
Down the Line...

Supplier Upgrading, Evolving OEM-Supplier Relations,
and Directions for Future Manufacturing Modernization Policy and
Research in Wisconsin

A report prepared for the WMEP by

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December 2000

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Executive Summary

In 1998 six Wisconsin original equipment manufacturers (OEMs) — John Deere, Trane Corporation, Harley Davidson, Case Corporation, Mercury Marine, and Ariens Corporation — together with the Wisconsin Manufacturing Extension Partnership (WMEP) set up the Supplier Training Consortium (STC). The objective was to improve the performance of Wisconsin small and medium-sized enterprises (SMEs) through problem-oriented training, leading to gains for both the OEMs and their suppliers. This goal derives from the OEMs' pressing need to maximize the effectiveness of a vertically-disintegrated structure, with its advantage of flexibility and simultaneous difficulty of continuous cost and quality controls over suppliers. At the same time it addresses SMEs' needs for affordable quality training and development, thus aiming to increase productivity and enhance companies' strategic capacities in the long run.

In June of this year, the Center on Wisconsin Strategy (COWS) released *Common Problems and Collaborative Solutions*, a study of the changing relations between original equipment manufacturers (OEMs) and their suppliers, with special focus on participants in the Supplier Training Program (STP) activities of the Wisconsin Manufacturing Extension Program (WMEP), as led by the OEM principals of the Supplier Training Consortium (STC). Based largely on interviews conducted a year or more before its publication, the report provided strong preliminary evidence of the ability of the STC to stimulate mutually rewarding collaborative relationships between OEMs and suppliers.

Following the publication of *Common Problems*, the WMEP requested that COWS conduct a follow-up report, focused on STP/STC's performance effects on participating suppliers, the evolving structure of relationships between and among OEMs and first and second tier suppliers, and the endurance and evolution of collaborative OEM-supplier relations. Our central findings are:

- ◆ Even more clearly than in *Common Problems*, the follow-on interviews make clear that the STC program has measurable positive impacts on suppliers on such important manufacturing metrics as, *inter alia*, cycle time, productivity, and on-time delivery. The stories of suppliers restructuring, upgrading, or otherwise refining their operations clearly show that the WMEP STC has created a program that is a useful external training arm for suppliers' managerial and production staffs alike. In some cases, the provision — by OEM customers or the WMEP itself — of needs assessment and other strategic tools was crucial in pushing suppliers to recognize the possibilities embodied in modern manufacturing practices.
- ◆ Of importance to determining the mode and targeting of modernization services, the Wisconsin supply base seems to be organized neither as a “web” in which all suppliers have equal access to OEMs nor as an orderly hierarchy everywhere “tiering” first and second tier suppliers. Rather, although the structure of our sample limits us to provisional statement, we encounter a complex mix of relationships — a “structured web with tiered portions.” In the latter, however, it seems clear that the provision of training, OEM expertise and resources to second tier suppliers would improve delivery and quality to the first tier suppliers, ultimately helping the OEMs themselves.
- ◆ Finally, while the WMEP STC has been able to improve supplier performance, in the long run supplier performance depends more fundamentally on convergent and consistent OEM practices, including a willingness to share the gains of improvement in the base.

Three recommendations follow from these findings:

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- ◆ The WMEP and OEMs should take seriously their stated goal of assisting suppliers in “training selection based on an assessment of needs.” Making training affordable is an important first step in modernizing the supply base, but suppliers must also know *why* their customers want them to train, *what* training to use, and *how* to make that training pay off.
- ◆ The consortium should explicitly encourage greater cross-supplier interaction. For example, suppliers should be provided with the names of other suppliers who have used particular training programs, so that they can contact each other for candid assessments of the value of the training.
- ◆ Greater effort should be made to increase supplier input in the governance of the STC. This would pay off in two ways. First, it would provide consortium members with better information about areas in which the suppliers themselves believe that training would improve performance. Second and more importantly, supplier input could substantially improve the nomination process itself by allowing first tier suppliers to nominate second tier suppliers, improving in turn the performance of the entire supply chain.

Evident from our work to date, however, are also a number of questions in need of answer:

Tiering: Perhaps the most pressing need is to fill in or amend what is now a provocative but incomplete picture of the structure of relations in Wisconsin’s supply base.

Pathways to success: Given the difficulties experienced by suppliers attempting to upgrade, it would be extremely desirable to identify more clearly the pathways to success in supplier firms.

The decision to modernize: While we know some of the positive effects of modernization, we still do not know enough about what drives firms to make that decision, or to stick with it through adversity.

Workforce effects: Thus far we have focused on the STC’s effect on firm performance and inter-firm relations. At least as important as a matter of policy, and likely critical to program improvement, is the effect on workers themselves.

Other learning from experience: We are not alone here. There are similar collaborative and single firm efforts to train suppliers in other states and countries that could be systematically mined for ideas to improve the WMEP STC.

In conjunction with scholars from Ohio, Illinois and Michigan, COWS hopes soon to obtain national foundation support for the establishment of a research consortium on these and related issues. This Advanced Manufacturing Project (AMP) will investigate the determinants and possible policy supports of improved performance in component manufacturing, with a particular focus on the role of the base of small and medium sized suppliers, and the most effective targets and means of its modernization. The AMP research framework, and the leverage with other scholars and funding streams it offers, thus provides a natural venue for further WMEP support for research on these questions.

Introduction:

Common Problems and Collaborative Solutions Revisited

In June 2000, the Center on Wisconsin Strategy (COWS) released *Common Problems and Collaborative Solutions: OEM-Supplier Relationships and the Wisconsin Manufacturing Partnership's Supplier Training Consortium*, a report based on interviews with the six Wisconsin original equipment manufacturers (OEMs) who make up the Supplier Training Consortium (STC) — Ariens Corporation, Case-New Holland, Harley Davidson, John Deere, Mercury Marine and Trane Corporation — and several of their suppliers. The report provided strong evidence of the STC's ability to stimulate mutually rewarding collaborative relationships between OEMs and suppliers. However, it was necessarily limited in empirical descriptions of concrete performance improvements at suppliers because it was based on interviews conducted in the program's infancy, and also could not make substantive statements about the overall structure of the Wisconsin supply base.

Hence, upon request of the WMEP, COWS has recently re-interviewed many of the suppliers contacted for the June 2000 report to discuss their ongoing experience with the STC, as well as their relationships with their own suppliers.¹ In this report, we present this new data to show that suppliers have successfully coupled the Supplier Training Program² (STP) with other OEM aid and internal resources to improve performance measurably. We also discuss the tiering structure (or lack thereof) of the Wisconsin supply base, as a means to open discussion of the feasibility and utility of widening program access to include lower tier suppliers.

Collaborative Solutions and Common Problems richly detailed the inability of many suppliers to meet the changing demands of their OEM customers. It described the supply chain management strategies of the STC OEMs, showing that these large firms are seeking closer relationships with suppliers to get products to market more quickly. However, as they do this, they have not entirely jettisoned certain procurement practices that negatively affect long-term supplier performance and inhibit supplier improvement. Most importantly, it explained how the WMEP STC can potentially facilitate a significant upgrading of the Wisconsin supply base. To this end, the report proposed improvements in the STC's organization and policies, and recommended an ambitious future research agenda. This report begins to tackle two key elements of that research agenda — supplier tiering and concrete results of the training.

Because the WMEP STC is fundamentally structured and envisioned as a collaborative response to difficulties engendered by the shifting paradigm in OEM-supplier relationships, the discussion begins with a return to this underlying theme by describing new strategic possibilities that have been ceded to

¹ We re-interviewed 10 suppliers, including both firms interviewed specifically for the June 2000 report, as well as some who had been interviewed by Jeff Rickert of COWS for *Supplier Development at John Deere Horicon Works* (1999). This latter group was included because they are now participants in the STC training. Four suppliers were dropped from the sample, one for reasons revolving around discontinuities at the supplier, while the other three were dropped simply because we were unable to contact them (they did not return phone calls). Of these three, two were effectively non-users of the training, so it is rather unsurprising that they were resistant to giving up time to discuss a program from which they had drawn no benefit. The third has made some use of the training, but is only a minor participant.

² As a denotational shorthand, when referring to the courses themselves, we will say the "Supplier Training Program" or STP, while the "Supplier Training Consortium" will refer either to the OEMs who form its board or to the entire initiative. In short, the STC governs the STP with the help of the WMEP.

