft skills" of teamwork and group dynamics instituted new practices. Technical background or mastery of industrial process was actually often considered a negative because that might mean the individual had learned bad practices at other jobs.

In any OEM auto facility doing hiring of hourly workers in the 1990s, standardized tests were supplemented by lengthy interview and screening processes which were inserted to "cream out" the best workers for the auto systems. Specific vendor products were sold to auto companies to select the workers. It was estimated that auto companies spent over $2000 per worker hired in the selection process in the mid-1990s. In the supplier plants, practices were less rigorous. Not only were auto suppliers unable to afford these expenses, but also, because they paid less than their OEM counterparts, it was virtually certain that their talented workers would gravitate to the better paying jobs with the OEM when hiring occurred. The result was a "hiring food chain" in which the talent from the suppliers was devoured by the OEM. The location clustering of the industry made this very likely in the Detroit area.

In large part, the clustering of the industry capacity continued to serve to turn educational and training issues "inward" to be resolved by the management and the union. The industry played virtually no role in the development of national skill standards, arguing that the auto industry required far more technical sophistication than what normally was considered in other systems. Moreover, in the "Big Three" (GM, Ford, Chrysler), virtually no educational practices were instituted in the hourly ranks without direct negotiations with the UAW, who made it clear that the imposition of any skill standards was for the future workforce and not for any present workers it represented.

Finally, the increasing need for more skilled hourly workers was occurring just when young people perceived the auto industry as not an attractive career option. Most young people were con-

vinced that a four-year college degree was a means of avoiding industrial work. While part of this is connected to the layoffs and disruptions of the industry in the 1979–1984 period, when thousands of autoworkers were unemployed, the inability to attract young people to industrial work is a common one in all industrial economies. Despite high wages and very important medical, retirement, and other benefits – not provided for in the United States by the government – young people were not interested in working in factories.

This left industrial work to the "non-college bound" – many young people whom barely completed high school and often-possessed marginal fundamental skills. These individuals were entering the workforce believing their skills, which were no different from their parents', were sufficient to get a job in the auto industry. However, they were often unsuited for the work and were rejected by the OEMs in their hiring. This quickly turned into an issue in many plants as many hourly workers found that their sons and daughters did not possess sufficient educational skills to pass entry-level tests for the apprenticeship programs. In many instances these young people were also unable to get production jobs in unionized sectors of the auto industry, further intensifying pressures for new approaches to education and training.

In the "new auto industry" education and training have emerged as important new variables to consider in maintaining comparable advantage. For the first time, the various sectors of the auto industry are utilizing their own resources to conduct large-scale training as well as develop programs that encourage greater worker participation in education and training programs. The consensus within the industry is the rising skills will be beneficial to productivity increases. In some instances there are experiments with empowering work teams, eliminating lower level management, and allowing some decision-making on the part of workers in the operations of the remaining unionized workforce in the auto industry. At the same time, there is continuous erosion of parts-making jobs from the unionized large OEM establishments to many lower wage-manufacturing establishments, many of whom are far removed from the Detroit metropolitan area.

Another significant development that will serve to promote Southeast Michigan regional development has been the recent trend of "globalization" of the industry. The recent purchase of Chrysler by Daimler-Benz has ushered in a new level of merger and worldwide alignment of automobile companies. Ford bought Volvo passenger car division. Saab now is 100% owned by General Motors. GM has also acquired a one-third interest in Fiat and is consolidating its investment in Korea. One result of these changes has been the considerable increase in European and Japanese offices and manufacturing investments within Southeast Michigan. While both General Motors and Ford have maintained overseas operations for 60 years, these new activities represent a qualitative leap in that the new organizational arrangements will create integrated new business organizations that will seek to coordinate design, development, and product marketing throughout the world. This form of close organization integration could not have been possible without e-mail, teleconferencing, the Internet, and other aspects of the information age. Indeed, the embedding of these technologies in the "new economy" has made it possible for the auto industry to recentralize its activities within the Southeast Michigan region and coordinate worldwide operations. The paradox now presented to Southeast Michigan communities is that in order to continue the local industry growth, it is necessary to develop a global perspective.

5. Empirical data on occupational change in Southeast Michigan auto region

Is this brief impressionistic portrait of the changes in the auto industry confirmed by an examination of the empirical data of the industry? In order to provide an answer, we have adopted a methodology developed by Carnevale and Rose (1998a) in their important examination of the shifts in the American workplace entitled *The New Office Economy*. By looking at the functional distribution of work within specific industries, they have concluded that the principal place of work for Americans has shifted from the factory to the office. Moreover, there has not been a proliferation of technical jobs, but rather a growing number of individuals involved with the planning, coor-

dination, and administration of work. There are considerably fewer individuals involved with direct production and far more with the coordination and administration of the process.