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suppliers by OEMs' focus on a narrowing range of activities, touching as well upon the difficulties experienced by many small firms as they try to seize these new opportunities. Sections 3 and 4 present and explain the observed performance effects and tiering, while section 5 emphasizes that OEM practices nevertheless remain, on the whole, an important but erratic element in the success or failure of supplier efforts to upgrade. Mirroring the structure of our previous report, we close with some recommendations for improvement based on what we now know, and suggest new research that could help the WMEP STC to further improve.

1. Shifting OEM-Supplier Relations in Context

Visions of a New Production Paradigm

It is becoming a commonplace that the organization of manufacturing firms in the U.S. and elsewhere is rapidly changing. Vertical integration is giving way to close long-term relationships with outside suppliers, as a hedge against volatile and fragmented markets that grant little cost leeway but demand ever more diversified products with ever shorter life cycles. Many OEMs have tried to slim down by focusing on core activities — often design, final assembly, and marketing — while outsourcing other operations. Corollary to this, strategic supply chain management becomes more central than ever before to corporate strategy. Efforts to quickly produce a wide variety of products have pushed OEMs that once held large stocks of inventory and work-in-progress to seek out suppliers able to consistently deliver high-quality parts just-in-time (JIT). Their devolution of day-to-day production also leaves them increasingly dependent on suppliers for help on process and design improvements, especially if they are to quickly turn new ideas into marketable products.

As they work to increase inter-firm cooperation, OEMs often give more business to fewer suppliers, and forge closer relationships with a core “strategic” group that they hope to align with their own goals. However, these key suppliers are *not* envisioned as satellites orbiting a dominant but benevolent patron, dependent and beholden. Rather, in a practice somewhat in tension with the desire to extract priority treatment when needed, OEMs are pushing these same suppliers to be *more* independent, telling them to work closely with other customers and other end-use industries. They share ideas, technology and fixed costs with these “partner” suppliers in ways they recognize may benefit competitors, but they hope that these smaller firms will learn from *other* customers, acquiring competencies that can turn the supply base into a *source* of new ideas and technology.

At their best, these changing practices present a vision of a highly flexible and reactive model of production. OEMs specialize in designing, assembling and marketing innovative products, while their nimble but restricted group of suppliers delivers high-quality parts on demand, and regularly suggests incremental design modifications to lower the final cost of products. The end result is a happy one: profits for all.

However, as was made clear in *Common Problems and Collaborative Solutions*, this attractive model is at present more vision than reality. Relative to their OEM customers, small suppliers are, on the average, less productive, less capital-intensive, and have a worse paid and less skilled workforce that is supported by less managerial and professional staff. Their often long product cycle times require them to meet customers’ just-in-time delivery requests by holding inventory, shifting costs that should be eliminated and damping the continuous quality improvement potential of make-to-order strategies. Exacerbating an already pessimistic scenario, processes pushed onto suppliers tend to be the simpler, less profitable, less capital-intensive tasks that can be done with a lower skilled workforce.

At first pass, this does not seem to bode well for OEMs. To draw on the flexibility of a decentralized production network, they require improved quality and delivery benchmarks from their suppliers, along with rising productivity and an ability to keep up technologically. And because JIT production for uncertain markets necessitates irregular delivery of parts on short notice, OEMs often cannot easily look elsewhere if the regional supply base is not up to the task.

From Vision to Reality?

At present, many small firms are not capable of reconfiguring their operations to meet the demands of a new reality, but those who *do* manage to partner with successful OEMs can focus on a core competency of their own, garnering the benefits of specialization by learning to “do one thing and do it well.” Rather than seeing JIT production as inventory shifting, such firms reduce cycle times in an effort to drive inventory, costs and work-in-progress out of the *entire* supply chain. They become the real experts in production, using this position to improve margins, revenue, or value-added by taking on complementary operations and focusing on process or design improvements in ways not possible before, when they simply built to specifications provided by engineering departments so unconcerned with inter-firm collaboration that they did not even tell suppliers the end use of components.

Thus, there are two underlying patterns of supplier response offered by the new realities. Suppliers can focus on reactive production, eliminating any operations or processes at which they are not competitive, and suppliers can make themselves relatively indispensable to their customers by providing more design and other services. Though conceptually separable, these strategies are often complementary.

The first, a tendency towards specialization, was evident in *all* suppliers interviewed who were not already quite specialized. So long as they quickly deliver quality at a competitive cost, they can expect more regular orders than in the past era, when they were regularly used as “capacity subcontractors” by customers shunting excess orders. Efforts to avoid being constantly buffeted by the cyclical fluctuations of capacity subcontracting sometimes led small firms to venture into areas in which they were less capable, including at times unprofitable proprietary products taken on to get “control of their destinies.” They simply tried to get business — any business, from any value chain, no matter how profitable — in the door to amortize the overhead. Now, in firms focused on a coherent set of core activities, revenue enhancement tends to depend on capturing slightly more of the *same* value chain, either by improving quality to move upmarket or by “verticalizing” — that is, by adding complementary upstream or downstream operations (without moving too much into the core competencies of either their customers or suppliers).

This pattern is well exemplified by an interviewed firm that had gotten into proprietary products in the early 1990s to supplement irregular orders from OEMs. But as the supplier built up this line of business, the OEMs were increasingly realizing that they were not necessarily competitive at all phases of the production process. Describing the Supplier Training Consortium as indicative of this fundamental change, the interviewee said that although his customers are better, perhaps, at designing and marketing products, his firm is good at production. Upon this realization, they sold the proprietary product line and restructured to build exclusively for OEMs. To replace the lost revenue, they are looking at ways to increase value-added by “verticalizing” some operations. For example, they have a contract to make parts and then do final assembly work for some large items designed and marketed by an OEM, and are also quoting some jobs in multiple ways (when customers give them sufficient information about a part’s eventual use), with and without supplementary steps to see if they are competitive on these additional steps.

Other suppliers present similar and reinforcing examples. One, who presently has a proprietary product line that was brought in many years ago to load-level a seasonal spike in their OEM contract work, recently “fired” about a third of the customer base in an effort to focus on a single core business. Even in their proprietary branded line, they are looking to keep only those steps that fall into their specialty, and hope to find a partner to do the assembly. Another told of quoting a job that, once landed, required him to buy new machines. When he won the quote, rather than buying used equipment from the customer, he elected to buy a high-end new machine that he has since used to expand the range of steps he does for other customers as well. Even a distributor interviewed has been raising the share of business

in his lone manufacturing operation — cutting products to length — in an effort to increase value-added to offset downward pressure on margins.

The rationale behind the intensive focus on a single business was clarified by a supplier who has been significantly shifting the composition of his end-user industries (and hence customers) by investing in capital equipment and focusing on a single type of part. They recently acquired a contract from a major OEM known for keeping work inside because “[the OEM] realized their internal costing was [bad]. They don’t use automated equipment, we use automated equipment” and can thus make the parts more cheaply. The OEMs do not always have more advanced capital goods and better productivity; suppliers can specialize.

Along with the efforts to improve core manufacturing activities through specialization, there was ample evidence among suppliers interviewed that some use their role as specialists producing particular components to provide more design and service. One small supplier that has steadily become increasingly engineering driven (from two engineers to six in just five years) comments that “the OEMs don’t have the [design] horsepower anymore, they don’t want to mess with it. They recognize that we are the experts at handling [our specialized operation].... They ask us to help with design and we do that,” adding that “in my short time (12 years) with this company, I have watched it go from OEMs going ‘no, no, no, don’t touch our drawings to OEMs saying ‘hey what’s the matter with my drawings’ or ‘give me suggestions.’ They have gotten to that point, now all they have to work on is making the changes.” Another told of a customer with which they were working that had let go so much of the engineering staff that they invited the supplier to come and work on-site, since the customer had so many empty offices. For suppliers doing more intensive or specialized design, it is quite rare for a customer to come to them with prints ready, because, one commented, much of the information required to complete those prints resides with suppliers’ engineers.

The importance of design and service to the niche being carved out by some of these suppliers is, on one level, obvious. If a supplier can make a customer dependent for design work, or convince them to use proprietary materials or processes, the customer is temporarily “locked in.” Likewise, through engineering and service, suppliers are able to improve margins or add more value. Nevertheless, they recognize that the ability to be a “partner” — including offering service and design — is often what it takes to get to the table in the current economy, and that the balance of power still sits with their larger customers. It was well put by one supplier who explained that while it was useful to get customers to use their patented materials, they could not really turn this significantly to their advantage in price negotiations because “a supplier who is trying to put forward his 2 to 3% every year is in big trouble. You will get shopped around. If you are not holding prices, you are a bad supplier” and you will be replaced. It is just a matter of time before the customer finds a way out.