We have utilized their approach to an examination of occupational changes in the Southeast Michigan region. While Carnevale and Rose (1998b) use 15 separate categories in their national analysis (for the entire list see the Appendix), we were examining only one industry – auto – and so we decided to focus our efforts only on selected functional areas. We have taken annual occupational data from the Current Population Survey (CPS) and reclassified the data according to the approach taken by Carnevale and Rose. This data is from the Detroit CMSA, representing all the major counties in Southeast Michigan. We will concentrate our analysis only on the present decade – in which the automobile industry has enjoyed record years of sales and production.

In order to highlight these changes that are occurring in the last decade, we have employed a shift share analysis method. This approach takes the 1990 Census figures and projects them forward in order to give an anticipated functional distribution of work in 1998 based 1990 patterns. This is compared to the actual employment from the 1998-CPS data. Table II indicates the growth of selected functions within Southeast Michigan as well as the anticipated changes since 1990. Thus, while actual employment in high wage employment was 447,000, representing over a 69,000 increase in jobs, this was actually 12,600 jobs *less than anticipated from 1990 projections*. The areas that grew the most, both in terms of real numbers as well as anticipated gains, were in two major categories: F11 administrators and managers and F13 professional coordination and sales. In the case of administrators and managers, there was a 33% growth in this work group, one quarter higher than anticipated by the data. These aggregate data appear to confirm the Carnevale and Rose findings that the American economy is adding many more jobs concerned with coordination and administration functions.

The significance of these findings is that, especially since 1994, the United States auto industry enjoyed substantial increases in markets (over 15 million units sold per year). Thus, even during this major expansion of the industry, there was a relative shrinking of high wage industrial jobs. Moreover, the expansion of the industry was accompanied by growth in administrative and coordination functions, suggesting that production was moving elsewhere, but the administrative and technical hub remained in Southeast Michigan.

However, in order to examine this trend more closely, Table III presents the same data set, but only for the durable goods sector. Almost 90% of all durable goods operations in Southeast Michigan are related to the auto industry. There was an actual change of 71,000 in the growth of jobs in high wage manufacturing, and an increase of 28,406 in the growth of managers within the

TABLE II
Shift-share analysis of Southeast Michigan occupations (1990–1998)

		1998 Actual employment	Actual change	1990 Based estimated change	Net difference
F2	Direct labor high $ manufacturing	447,121	69,112	459,809	–12,688
F3	Direct labor low $ manufacturing	40,133	–3,457	53,023	–12,890
F4	Direct labor other industrial	188,678	42,067	178,337	10,341
F5	Personal services	262,910	47,236	262,345	565
F6	Retail & wholesale	373,918	59,215	382,804	–8,886
F7	Direct labor health care	186,707	9,608	215,423	–28,716
F10	TCU	27,882	6,267	26,292	1,590
F11	Managers	300,622	103,184	240,163	60,459
F13	Prof coord/sales act	204,054	78,471	152,759	51,295
F14	Support labor coord.	359,585	36,583	392,899	–33,314
	Other functions	468,853	60,591	496,609	–27,756

TABLE III
Automobile manufacturing jobs, Southeast Michigan actual change, 1990–1998

		Manufacturing: Durable:			
		Electrical and machinery	Transportation equipment	Other	Total
F2	Direct labor high $ manufac.	14,697	58,729	–2,189	71,237
F3	Direct labor low $ manufac.	0	0	2,677	2,677
F6	Retail and wholesale	–1,479	0	0	–1,479
F7	Direct labor health care	0	–2,700	0	–2,700
F11	Managers	4,645	19,522	4,239	28,406
F13	Prof. coord/sales act.	–4,903	–2,089	2,151	–4,841
F14	Support labor coord.	–16,099	2,331	3,552	–10,216
	Other functions	0	3,462	0	3,462

durable goods industry. It is significant that all other function categories are declining or experiencing little growth. This data suggests the auto work in Southeast Michigan is concentrated within two major functions – high wage, high skilled manufacturing work and administrative and managerial work. The significance of this growth is underscored in Tables IV and V, which indicate how modest growth had been projected in these categories. In contrast, the category of administrators and managers grew by 21,000 jobs with two-thirds of that employment growth unanticipated in 1990!

This suggests two significant trends that appear connected. First, as indicated above, the auto industry continues to expand in Southeast Michigan. However, many manufacturing and associated functions appear to be eliminated – as either these tasks are replaced through technology and/or they are subcontracted or decentralized to other locations out of the area. The relative disappearance of low wage manufacturing – historically associated with auto component parts making in the area – confirms this trend. What is left in terms of manufacturing is significant high wage manufacturing and, while the data is insufficient to specifically probe further, these remaining tasks tend to be technical and skilled work – the making of machines tools, fixtures, and the development of the manufacturing process rather than semi-skilled or production work.

Second, corresponding to this trend has been the absolute growth in the management occupations directly associated with the durable goods industries. This increase of management appears counterintuitive: how could there be more managers when the number of workers was actually declining? It also appears curious in light of the recent growth in productivity for the industry and general productivity advanced within the United States over the past nine years. However, the growth in the administrators and managers should be viewed as an increase in the number of individuals involved in the administration and coordination of the production process, not simply in the supervision of direct labor. Indeed, in the context of the auto industry, this would suggest that the decentralization of production processes and the development of modular sourcing through complex supply chains are formidable administrative challenges, which require human labor. Computers, telecommunications, and the use of the Internet facilitate the process, but there is a real increase in the number of people who perform this work within the industry.

Thus, there is the shift of the industry in Detroit into two important occupational groupings: the retention of the skilled manufacturing and technical work within the production process as exemplified by the retention of many high wage manufacturing jobs, and the growth of the coordination and administrative functions through the adding of managers and administrative support staff. This mixture is responsible for the growth in productivity of the industry.

The significance of the administrative coordination function within the auto industry is partially revealed in a survey of automotive executives con-

TABLE IV
Automobile manufacturing jobs, Southeast Michigan estimated change, 1990–1998

		Manufacturing: Durable:			
		Electrical and machinery	Transportation equipment	Other	Total
F2	Direct labor high $ manufac.	–2,121	58,695	3,769	60,343
F3	Direct labor low $ manufac.	0	0	3,912	3,912
F6	Retail and wholesale	–26	0	0	–26
F7	Direct labor health care	0	828	0	828
F11	Managers	–270	6,215	1,310	7,255
F13	Prof. coord/sales act.	–228	6,210	0	5,982
F14	Support labor coord.	–494	7,306	1,439	8,251
	Other Functions	0	0	0	0

TABLE V
Automobile manufacturing – Southeast Michigan net change, 1990–1998

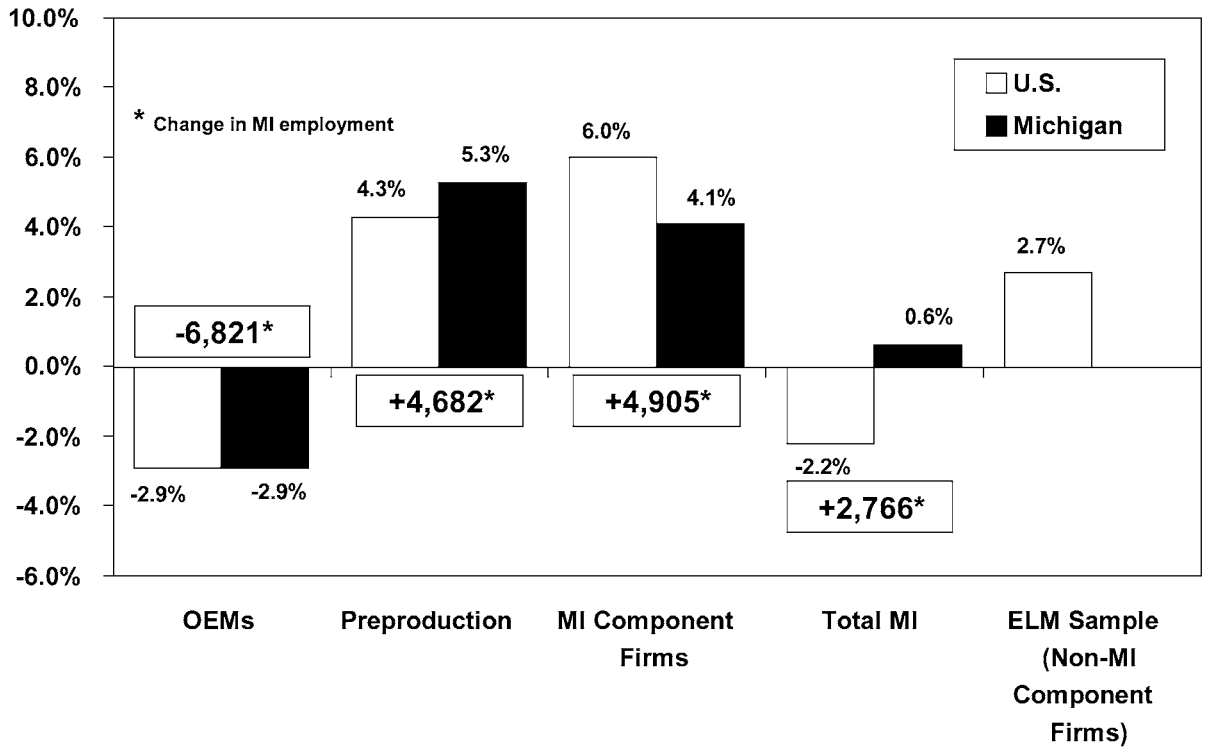
		Manufacturing: Durable:			
		Electrical and machinery	Transportation equipment	Other	Total
F2	Direct labor high $ manufac.	16,818	34	–5,958	10,894
F3	Direct labor low $ manufac.	0	0	–1,235	–1,235
F6	Retail and wholesale	–1,453	0	0	–1,453
F7	Direct labor health care	0	–3,528	0	–3,528
F11	Managers	4,915	13,307	2,929	21,151
F13	Prof. coord/sales act.	–4,675	–8,299	2,151	–10,823
F14	Support labor coord.	–15,605	–4,975	2,113	–18,467
	Other Functions	0	3,462	0	3,462