If we look only at the positive strategic possibilities that have been opened up for capable suppliers by shifting OEM strategies, it may seem as though worries about suppliers’ ability to handle their new responsibilities are misplaced. Unfortunately, such qualms are well founded. There remain many OEMs who hew to traditional practices of supply management, focused largely on price and squeezing margins to unsustainable levels for short term gains. This undermines the efforts of others to upgrade the supply base. Restructuring to improve quality and delivery while reducing costs is not cheap. It is unrealistic to expect suppliers to take a long term view when many of their customers do not.

Even if all OEMs were to reform their practices and take a long view, there would remain another obvious and crucial problem. If it were *easy* to provide high-quality parts with low lead times and near perfect delivery, everyone would already be doing it, not merely *trying* to do it. Suppliers who have long engaged in low-technology, low-wage, low-skill batch production often do not have the managerial capabilities, the manufacturing engineers, the workforce, or the training wherewithal to upgrade their

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operations. To make the jump, many of them will require extensive help and intervention, be it from consultants, their customers, training providers, or a crystal ball. Many will not make it on their own. It is in this context that the WMEP STC and the goals of supplier training must be understood

2. The Wisconsin STC

STC Mission and Basic Program

The WMEP STC is a problem-centered program that primarily focuses on the concrete goal of improving supplier performance in lead and cycle time reduction, delivery, product quality, and cost. It also aims to generally improve supplier viability by enhancing supplier/OEM business relationships, increasing understanding of OEM performance expectations and helping suppliers to gain additional customers. Training is limited to firms nominated by at least one of the 6 governing OEMs. To be eligible, suppliers must be based in-state and employ fewer than 500 people (that is, be considered SMEs as defined by the National Institute of Standards and Technology). Furthermore, the OEMs are required to select firms they consider “strategic,” and with which they have at least a 24 month relationship that they intend to continue.

The consortium claims in its mission statement that it will establish a “curriculum of emphasis” based on a consolidation of the OEMs performance expectations, and will help suppliers to assess training needs. In practice, this has been a somewhat uneven process. Needs assessment and guidance have been somewhat sporadic, though important in some cases (discussed in the next subsection). The course offerings were originally selected by the OEMs to reflect their own supply chain management strategies, from a list provided by the Wisconsin Technical College System and the Deere training department. A subset of these were then agreed upon by the consortium as a whole. WMEP has since culled from the list courses that nobody takes, and added others upon OEM request (requiring that the OEM requesting an addition send someone to audit the course, to ensure that it be of value). Whether or not this process has resulted in a course selection that can truly be considered an integrated “curriculum” rather than a menu of related classes from which suppliers can select à la carte remains an open question (though the latter seems — tentatively — to be a better description).

WMEP schedules the courses in numerous areas around the state and contracts with instructors to teach the courses, using personnel from the technical colleges, the Deere training department, and other independent instructors. Courses are (somewhat frequently) cancelled when enrollment is too low, but suppliers are not limited to the scheduled times and can arrange instead with the WMEP to hold a (nominated) course on-site. To increase program uptake, on-site courses are offered for a flat rate, permitting the supplier to bring as many people as desired (and allowing them to divide costs with other nominated firms by sharing classes). Perhaps unsurprisingly, on-site courses have proved the more popular option. In the 1999 fiscal year (July 1999-June 2000), 36 classes were held “as scheduled,” while 106 took place on-site. Overall, 50 different companies sent 1586 students (1135 “unique” students) to 2244 8-hour training days, over \$250,000 in training at market rates, though suppliers are charged only about half the market rate. The remainder is subsidized by the \$500,000 grant from the state budget. Each supplier is allowed to receive up to \$20,000 in subsidies, while the sum total of suppliers nominated by a given OEM are not to exceed \$100,000. This latter constraint is somewhat loose, because many of the suppliers work with multiple STC members, allowing their nomination to be shifted around should the cap become a problem.

Attendance in 1999-2000 was lowered by some difficulties in implementing a shift in STC administrative governance (see below), which led to a poor showing at the program’s 1999 kickoff meeting and an ensuing slow start on program uptake. However, such kinks seem now to have worked themselves

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out, and the changeover can conditionally be deemed successful. No supplier interviewed for this report had noticed any drop-off in program performance as a result of WMEP's new role. Kickoff meetings at each of the participating OEMs in July 2000 were well attended, and recent partial data (that may underestimate program use) shows that attendance at program classes from July to September 2000 has been four times greater than in the same period in 1999 (the low attendance months immediately after the transition).

Recent Changes in Administration

In existence since 1998, the Supplier Training Consortium is a joint venture of six major Wisconsin OEMs — Ariens Corporation, Case-New Holland, Harley Davidson, John Deere, Mercury Marine and Trane Corporation — and the Wisconsin Manufacturing Extension Partnership. It draws support from the state technical college system and has been substantially aided by a \$500,000 grant from the Wisconsin Department of Commerce, which has not yet been exhausted and thus recently extended to December 31, 2001, at which time the consortium may seek to become a line item in the state budget.

In some senses a continuation and widening of the antecedent John Deere Supplier Development Initiative (SDI), the consortium was founded when the other member firms were recruited by Paul Ericksen, a Deere manager then serving as president of WMEP's board of directors, and Mike Klonsinski, the executive director of WMEP. In the first year, Deere provided the program's administration and much of the training because of its experience with SDI, while the WMEP raised most of the funds and contributed from its own budget to facilitate the project's implementation. In July 1999, WMEP took over full management of the consortium, raising some fears among suppliers about continuity and causing concern at Deere corporate headquarters as well, given the potential loss of control of a program viewed as having effectively improved the performance of many Deere suppliers.

Despite such worries, the shift in administrative governance seems to have gone smoothly (according to the suppliers we interviewed). It also should bring a number of positive opportunities for all involved. The other OEM partners acquire a greater ability to choose the training curriculum but are also obligated to give real input. The WMEP's greater role puts them in a position to act as an "honest broker" to ensure that the costs and benefits are shared out fairly among the participants, and discourages opportunism by firms that often compete for the same customers and suppliers. All told, the administrative transition should reinforce the commitment of all to shared governance.

3. STC Effects on Supplier Performance

High rates of supplier participation are undoubtedly important and indicative of the training's utility, but the real goal of the WMEP STC is to deliver concrete performance results that help provide Wisconsin OEMs with a high-quality supply base. In our sample of 10 firms, 7 of whom have significantly used the program (and in some cases its Deere antecedent as well), the interviews make it quite clear that supplier training programs can be a significant part of supplier upgrading and improvement in such important manufacturing metrics as cycle time, productivity, and on-time delivery (among others).

In response to OEM focus on defining a core competency, their suppliers are also seeking to “do one thing and do it well,” but as they restructure and refocus, they cannot lose sight of basic manufacturing performance. Commenting on the diversity of his end-user industries in some regards, a supplier noted that “in terms of quality, cost and timing, they are *exactly* the same.... People are looking for 99.8% or so on time, 500 ppm or less defects and 5-7% cost reductions over the year.” The STP provides these small firms with a toolbox, an external training arm that can provide an economical source of on-going training for both managerial staff and production workers as they structure their operations to navigate new and choppy seas.

One company president made clear some of the difficulties inherent in program assessment in an economy in which there are hundreds, if not thousands, of other things occurring over the course of a year. The manager remarked that in trying to benchmark the classes, one wants to know how much was saved, but

my system is set up to manage the products, to cost the products we are building; it is not set up to come back after the fact and do any comparison. So I don't know how much we saved. I have this gut feeling that things are better. But all I can really point to is the bottom line. If we are doing the same level of business, we have improved the bottom line a quarter of a million dollars in the last year. And I will make the comment that 99% of that is WMEP. Because we have done process improvement, we have done lots of things in that time frame. But the motivation was the training from WMEP... At the end of the year, you're going to say 'you took these classes and we want to know how much money you saved'. I'm sorry....

Although polemical, this manager was pointing to the impossibility of perfectly separating out and quantifying the effects of *any* supplier training program — in the abstract language of statistical methodology, there are too many sources of variation — but pointing also to the ability of the suppliers themselves to recognize and understand how their companies have changed and to assess the impetus for those changes. The variegated nature of individual firms' restructuring processes makes necessary an interview-based research methodology, in which subjects are asked to explain their experience with the training program and the ways in which it may (or may not) have benefited their firms' performance.

To explain the myriad effects of the Supplier Training Program, we simply briefly tell the suppliers' stories as related in the interviews, with a particular eye to the key dimension of variation — the extent to which the decision to train (and perhaps restructure) is primarily a result of direct pushing or aid from an OEM, new knowledge gathered from the training, or was a result of an internal strategic decision in the supplier firm to which the STP then played a supplementary role. Complicating the picture, in any given firm, these three possibilities vary over time and are difficult to fully differentiate. For example, an OEM that proposes a specific supplier training initiative depends as well on the internal willingness of the supplier to support that initiative. Or the initial impetus to train can come from a gentle push by the OEMs to take a few classes, which in turn opens the eyes of the supplier to new possibilities. Suppliers who begin to restructure with the help of a customer generally do so with an eye to becoming

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“trained by the trainer” as it were, so that in the future (and the present) they are able to take on new projects as a result of internal initiatives for which the STP gives only external training support. Despite the fluidity of these boundaries, this dimension of variation remains of particular relevance, both because for some firms — particularly those involved in the antecedent Deere program — the direction and aid provided by the OEM was central to their improved performance, and because it is important to understand the determinants of supplier decisions to upgrade and the potential role of the WMEP in pushing that process.

Here, then, in evaluating particular participating firms, we array them in order of the (approximate) degree to which external actors (customers or the WMEP) played a fundamental *initial* role in a relatively major restructuring process. Again, it cannot be overemphasized that the suppliers themselves ultimately make the strategic decisions (and live with their consequences). It is not our intention to delegitimize their managerial capacities. Rather, we speak only to the useful role of external actors as “strategic catalysts.” But we will return to this issue once the stories have been told.

Company A

Company A had specialized in the “engineering side of the business” and “designing out of failure problems,” but was weak in the “normal manufacturing metrics” with poor on-time delivery, good to fair quality, high cycle time, and problematic productivity. Hence, in 1995, they were a likely candidate for the Deere supplier development program, and undertook a major project in which Deere assisted them with process mapping and assigned a manufacturing engineer for a considerable amount of time to help build a cell. That first cell is now considered a grand success, in which parts once processed in 2 weeks are now turned out in just 1.5 days with the lowest customer reject rate in the plant. In that cell’s first year, productivity improved 24%, and, aided by a team incentive plan, continued to improve another 7% over the next two years. Company A has since worked with Deere on another project involving process innovation and a second cell, which, in combination, have led to cost savings and another high productivity area. Because this project was jointly developed with Deere, the supplier gave them an exclusive on the new materials for a year, but now hope to reap benefits with other customers as well.

Beyond the obvious and easily measured gains from these specific projects — overall plant cycle time has been halved relative to the 1995 process mapping and WIP is dramatically reduced — the plant manager explained that they got more than just these immediate tangible gains from first the Deere program and now the WMEP STC. They have expanded their business considerably in the last few years, and have been raising wages (1993 starting wage of \$5.75 is \$8.50 now, veterans were around \$8 in 1993, but earn \$10-12 today) to be competitive in their labor market. Unable to expand their facility, they have used the reduced cycle time to free up space previously dedicated to work in progress. Customers no longer come in to do the extensive directing that they did five years ago, but Company A has learned to value and measure cycle time and throughput, is able to build cells on their own and uses the STP as an outside training provider to aid them in this process. The interviewee suggested that a value of the WMEP STC relative to the Deere program is that although suppliers do not necessarily get the intensive aid of the very talented Deere supplier development team, a supplier who is able to use the program to initiate successful changes is not required to share savings on any fixed formula (beyond meeting their cost targets); it becomes a tool they can use to their advantage, giving them greater incentive to upgrade.

Company B

Company B completely revamped their operations in 1996 when they were teetering on the verge of bankruptcy. They are presently a smaller but profitable firm, after having sent an enormous number of people to WMEP-sponsored training (roughly \$40-50K in labor hours, for a firm of less than 75 people). Much of this occurred in conjunction with WMEP before the consortium existed, but B has continued to

use the STP for some ongoing training. They use less outside training than in the past (in part) simply because they have already taken many of the courses, and have largely turned their operation around through capital investments, a move to a team concept and cells where appropriate.

Since their previous difficulties, the company has improved gross margins by about 50% (in spite of wages that rose 6% in the last year and will continue to rise at a similar rate, albeit from a relatively low base), has very low reject rates (so low they don't track them: "it doesn't fit value-added manufacturing principles to spend all your time worrying about this [stuff]"). Cycle time is down about 50% as well, something the company president argues was key to obtaining a new and very important account. A further (and important) side gain comes in the form of improved safety. After moving to teams and doing group stretching to mitigate repetitive stress injuries, they have gone from \$45,000 in workers compensation claims three years ago to \$12,000 last year, and a mere \$100 in the first 7 months of 2000!

Company C

When they were nominated, Company C talked to the OEM and asked them for training suggestions and ideas. They then sent a considerable number of people to, using a range of options. Production workers (especially people in whom the company was looking to invest, people they were looking to give raises to, etc. — wages are rising about 3% annually, so the company must get more value-added out of each employee) were sent to skill-based training offered on-site by the technical school (i.e. blue-print reading, geometric dimensioning and tolerancing). Supervisory and management staff also attended courses, looking at cycle-time reduction, set-up reduction and other things aimed at reducing non-value added activity.

In that first year, the company president and other "strategy-makers" attended courses as well, and "learned some things and [they] felt that [they] needed to make some structural changes in the nature of [the] company.... Things just started to click and we decided to change." They started asking "what is our asset utilization, [what is] the best way to improve it, what drives our cash flow" and decided to slough off a significant portion of sales for which they were providing only minimal value-added, acting largely as middle-men distributing the products of an overseas supplier. They realized that their core competency was just "making stuff," the inverse of the OEM shift. As a result, the company is refocusing, trying to become a "partner" to their OEM customers and improving processes. Notably, they have not lost a direct labor employee — much of the sales they lost were largely resold equipment — and they have acquired new contract work in their present "core" to replace the rest. Because of this shift, they have been using less training recently than they did early on (though that will change when the reorganization is complete), and in a certain sense, recent measurable improvements are perhaps more a result of the focus on process improvements than direct skill training. However, the company president stressed, these process improvements cannot be separated from Company C's early involvement with the WMEP STC.

Despite difficulties inevitably engendered in a major strategic redirection, operations are clearly improving. Inventory is dramatically reduced — by 70% — but cycle time is also improved, from about seven weeks three years ago to four weeks today. There are still some long lead time products, but only in cases where they depend on parts from the OEM to build items for which they do the do final assembly in addition to making some major parts. The customer reject rate has spiked up and down, but is now generally between .25% and .5%, where 3 years ago it ranged as high as 1.5-2%. The improved quality, the president said, is due to a combination of factors, including training, but the focus on process has undoubtedly been a factor, remarking that "three years ago, if you had asked me what our rejects were caused by, I would have said 'operator error'; but now, rejects are more caused by process problems." The company has been reducing job classifications, and has doubled — to 50% — the percentage of the workforce that is cross-trained.

Company D

They are a “full-service” machine shop that is trying to find their own “core competency,” looking to upskill and training more than in the past, both on their own and with the STP. These efforts, initially coming out of the original John Deere program but continuing after the advent of the consortium, have measurably improved performance for all their customers, not just those involved in the STC. Wages are rising (4% annually), as are customer demands for cost reduction, so improving manufacturing operations is necessary for their success and survival.

For them, things began with the Deere program, where, with some trepidation, they let Deere in the door to look at their operations, and with Deere help, established a demonstration cell that is considered a success. But like with other suppliers, the program was both more and less than just the establishment of a demonstration cell. Less, in the sense that while they have been active in Deere’s supplier development program and Deere does help them to decide their needs, their use of the program is a part of an overall strategic change in which they do not perceive themselves as mere passive recipients or beneficiaries of OEM largesse. Rather, the program fits in as a sort of external training support to an overall strategic change, where they have *chosen* to do more comprehensive training to mitigate safety and cycle time deficiencies.