ducted in 1998 by the Office for the Study of Automotive Transportation at the University of Michigan (OSAT, 1998). This series of interviews attempted to discuss human resource practices and hiring patterns in the automobile industry in Michigan. While this is a survey which attempts to discuss auto industry behavior in all of Michigan, and is self-reported opinions and plans without confirmation, the evidence is useful in confirming whether auto executives are aware of the changes in occupational trends within their industry.

The auto executives were asked to project automobile employment growth for the next year. These responses were weighted by the size of their firms (Table VI). The two biggest increases are among salaried and engineers and technical persons. While the OEMs are projecting attrition of their workforce, pre-production and component firms are planning to increase their workforce over 5% in those two categories. This suggests the dual employment development of new technology and more administrators and managers. It also indicates that as suppliers are brought into an integrated manufacturing process, the demand for administrative and managerial skills increases at their levels.

The survey respondents were also asked to indicate any skill sets that were difficult to find or to retain (Table VII). Responses to these questions are sorted by whether they are OEM or Michigan supplier firms. Predictably, there were shortages of technical workers, both among skilled trades and computer programmers-product engineers-support technicians. These functions represent the skills necessary both for skilled technical production and administrative coordination. Note that demands for labor at all levels are greatest

TABLE VI
U.S. and Michigan employment change by industry group, 1998–1999 (employment weighted)



Source: OSAT – Automotive Policy Study, 1998.

among the supplier firms because in general their compensation packages are less than the OEM's. Indeed, what has developed is a human resource food chain where the OEMs recruit from the suppliers to fill their skill needs.

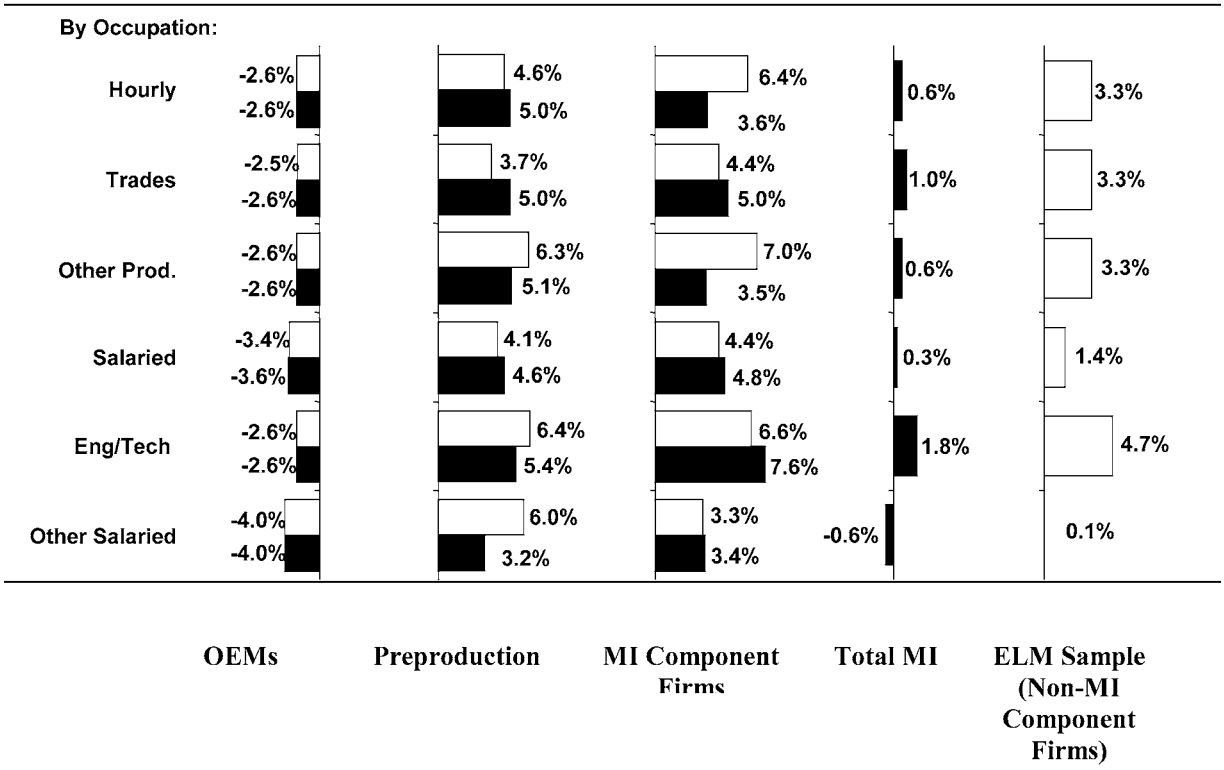
The survey respondents emphasize the need for specific technical competancies. This is not in contradiction to our argument. There is a strong demand for technical competency among white-collar workers of all types. This is precisely why we have argued the coordination and administrative function is more value added in the world of manufacturing today. Second, the specific skills in high demand tend to be those associated with information technology and other areas that underlie the implementation of management and administrative functions.

Finally, the respondents were asked to identify factors that contributed to these skill shortages in three important areas: product engineers, IT systems support technicians, and computer programmers/software specialists (Table VIII). The most cited barrier (Table IX) was the lack of recent graduates and the strong competition from other employers for the skills that were available. Thus, the educational system and the relative absence of enough graduates who have skills in these areas were identified as significant. This lack of suitable young people with these skills is a sign of some of the problems ahead for education and training policymakers.

6. Educational training in the new auto industry

The growing significance of education and training in the auto industry has meant major changes in their relationships with regional educational institutions. Where in the past, the auto industry assumed the high wages and benefits

TABLE VII
Percent change in U.S. and Michigan employment by occupation group within industry group, 1998–1999 (employment weighted)



Source: OSAT – Automotive Policy Study, 1998.

would attract suitable candidates to be trained internally by the companies, for the first time, the auto companies are beginning to play a proactive role with the school systems in attempting to communicate their needs for greater technical and foundation skills of their workers. Auto companies, in the past, involved themselves with local schools as public relations and community relations efforts within their local communities. Now, companies were recognizing that it was in their self-interest to create educational programs for schools and their employees that concentrated upon the development of skill sets for the next generation of autoworkers.

In 1995, one of the first public recognition of the new educational concerns for the auto industry came with the publication of *Driving America's Renaissance: Human Resource Issues In Michigan's Auto Industry*. Written by the University of Michigan's Office for the Study of Automotive Transportation (1996), this report reflected the opinions of executives from a state organized auto advisory group, the Michigan Automotive Partnership (MAP). The report predicted increased hiring of new workers within the industry and documented some of the new technical and skill needs. Moreover, the report indicated "an equivocal desire to upgrade the quality of labor employed in Michigan's automobile industry. According to the MAP, the incentive now clearly exists for the state's educational institutions to reconnect with Michigan manufacturing. The most critical determinant of our state's automotive future will be the near and long term performance of its largest public investment – education" (1996, p. 2).

What is significant about the report is the attention the industry devoted to human resource practices and tied then to educational policy. In the past, issues such as tax abatements, health and

TABLE VIII
Labor scarcity

Q. Many automotive firms have experienced difficulty in acquiring or retaining adequate human resources in recent years. Please rate your firm's current experience in the following U.S. and Michigan (if applicable) labor markets.

Where: 1 = amply supply/no scarcity, 3 = moderate scarcity, and 5 = severe shortage/scarcity

Labor market – Michigan	Mean rating	
	OEM	MI
General production labor	2.3	3.0
Skilled trades labor	3.0	3.8
General production supervisor	1.7	3.1
IT systems support technicians	3.7	3.3
Computer programmers/Software specialists	4.0	3.2
CAD technicians	2.7	3.2
Other specific technician labor	2.5	3.3
Product engineers	3.7	3.5
Business management	2.7	2.6
Clerical/Office	1.8	2.1

Number of responses = 93

Source: OSAT – Automotive Policy Study, 1998.

safety legislation, and employment law may have dominated their concerns – human capital was cited as most significant. Furthermore, the auto companies were interested in having the educational infrastructure play a role in the development of the trained workforce. This recognized the significance of the educational infrastructure as part of the solution to the needs of the auto industry (for a discussion of the significance of infrastructure in the development of the "new economy" see Bluestone, 2000).