Operations are a mix of batch and cell production — and they have no intention of getting rid of the batch production as it remains profitable and appropriate for some of their business — but they have now learned to initiate cells and are able to (and do) implement them alone (though Deere continues to track their performance and gives feedback, which they do find useful). They have seen measurable improvements over time in important performance metrics. All jobs were once quoted at 6-8 weeks lead time, but now average just 3 weeks, and much less in some cases. In their second cell, for example, cycle time dropped from 47 days to 3, and scrap rates in cells have been more than halved. Even in the batch area, working often with very old but still efficient (and paid for) equipment, they have managed to reduce cycle time by improving set-ups. Overall reject rates are below 700 ppm, work-in-progress is improved, and while they are holding more raw inventory than before, that is actually a cost-savings effort — they are buying steel in bulk to lower prices and do not hold it longer than three weeks. Their safety has improved considerably, so much so that a workers compensation insurance rating of 1.8 just 6 years ago has been reduced to 0.8. Perhaps most importantly, both profits and margins have improved.

Company E

Company E is yet another firm in the process of defining their own core competency in a world of shifting customer practices. In the past, they were highly vertically integrated, and found that they were designing around processes that they had in-house; this provided lots of value-added in a traditional accounting system, but also led to very long cycle times, especially since they were in batch manufacturing. They have since done a lot of process mapping, value analysis and the like, and are discovering internal operations that are not competitive and which should be farmed out to subcontractors. Like D, they were involved with the Deere supplier development program for some help in building a demonstration cell, one that by and large — with a few hiccups — is considered a success, enough so that they have gone on to implement other full and partial cells. These are dedicated to product families, but not necessarily to specific customers. Since then, they have assimilated many of the ideas learned from Deere and are presently undertaking a major project to reorganize their plant into a series of “focus factories” organized around complementary products, and will continue to use the STP as an external training arm.³ The interviewee commented that the message from the STC is “do this concept

³ In selecting courses, E first formulates a corporate initiative, such as a focus factory or a cell in X area, asks who has the past experience to support the change, and then asks who will join the project. The STP is then used to

because it will be good for you, and here is why, and we will help you if you need help. Here are a couple of classes we recommend and you take it from here,” a process Company E finds completely satisfactory.

The move to focus factories and cells has been significant. Presently, almost a third of sales are produced in cells, and the next focus factory of five cells will raise that to more than half. This has created considerable adjustment problems at the level of the workforce. Job classifications have been reduced, department lines have been blurred, and cross-training has become more important with the cells. Some workers were initially uncomfortable and resisted, though that has dissipated as they learned the new jobs. A more significant difficulty relates to the shift from piece rates to hourly, something that meant a raise for 70% of the workforce, but potential pay cuts (depending on the outcomes of a gainsharing program) for a few.

The transition has been by no means completely smooth (they actually believe that the difficulties experienced are largely a result of not going *far enough* with the new ideas, and are in the process of investing themselves more completely in the concept), but there are still measurable improvements. Inventory is an improving trend, though inventory turns are not quite where they would like them to be. In the first demonstration cell, there was an initial reduction in productivity, but they are now seeing some gains (measured relative to standard labor hours on the old system). In the cell areas, cycle time has ranged from a 35-40% reduction in the worst case, to a nine-fold reduction in the best. Training and improved set-ups have led to a higher utilization of machines in the cell areas (something they began to track as a part of the initiative), moving in some cases from 25-40% to 65-80%. Because they began to track the causes of machine downtime, they were able to isolate occurrences in which the cause was insufficient training of workers in areas relevant to their jobs (like not knowing how to set up a particular machine), and then moved to correct the observed deficiencies. They have gone from 20-25% of setups presented to QA being correct to a situation in which a majority are done entirely by production staff.

Company F

Company F has used the STP often, and has also seen measurable performance improvements, but stressed that it is far too simplistic to ascribe these changes to the program. Rather, firm management have used it as a tool as they move to change processes and (to some degree) demand greater skills from their workforce (they no longer use temps; when they stopped they noticed a significant increase in product quality). Like other managements in the sample, they have raised wages somewhat in recent years and experience constant pressure for cost reductions.

Management recently made some changes in the business philosophy related to team training and the implementation of cells. To get more information on how to make the new systems work, they sent a considerable number of people to an in-house course on cell manufacturing, as well as some to courses on continuous improvement. The plant manager was emphatic that the STP was not their only source of information, but it was helpful and allowed them to send a considerable number of people and supervisors, to help create “buy-in” to the program. To incent worker upskilling consistent with the new focus, they have begun a pay-for-skill program. They have also sent production people to courses, sending a portion of the staff to team training.

Although an effect whose causes cannot be fully disaggregated, where the STP is but a partial and enabling element to an overall strategic change, plant performance is improved. WIP is down about 10%

train other key players and personnel who will be involved. According to the interviewee, they would go to the same frequency and number of courses without the subsidy, but they would and could not send as many people. In short, the subsidy allows them to send enough people to get the internal critical mass necessary to build support for the strategic redirection.

14, *Down The Line...*

and inventory turns have improved. Cycle time has been halved — from eight weeks to four — efficiency (measured as machine up-time) has improved, and they have managed to lower prices on about 10% of their products (at times a cost reduction, at times cutting into margins).

Company G

Company G provides support for the fundamental underlying thesis of this report, that if correctly used, the STP can be an external training support to firms that are expanding or otherwise in transition. G is expanding (about 15% in the production workforce) and is having some trouble finding enough skilled employees, despite raising wages (an average of 4-4.5% annually) from an already relatively competitive average. They would like to have a more formal training program but are just too small. As a result, they use outside training vendors, and budget about \$2500/employee (much of which is lost production time) annually for training. The company president was very supportive of the WMEP STC, and also of OEM customers pushing them to train, which he said they did largely by emphasizing the extremely good value of the courses. He remarked that the focus on training had convinced him to bring in an instructor from the community college to provide a course geometric dimensioning and tolerancing to a substantial portion of the production workforce.

In recent years, the firm has increased output per employee by 7.5%, has near perfect delivery for their major customers (though they struggle for some of the smaller ones), and a defect rate of under 10 ppm. Lead times range from 1-6 weeks and can be as low as a few days if necessary, and productivity has been increasing. However, in the past few months, set-up times have become a bit of a problem, attributable to the transition and ensuing new employees. The firm is considering soon taking advantage of courses from the STP to help mitigate this problem. Training is a particularly crucial issue at the moment given their expansion.

Companies H, I, J

Three of the firms interviewed have used the training only minimally, but their experience is still somewhat instructive for the program. Two of them thought they were simply a bad fit for the program. One, a spring-maker, argued that while he had been nominated because his firm is an “excellent supplier,” processes in his industry are different enough from others that he is generally required to get his training from spring-making associations. He would perhaps have some use for subsidization of courses on math skills. Another is essentially a distributor, but did manage to utilize the program to save money on their ISO certification. The third, company H, provides a useful corrective to the notion that the WMEP STP is the only route to supplier improvements, but *not* to the notion that training and strategic refocusing are important for makers of industrial components. H has not used the STP much, but does use other training, commenting that “there is a lot of training out there.” They use other sources of seminars for lead people and engineers, and have managers capable of leading in-house classes for production workers. Notably, they have used the WMEP STC for some cell manufacturing courses.

Just a few years ago, H produced a mishmash of parts, whatever they were asked, and had a proprietary assembly business on the side. But now they are trying to get rid of all but their main focus, even trying to slough off aspects of the proprietary business that are a poor fit. The vice-president commented that “five years ago, it would take me an hour to tell you what we did here” but now he can do it in one sentence. Where before, they had 60 customers, they fired 15 recently, and are focusing on “doing one thing and doing it well,” investing heavily in new capital and becoming increasingly engineering-driven.

In the wake of all these changes, they have seen measurable performance improvements. The vice president ascribes the improvements largely to the careful measuring of performance associated with their

new “metrics nut” plant manager (“when you measure things, they improve”) and to the company’s strategic redirection. They have low reject rates, below .5% for most customers, have increased machine uptime to 74-80% (from the mid 60% range), and have improved on-time delivery to 80% from 60% (over 6 months). About half the production workforce is in cells, and a quarter are cross trained. The company’s next challenge, he said, is improving the workplace “culture,” through cells, reinvestment, training and raised wages: “we have to compete with the big guys. It used to be out of whack. We used to be one of those companies that would pay them seven to ten bucks an hour. We can’t do that anymore. No one walks in here at less than ten dollars an hour.... Over the last two years, we raised the base wages tremendously.... We were losing skilled people like crazy. It had to be done.”