Moreover, when asked what were their recommendations for change in the educational system, the automakers were fairly clear and consistent (Table X). They wanted a consistency of responses and these guaranteed through some form of validation process. They were also interested in the credentials of the instructors to insure that the quality of the personnel was present. They were very interested in awareness programs to promote the industry among grade and middle school students. Finally, they appeared to be more interested in providing work-based learning experiences for students than advocating "state of the art" technology for the schools. These suggestions indicated a coordinated response to the educational issues.

The response of American educational institutions to the concerns of the auto industry is not a simple matter. As many observers have noted, the American education system is very decentralized. In Southeast Michigan, there are more than 160 different school districts, 11 community colleges, and at least an equal number of public four-year institutions. There is also a network of important private for-profit training institutes and private universities and colleges. Any ties between these institutions have been voluntary; indeed, many tend to view education as a "non-system" of governmental and private activity. The result is a lack of coordinated effort to product skills that can be utilized by the industry.

However, in the most recent period, there has been some recognition by state authorities that a regional perspective must emerge for the response of the educational institutions to be viable. The state of Michigan has developed a set of decision-making entities entitled Workforce Development Boards. The majority of these boards are comprised of individuals from the local business community. Many of the occupational and career preparation activities of the state have now been channeled into their boards. In Southeast Michigan, the Workforce Development Boards have begun to meet regularly and prepare a regional strategic planning approach to understanding the new needs of the auto industry.

Another approach, which has united some of the federal government programs, has been the development of a new organization called the Design and Manufacturing Alliance (DMA). This group is explicitly organized to "support development of a regional, collaborative educational infrastructure in partnership with business for manufacturing and design skills in Southeast Michigan." The organization has begun to initiate curriculum changes and staff development across the school districts and community colleges within the region in order to align the activities within the educational institutions with the needs of the automobile industry. The approach has strong support from many in the automobile industry.

Finally, the industry has made an attempt to

TABLE IX
Why scarce?

Q: Round 1 results identified relative scarcity in the following labor markets: product engineers, information technology (IT) systems support technicians, and computer programmers/software specialists. If your company has experienced difficulty in acquiring or retaining adequate human resources in recent years for any of these labor markets, please rate the following possible causes of the labor scarcity. (Note: this question was asked in round 2.)

Where: 1 = not a factor, 3 = moderate factor, and 5 = a major factor

	Product engineers			IT systems support technicians			Computer programmers/ software specialists		
	OEM	MI	Non-MI	OEM	MI	Non-MI	OEM	MI	Non-MI
Inadequate supply due to lack of recent graduates	3.0	2.7	3.0	4.0	2.6	2.9	4.0	2.7	3.0
Inadequate supply due to poor quality of recent graduates	1.0	2.3	2.1	2.5	2.0	2.1	2.5	1.9	2.1
Labor scarcity due to strong competition from other automotive employers	3.0	4.0	3.6	3.5	3.6	3.6	3.5	3.6	3.4
Labor scarcity due to strong growth in industry sales	1.0	3.7	3.4	1.0	3.4	3.2	1.0	3.3	3.2
Labor scarcity due to inadequate industry wages and salaries	1.0	2.1	2.5	1.5	1.7	2.9	1.5	1.9	2.7
Labor scarcity due to high industry retirement attrition	1.0	2.0	1.9	1.0	1.6	1.7	1.0	1.5	2.0
Labor scarcity due to unpopularity of manufacturing employment	1.0	2.7	3.0	1.0	2.1	2.9	1.0	2.1	3.1
Labor scarcity due to unpopularity of technical employment	1.0	2.5	2.5	1.0	2.0	2.0	1.0	1.9	2.4

Source: OSAT – Automotive Policy Study, 1998.

develop specialized auto career academies that would produce students who were more prepared to participate in jobs with the industry. Currently, there are two institutions initiated by auto companies that are similar to this approach. Three years ago, Ford Motor Company has established the Ford Academy for Manufacturing Studies, a publicly chartered school open to all student in the region buy drawing most of its students from a variety of school districts in Wayne County. This year, DaimlerChrysler opened the Walter P. Chrysler Academy, which is operated through a consortium of school districts in Oakland County. These efforts are the first attempts at direct involvement by the auto industry in the educational process. The auto industry remains somewhat divided on this approach – because many firms believe entry level workers should have good foundation skills first, before any particular automotive specialization is advanced. In addition, there may be some concern that directing a school will raise the expectation of the parents and the students that they will be immediately hired into the industry.

All these approaches are immediately faced with four major barriers. First is curriculum. How much should foundation skills and technical skills be taught? Is the goal of the education process the creation of students with basic orientation toward the industry and provided with the learning tools so they can master activities at the workplace, or should there be technical training of students? Educators and firms are often unsure about the direction in this area urging that there be some foundation technical competancies, but assume these will be supplemented through workplace training after the individual is hired.

Second, what is the role of education for the auto industry and preparation for college? Over 90% of high school parents want their children to go to college. Any attempt to create a "vocational" school concept that might be perceived as limiting college attainment would not be supported by parents and/or students. This is very significant

TABLE X
Policy changes suggestions

A number of public policy actions have been proposed by state and local policymakers to improve general and technical education for manufacturing industries, such as the auto industry. Please rate your opinion of the potential effectiveness of the following policy changes.

Where 1 = is likely to be ineffective, 3 = neither effective nor ineffective, and 5 = potentially very effective

Policy changes	Mean rating		
	OEM	MI	Non-MI
National standards for curriculum and content	4.3	3.4	3.6
Competency testing for graduation	4.7	3.9	4.2
Improved technical training on state-of-the-art technology	4.3	4.2	4.2
Higher or required certification of instructors	4.7	3.9	4.0
Expansion of co-op, school-to-work programs with private employers	4.7	4.2	4.3
Closer communication with school administrators and school systems	4.3	3.7	3.9
Closer communication between employers and individual instructors or teachers	4.0	4.0	3.9
Higher standards of conduct for students (stressing employability skills)	3.7	4.4	4.2
Higher work experience requirements for engineering and technical graduation	3.7	4.0	3.9
Locally determined (not national) higher standards for curriculum and content	3.7	3.7	3.8
Grade school and middle school automotive industry or manufacturing-awareness programs	4.0	3.5	3.4
Specific automotive trade academies	4.0	3.8	3.3
Increased business content in school curriculums	4.0	3.6	3.7
Training in team skills	4.3	3.8	4.0
Closer communication between engineering faculty and actual manufacturing firms	4.3	4.2	4.2

Source: OSAT – Automotive Policy Study, 1998.

to the auto companies, which are interested in attracting capable students. The linkage of community colleges to their career academy efforts are important means of obtaining support for these activities, but the issue of obtaining a degree is an important one in the future.

Third is the issue of on-the-job learning. While most of the firms have rejected the "dual system" approach as practiced in Germany and other European countries, many are convinced that work-based learning is significant. Yet how to introduce young people to work becomes a major issue, from the perspective of both the students and the firms. Therefore, how to measure the learning experiences and validate it becomes an important issue in the future.

The fourth concern is the need to make all students aware of the educational needs in the automotive industry. As the industry changes its educational needs, not all school districts have the staff or equipment to make adjustments to these changes. This is particularly true with the poorer urban school districts in the region often serving urban Afro-American students. How do equity issues and the development of a regional approach actually serve to strengthen these areas? Not only are the schools decentralized, but also the funding for them is uneven and often there are wide disparities between school districts. Presumably the sharing of resources could rectify some of this; however, schools systems, which are products of specific geographical boundaries, have been reluctant to undertake this approach.

Finally, what is the role of the government in the development of this regional economic growth? Historically, with the exception of the defense industries, the United States government has played very little role in the development of programs or targeting resources for the development of specific industries. There is a real aversion to "picking winners," and a belief in the fundamental worthiness of competition to develop the regional concentrations. Yet, it is painfully clear that especially in the areas of education and training – which are public functions – there is a role for the public sector. What is that role, and

how is the training and education most useful for the companies and the citizens is an important issue that needs to be addressed in the future.

7. Conclusion

In February 2000, Ford Motor Company stunned both educational institutions and corporations when the company announced it would purchase a computer and printer for every one of its 320,000 employees.[5] This bold step underscored the significance of workplace change in the largest manufacturing industry in the United States. It also signified to Southeast Michigan that this is a different auto industry evolving in the region, one that would require not only different work skills, but also new educational and training delivery systems. Yet, a review of the past history and the data on occupational trends in the industry should have made this decision not so surprising. Jobs in this industry, and the skills required to hold those jobs, are increasingly characterized by greater high-tech skill requirements. While the computer and printer program reflects the Ford Motor Company's awareness that greater technological competence is critical in the workforce of tomorrow, it does not address the need for real training and preparation for work of tomorrow's young adults and the retraining of their existing workforce.