Summing up the Effects of the WMEP STP

Drawing out the underlying pattern that connects these varied stories of suppliers restructuring, upgrading, or perhaps merely tweaking their operations, it is quite clear that the WMEP STC has created a program that is a useful external training arm for suppliers’ managerial and production staffs alike. It serves, *at a minimum*, as a complement to other initiatives, and helps suppliers to measurably improve performance.

Direct effects at the level of the workforce are difficult to measure, but the program undoubtedly has some impact there as well. Some interviewees asserted that in selecting workers to be trained, they looked to those in whom they intended to make long term investments and develop for promotion. It is perhaps too much to ascribe to the STP the observed rising wages of much of the production workforce at firms interviewed, but it is not unreasonable to note that a program aiding firms to upgrade their operations and providing workers with new skills can at least partially mitigate wage pressures by raising worker productivity, in effect permitting wage increases driven largely by other factors (i.e. a tight labor market) without threatening small firm competitiveness.

Although these OEM-led efforts aim primarily to improve supplier performance in ways *directly* beneficial to the initiating OEM, there can be positive indirect spillover effects. Suppliers acquire new capabilities that they can then use to their advantage with all customers, but this helps in turn the initiating OEM, who benefits from their suppliers’ larger customer base, greater stability and access to resources. A particularly salient example of a supplier taking ideas from a specific project and using them to improve general performance is discussed above in the brief profile of Company A. They hope to use a new process and material developed with one customer to (profitably) lower costs and improve quality for other customers, after having provided exclusivity to their initial partner for a period of time.

The issue that remains somewhat open, but of clear importance, is the extent to which it is essential that an external actor — either a customer or WMEP consulting services — must act as a “strategic catalyst,” pushing small firms to recognize the possibilities embodied in modern manufacturing practices. For company B, WMEP consultants and the threat of imminent bankruptcy pushed them headlong to restructure, while in the cases of firms A, D and E, their involvement with the Deere supplier development program and access to Deere’s talent was of considerable importance in the initial decision to undertake quite major (and successful) investments in cellular manufacturing. It is encouraging that all three of these firms believe they have been able to assimilate many of the underlying concepts taught by Deere. With the aid of the ongoing subsidized training, they will be able to undertake new operations themselves with the possibility of offering cost reductions to the OEMs but the hope of keeping a bit more to themselves as well. There are also stories of firms putting together apparently successful plans alone, using the classes to provide grist for their internal managerial mill after only a gentle nudge from customers to have a look at the program because it is such a good value. Here, there is again variation in the extent to which interviewees ascribe the key push to redirect operations as coming from the classes or

from management who in turn look to the classes for support. Company C views information from the courses as a seed that led to a relatively dramatic strategic change, while F and G have used the program to aid in operations they had already decided to undertake.

Pressure by external actors is certainly not necessary for the STP to be of use to suppliers, but the provision of needs assessment and other *strategy-making* resources can be a crucial factor in performance improvement, so long as OEMs are sufficiently respectful of supplier boundaries and are careful not to misuse sensitive information, such as costing data (an issue discussed extensively in our first report). As one supplier commented, “honesty” is becoming the process. “Years ago it wasn’t, and there is still a lot of [deceit] going on. But what we are finding is that when we run into these younger buyers, honesty is working a lot better.” The dangers of opening one’s company were colorfully described by another who said that “you can get your customers so far in your pants that they are running your company, and you have to be careful about those kinds of things.” The risks are well illustrated with an example from another company, who, after successfully allowing one customer to help them build a cell, allowed another to come in to “help” on another project but who came in and was extremely demanding. The interviewee pointed to a picture that he kept on his wall as a reminder of the experience. It showed a red-faced man holding a bull-horn, who was the customer representative who had run the project. He recounted with some rancor that although his company’s management had attempted to comply with the customer’s demands, they were met with considerable internal resistance because the project was perceived — correctly — as something being rammed down their throats, setting back their modernization attempts not inconsiderably.

Despite the need to speak conditionally and with caveats when trying to assess the *specific* contribution of the STP, its biggest impact again seems to result from generating greater complementarity between OEM and supplier strategies. As it was summed up by one supplier:

The idea that two of my major customers would form a consortium with other people to help train their supply base... I saw that as ‘we’re in a whole different world now.’ This is no longer ‘we do three quotes and send it to the lowest bidder and every year we go out and rebid it... and if things slow up at all, we cancel everybody’s orders and we make it in our own shop.’ That was the paradigm in 1990

but things are very changed today. So long as the OEMs are respectful of these firms’ need for autonomy and provide a market for those which gear their operations to be partners to their customers, they can reasonably expect that their efforts to help suppliers upgrade will be met with success.

4. The Evolving Structure of Supply Networks

The OEMs' increased outsourcing of production might be expected to lead to an organization of the supply chain in which certain "first tier" suppliers will become responsible for building modules and managing the rest of the supply chain themselves. If this occurs, it is of obvious relevance to the supplier training consortium. A significant and complex portion of the OEMs' final products — not just off-the-shelf standard components — would be made by suppliers with whom they have no direct contact. Efforts to drive out costs or reduce cycle time could become quite limited by the necessary mediation of all communication through first tier suppliers.

The 10 firms interviewed for this report were chosen primarily to get a good sense of the effects of the WMEP STC on firm performance. All had been previously interviewed by COWS, so the new interviews could be appended to the old ones to give a sense of change over time. This makes us relatively confident that the positive impacts described in the previous section are real. However, returning to this sample proved quite limiting in making any strong claims about the tiering structure of STC firms' supply bases. Fully investigating the tiering of the supply chain would require a targeted sample aimed specifically at the question, including several major first tier suppliers. Many of those interviewed for this report were, by their nature, simultaneously first tier and at the bottom of the supply chain. That is, while they were makers of engineered components, sometimes relatively complex, for the most part they "brought it in raw, and sent it out done" directly to their OEM customers. Their suppliers were either not the sort that might reasonably be called a "second" tier — large firms providing raw materials (i.e. steel) or standard components — or were very small local firms to which they sent parts for single operations that were neither a strong source of cost or cycle time problems nor likely potential beneficiaries of supplier training.

Nevertheless, because this is such an important issue, all firms interviewed were asked about their position in the supply chain and their own supply networks. They were also asked specifically if they thought it would be useful to permit them to nominate their own suppliers for subsidized WMEP training. Even given the limitations of the sample, we learned enough of interest to make some tentative statements about the organization of the Wisconsin supply base, albeit statements that should be verified through further research.

Tiers and Webs: Some Preliminary Observations

Based on the interviews, the Wisconsin supply base cannot be adequately described either with the image of a web structure in which all suppliers have roughly equal access to OEMs, or with an orderly vision of hierarchically organized first and second tier suppliers. Rather, supply chains seem to be a complex mix of relationships, perhaps best described — in an ungainly metaphor — as a "structured web with tiered portions." Besides firms of the sort mentioned above ("first-and-bottom" tier suppliers) we spoke with one firm clearly in a first tier relationship to its customers, a firm making parts and assemblies in a first tier role but also serving as a second tier supplier to a separate first tier supplier, and a firm combining the role of second tier supplier to first tier suppliers while also working as a "first-and-bottom" tier supplier. Finally, another "first-and-bottom" tier supplier suggested that the firms to whom they did outsource particular operations were generally working for OEMs as well, and thus already within the purview of the STC. From this complicated picture, all that seems certain is that excepting the one clear first tier supplier, relations between the OEMs and their supply base are *not* organized into formal hierarchies, and are also likely to be relatively fluid, in the sense that "first-and-bottom" tier suppliers,

depending on the parts they manufacture, might plausibly become or simultaneously be second tier suppliers.

Despite this apparent complexity, there are still lessons to be drawn regarding the possible extension of the STC nomination process to include input from first tier suppliers, drawing particularly on the experience of the clear first tier supplier interviewed. Interestingly, this firm finds itself in a situation quite akin to that of the OEMs. They are trying to establish their own niche, seeking to reduce cycle time and costs, and are outsourcing operations in which they are not competitive. In so doing, they, like their OEM customers, are shrinking their own supply base (hoping roughly to halve the number of suppliers) and tiering it somewhat. For example, regarding a part for which they had 13-14 suppliers doing custom work, they went to one supplier and asked him to organize production and delivery by making what he chose and subletting the rest. The cost savings have not been as great as hoped, as the sub-supplier has not yet realized some of the potential efficiencies, but the interviewee expected that things will come around.