For over eighty years, Southeast Michigan has been dominated by the auto industry. Many local institutions have been shaped and developed by this industry. Yet, their views of the industry and its needs are often frozen in a past image. The reconstitution of the industry and its re-emergence within the past two decades has led to a misalignment between the human capital needs of the industry and the educational superstructure surrounding it. Much of the education establishment still regards the auto industry in Southeast Michigan as traditional metal bending processes, highly unstable, and not very intellectually challenging. Thus, relatively few resources are spent in education to aid parents or their children to choose an occupation in the automotive industry. It is only after attending college, and faced with the important new financial responsibilities of new families, that many turn to the auto industry for work. These views about the work performed, and the skills needed by those who perform the work, will have to change in the future if the industry will be able to attract the necessary talent. The issue of the absence of young people interested in manufacturing is a worldwide phenomenon and not at all restricted to Southeast Michigan.

Moreover, it is not simply that there is a misalignment. In the reconstituted auto industry, where both technical expertise and administrative and managerial competence are growing in significance, there is a far greater priority for education and training of the workforce. In a sense, if information and knowledge were of greater importance to the fate of the industry, it would be anticipated that there would be the establishment of knowledge supply chains (Hansen, 1998). Based on the experience of product supply chains, the auto industry is now faced with the need to construct these relationships with educational institutions. Where, in the past, regional efforts at retention of a significant industry turned to issues such as land use, location of railroad tracks, and environmental policies, the present regional issues become high school mathematics requirements, ability to engage in work-based learning, and the integration of academic and technical skills.

The transformation of auto is not restricted to the major manufacturers, but extends to a growing segment of small businesses involved in all aspects the industry: machine shops and design firms developing the latest techniques; engineering firms providing product and moment driven support for a particular project; training and evaluation firms seeking to improve the quality of the workforce inside and outside the plants; small to middle sized firms increasingly taking on the design, assembly and delivery of whole parts of the finished automobile. It is a transformation at all levels of production, training and investment.

Based on our findings, we suggest that the development of knowledge supply chains will become important regional consideration not only for Southeast Michigan, but also in many other regions around the world. There will be a need for policymakers, educators, community activists, trade unionists, and others to consider the impact of these relationships in their plans for regional development. Those of us in auto centers can learn from many other regions how these relationships can be implemented. In that way, we can provide

a better life for the citizens of our region, which should be the main goal of all our efforts.

Appendix

Functional classifications

F1: Extraction production in agriculture, mining, fishing, and lumber
F2: High-wage manufacturing (average production worker earnings higher than $25,000)
F3: Low-wage manufacturing
F4: Industrial production in public utilities, construction, and transportation
F5: Personal services
F6: Retail services
F7: Health care
F8: Education
F9: Police and firefighting
F10: Transportation and communication for personal consumption
F11: Administrators and Managers
F12: FIRE (finance, insurance and real estate)
F13: Business professionals
F14: Clerical and support labor
F15: Public administration and non-profit

Source: Carnevale and Rose, *Technical Report*, Educational Testing Services, 1998.

Notes

[1] An earlier version of this paper was presented at the Uddevalla Symposium 2000, 'Entrepreneurship, Firm Growth and Regional Development in the New Economic Geography', June 15–17, 2000

[2] The term Southeast Michigan refers to a relatively large geographical area of 10 counties in the southeast corner of the state. Over 5 million people reside in this area, of which about 20% are located in its major central city, Detroit. Geographically, the area is bounded on the north by the city of Flint, the west by Lansing and Jackson, Michigan, the south by Toledo, Ohio and the east by Windsor, Canada. While by European standards this is a large area, in the common United States travel measurement – commute time to work – it takes about 90–120 minutes to move from one end of this region to the other in a normal rush hour.

[3] These budding entrepreneurs formed the basis for small business development. In some cases employees of the major firms relied on their earlier training to begin businesses if they lost their corporate jobs, and in others a desire to remain business owners meant they continued to exist and became the seeds of the growth of small suppliers and R&D nodes throughout the region.

[4] After years of declining white population (many leaving after the period of violent social unrest at the end of the 1960s) Detroit elected its first African-American mayor. Many of the issues of poverty and disinvestments, as well as the pattern of new job creation, was couched in terms of a white region and a non-white inner city. The Poletown plant debate was no exception. By the 2000 Census Detroit is 86% African-American and the issue of regional development and race is at the forefront of current debates and programmatic responses.

[5] It should be noted that Ford has discontinued this program, and that there is a marked cooling over the high-tech aspect of employment. Recently an industry group reported that there was a net loss nationally of over 500,000 high-tech jobs as the dot.com bubble burst – though our analysis is not about the information processing end of high-tech employment but rather the increasingly high-tech component of traditional industrial jobs. As we show, this is a growing component of employment in manufacturing in general, and in this region's automotive sector in particular.

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