This first tier supplier has even held two supplier conferences to explain their desire for more standardization and value from their suppliers. Told afterward that the message ultimately received was that cost matters, the interviewee commented that “we didn’t quite hit the mark” as that was by no means what they were trying to say. In fact, delivery is their number one problem with suppliers. It is spilling over, causing them trouble with their own delivery and cycle times and forcing them to hold extra inventory as a buffer. He remarked that the company must “do more work in making suppliers understand about cycle time reduction and response time,” adding that “you would be surprised when you get into the companies in the 10 million and less... how many say ‘you are just forcing your inventory reduction on us’.” That is not, he emphasized, what they are trying to do.

Given this, it should come as no surprise that this company would like very much to be able to extend the STP down the supply chain, and would have numerous suppliers they believe could gain. Likewise, the firm doing a combination of parts for OEMs, assemblies for OEMs and parts for other first tier suppliers has in one case brought work back in from a second tier supplier (who had previously been doing the same work for the OEM) because of quality concerns. They too are generally supportive of the idea of somehow allowing suppliers to give some input into the nomination process and would use the prospect of subsidized training as a means to maintain relations with good suppliers. Several others thought it perhaps a fine idea, but did not think they would have many candidates to nominate.

Some anecdotal evidence of the potential of extending the STC to include supplier nominees is offered by the interviewee at the major first tier supplier, who recounted a time that he brought one of his own suppliers to an OEM supplier day. This sub-supplier also worked for the OEM but was not among the 50-75 large shops invited, at a limit of two people per firm. The first tier supplier perhaps broke protocol, but it seems to have been to successful ends. The sub-supplier was impressed that his customer thought him important enough to bring along, and four years later, he still has the materials distributed at that conference, and more importantly, has developed from a problem supplier to both the first tier supplier and the OEM into one that both are presently rewarding with new business.

A story offered by a supplier working at the second tier hints at another strong argument for extending and somewhat formalizing OEM relationships down the supply chain, to help disentangle the lines of communication between second tier suppliers and the eventual OEM customer. A supplier described an incident in which they had a

[heck] of a time with [OEM] through a supplier. We send a product to [tier 1 supplier] and they send it on to [OEM]. To get cost improvements through, I have to go through [tier 1 supplier] who asks [OEM], but gets no response. Yet [OEM] is beating them up and they are beating me up. It is what I call a captive product, a difficult thing to make... so I raised the price and they [complained]... We had to play

hardball with them. It shouldn't be that way. It is a very simple thing, we should be able to get the change made. It was even a cost reduction for them! Why wouldn't they want that? But for [OEM] it was nothing. They don't want to mess with \$10,000 savings, let the supplier struggle with it. But it'll become a big problem when the supplier says they don't want to do it anymore.

Of course, this could simply have been an isolated occurrence. However, given the relatively haphazard structure of many supply chains coupled with the more general supplier claim (reported in the previous report, and discussed in the next section) that their OEM customers often do not present a single voice to their first tier suppliers, let alone those suppliers' suppliers, it is at least indicative of the limits of a supplier development strategy that focuses exclusively on first tier suppliers with an assumption that they can manage a second tier whose interaction with the OEM is always mediated.

Should Second Tier Suppliers be Included in Supply Chain Improvement Efforts?

Enough can be drawn from the above examples to suggest that there could be some real payoff to including second tier suppliers in supply chain improvement efforts. In cases like that of the first tier supplier stratifying their own supply base, the interviewee stated quite explicitly that they had been hampered in modernizing their own operations by a failure to translate their emphasis on quick response manufacturing down the supply chain. But in *this*, they are limited by the inability of their own supply base to meet quality and delivery standards, forcing them to hold a buffer stock of inventory. In this and similar cases, if OEM expertise and resources can improve delivery and quality *to* the first tier suppliers, they will better their own bottom lines. The example of the second tier supplier unable to get a cost-saving design change without playing "hardball" is also indicative of the need to formalize OEM supplier development practices, to provide a direct channel from the people responsible for production to the people responsible for design.

Clearly, the strongest claim we can make based on the information available is that continued research into the tiering structure of the Wisconsin supply base is necessary, but it is not too early to begin discussing ways to improve the performance of second tier suppliers in cases where they are pivotal to the success of the supply chain as a whole.

5. Residual Problems, and Recommendations

Common Problems, Collaborative Solutions provided an in-depth analysis of the ways in which OEM practices can impose constraints on effective supplier development and collaborative relationships. It pointed particularly to OEMs' unrelenting pressures for price reduction, shifting costs to suppliers without compensation, abusing trust, and organizational inconsistencies such as high staff turnover and mixed messages from different OEM departments and divisions. When we returned to the same suppliers a year later, they had new but similar stories to tell. We heard of engineering sending parts out for bids without notifying purchasing (and hence inconsistent messages to suppliers), of problems with buyer turnover, of unrealistic customer expectations regarding the cost reductions to be expected with higher volumes (because of ignored new costs), of an OEM unilaterally changing pick-up times, forcing a supplier to take on the virtually useless cost of adding an otherwise unneeded second shift in the delivery area, and other such tales. In this report, we do not want to retread old ground, but at the same time, believe that it cannot be overemphasized that supplier performance depends *fundamentally* on consistent OEM practices. As one supplier noted, the OEMs are genuinely partnering "with the development end of it, absolutely, with the development end of it... but there is a lot more to the picture. There is the cost end of it, the scheduling, inventory control..." Thus, we return briefly to the issue of OEM supply management practices to make two key points.

OEM Practices and Competency Matter

The experience of the first tier supplier described in the previous section shows just how difficult it is for a customer to present a complex, multi-dimensional message to suppliers. Although the firm views quality and delivery as their primary supply problem, when they held a supplier conference, all their suppliers heard was "cost." They would like their suppliers to reduce cycle times so that *nobody* has to hold inventory, but are told that they are simply forcing it down a level. In short, it is not easy to optimize the supply chain, even for a mid-sized firm that knows first-hand the difficulties caused by excessive customer-imposed cost and delivery pressures. There is no magic bullet to make suppliers understand and believe the customer's word when he says that restructuring operations to meet new market realities will pay off, that competing on speed, quality and service is as important as competing on cost.

Nevertheless, despite the claims of customers and theorists of cycle time reduction that efforts to reduce inventory *do not* amount to pushing it down a level, but reflect instead a new manufacturing paradigm in which quick response is the key, one must entertain the possibility that sometimes suppliers are right when they complain that poor customer forecasts and "trigger" systems are a cost-adder that forces them to hold inventory.

Customer forecasts, suppliers say, sometimes change inside their cycle time "window" and as such, require them to hold inventory lest they damage the on-time delivery rating essential to retaining OEM business. A particularly chagrined subset of suppliers complained about one OEM's new computer system, and said that in addition to adjusting delivery dates, quantities were sometimes adjusted without sufficient notice, making pricing difficult in cases where set-up times were a significant portion of costs. OEMs are also not always particularly sympathetic to the costs imposed by these systems. A manager whose firm carries about 4 days of extra inventory to allow him buffer a customer's "trigger" system commented that "they just expect you to take all the classes and figure that [stuff] out, you know. [They say] 'don't come to me with your complaints about high inventory. If your cycle time was 2 days like it is supposed to be on everything.... Lot sizes, don't come to me with lot sizes.' We have decreased lot sizes, but...." It is

undoubtedly the case that some inventory carrying costs are a result of supplier inability to adequately reduce cycle times, and as has already been shown, the STC has been helpful in this regard. But suppliers are still limited by the information given them by their customers, who at times have unrealistic expectations.

History Matters: How Many Times Can You Take 5%?

The customer practice of asking a 5% annual price reduction is by now so ubiquitous that when suppliers are asked if they get requests for annual price reductions, they often laugh and say that they get the “form letter.” One even told of a (non STC) customer who had simply paid invoices 5% less one week after demanding a price reduction. Often, suppliers say, they are able to negotiate and sometimes resist these demands, but know that they do have to meet the spirit of these laws, if not always the letter. Still, even accepting the underlying principle of an expected annual cost reduction, there are some major points of confusion. It is not always clear what credit is given for past reductions, nor are all suppliers sure if they are expected to meet an *overall* cost reduction target or if they are expected to lower costs on *each* product by a specified amount.

One supplier was particularly clear about the importance of history in making cost reduction requests, noting that it has to end somewhere. You simply cannot feasibly remove 5% a year from a product where the major cost component is in the raw materials. Partially because credit for past success is not fully given, and because they are expected to meet annual targets, they feel compelled to play the cost reduction programs a little bit like a “game” in which they temporarily withhold ideas to make sure they fall into fiscal years correctly (that is, they are careful not to give 7% one year, lest they fail to meet 5% the next). This is exacerbated by buyer turnover so that “we might have made some guy a hero, and next year, you have someone who [could not care less] about what you did for that guy.”⁴

Recommendations for Improvement

Common Problems and Collaborative Solutions argued that the STC should enhance efforts to design a common curriculum of emphasis and should explore ways to harmonize supplier qualification and certification procedures. We said that cross-firm learning and networking could be improved by including employees from multiple suppliers on training courses where possible and by creating supplier forums and/or working groups for exchange of experiences and joint problem solving by SMEs themselves. The systematic inclusion of supplier voice in the training and development process could be brought about by recruiting supplier representatives onto the STC’s governing body and curriculum development committee and by establishing a regular OEM-Supplier forum within the consortium (similar to the advisory councils maintained by several OEMs, including Harley-Davidson and Trane).

Finally, beyond these recommendations to improve the functioning of the consortium itself, the report cautioned that while OEMs “talk the talk” of open and collaborative supplier relations, they don’t always “walk the walk,” largely because of internal organizational barriers. It is unreasonable and unrealistic to expect small suppliers to risk opening up their factories and restructuring to meet customers’ changing needs unless they can credibly expect protection from customer opportunism. While it is undoubtedly useful to provide suppliers with the training they need to meet the high standards of today’s markets, the value of that training will be limited by the belief of many suppliers that such protection will

⁴ In a customer’s defense, another supplier spoke quite positively about the Deere Achieving Excellence program, claiming that it made the cost reduction process relatively painless by walking suppliers through steps that showed where costs could effectively be reduced (though another representative of that same company said that some of the cost reductions they were forced to take were in fact price reductions necessary to meet the target).

not be forthcoming. Hence, we suggested that the STC could encourage participating OEMs to use their existing official procurement policies to design a common code of good supplier relations practice. Such a code could stimulate good practices among participating OEMs, guide suppliers towards a common set of performance expectations, and form a basis for dispute resolution between customers and suppliers.

Based on the new interviews reported on here, we would reiterate many of these recommendations — in particular the importance of a more systematic effort to guide suppliers in their use of the training, the encouragement of cross-supplier interaction, and the incorporation of supplier voice into STC governance.

Getting the “Why” (and the “What”) Clear From the Start: Training is the core of the program and has been key in the improvements at supplier firms. However, as discussed above, we cannot discount the role of external actors — OEMs and the WMEP — as “strategic catalysts” able to push suppliers to undertake upgrading projects. Small, overburdened suppliers are often unable to adequately assess their own training needs. At times they need their eyes opened to the opportunities available to small firms able to specialize and partner with OEMs in the current manufacturing economy. Making training affordable is an important first step in modernizing the supply base, but suppliers must also know *why* their customers want them to train, *what* training to use, and *how* to make that training pay off. It is important that the WMEP the OEM consortium members take seriously their stated goal of assisting suppliers in “training selection based on an assessment of needs.”

Shared Learning: A simple suggestion was offered by a supplier who said that the program would be significantly improved by providing suppliers access to references on the classes, commenting that “It would be nice if we could contact some people over at John Deere or Joe Blow company” to ask them what the courses were like and if they were useful. “We should be able to call WMEP, and they can say ‘call X company’” to see what they thought. Another, who complained that too many of the classes in his area (upper Fox valley) were not useful to him, said that they would perhaps consider putting together on-site classes with other suppliers, but were unaware who the other nominees in the area were, despite having attended two kickoff meetings.⁵

Increased Supplier Voice: Bringing greater supplier participation into the governance of the STC could conceivably pay off in two main areas. First, while the dissatisfaction of some suppliers with the range of courses offered is not necessarily indicative of any failings in the curriculum, the STC should at least be made aware of areas in which the suppliers themselves believe that training could improve their performance. The two suppliers who had not used the program because the course offerings did not fit their needs did regularly buy training from local technical colleges, indicating that giving suppliers some voice on which course offerings to subsidize might increase training uptake (though the OEMs should probably retain veto power). Second and more importantly, supplier input could substantially improve the consortium nomination process itself. Above, we made some tentative observations about the structure of the Wisconsin supply base, and suggested that as first tier suppliers attempt to upgrade, cycle time and performance problems may prove intractable unless the “suppliers to the suppliers” are able to improve quality and response. There is good reason to expect many first tier suppliers to benefit from nominating their own suppliers for training.

The details of adjusting the consortium to permit suppliers to nominate their own suppliers for training cannot be specified without significantly more information, both about the tiering structure of the supply base and about the desires and concerns of the WMEP and participating OEMs regarding such an expansion. However, we can specify the key issues that would have to be resolved. First, and most simply,

⁵ WMEP reports that it is already trying to make suppliers aware of the possibilities of partnering to make on-site classes feasible.

the guidelines specifying that all nominees be *direct* suppliers to a participating OEM would have to be adjusted. Second, the consortium would need to decide on a budgetary protocol by which spending on training for second tier suppliers is allocated to portions of the grant earmarked for particular OEMs. For example, if supplier X nominates in second tier supplier Y, would the money spent on Y count against the \$20,000 cap for supplier X? And would the training consumed by Y count against the allocation of the OEM who nominated X? These are not necessarily problematic but a protocol would need to be established, especially in light of the final and most delicate issue, raised by a supplier in an interview. Suppliers may in some cases consider their knowledge of second tier suppliers' capabilities to be a strategic bargaining asset. They may thus be reluctant to nominate some of their own suppliers, fearing that although costs would be reduced, they would see no gains (and perhaps even lose) if their OEM customers use new knowledge about the second tier supply base to threaten the margins of first tier suppliers. A system that protected the anonymity of the nominating supplier would not be possible without some adjustment to the current budgetary protocol, but it should take advantage of WMEP's central role as the "honest broker." Suppliers could provide nominations directly to the WMEP, which would turn them over to the STC governing board only in aggregate form.

Recommendations for Future Research

Along with these sorts of (we think natural) recommendations on reform of STC/STP program and process, the work to date identifies a number of outstanding questions for research. Among the problem areas worth more investigation:

Tiering

Perhaps the most pressing need is to fill out what is now a provocative but incomplete picture of the tiering structure of Wisconsin's supply base. Such research must be conducted in close collaboration with the governing members of the STC, as it requires the careful construction of an initial sample of first tier suppliers with a significant supply base of their own. These first tier suppliers would be interviewed, much as were the OEMs for *Common Problems and Collaborative Solutions*, and asked to facilitate access to second tier suppliers they believed could benefit from supplier training.

Based on our wholly imperfect (for this particular question) sample, there is initial evidence that in at least some cases, the poor performance of second tier suppliers can limit the ability of first tier suppliers to drive out costs and reduce cycle time. It is important to know if the cases we observed were simply isolated occurrences or are part of a larger pattern. Providing training to the "suppliers to the suppliers" may be the logical next step in upgrading the Wisconsin supply base, but first there is a need for a detailed understanding of the *specific* problems that relate to firms' structural positions in the supply chain.

Pathways to Success

Given the difficulties experienced by suppliers upgrading to meet the challenges of rapidly evolving market realities, it would be extremely desirable to draw a better map of the patterns of success available to supplier firms. We know that certain outcome metrics can begin to define success — for example, productivity (both labor and total factor productivity), quality, new product introduction, firm survival and growth, profits, wages, and emissions reduction — but much less is known about the policies that lead to good performance on such measures. We must develop a much better understanding of the connections between outcomes and technology strategy, industrial relations, customer/supplier relations, and linkages with intermediaries such as universities and technical assistance centers. This requires

additional in-depth research on individual suppliers as well as systematic comparisons among firms participating in STC programs.

The Decision to Modernize

Above, we argued that the decision to train, modernize, or otherwise change firm strategy is subject to the influence of many factors, both external and internal to the firm. A pressing issue for the STC, with its public mission of generally upgrading the supply base, is to learn *which* of these many factors are key in pushing or permitting suppliers to successfully implement advanced manufacturing practices. The candidates are many and known — institutional and locational factors such as the availability of skilled workers, proximity to specialized suppliers, and the strategies of rival firms, ownership structure (family/corporate, public/private, freestanding/subsidiary, domestic/foreign), unionization, position in the tier structure of the supply chain, local community colleges or other training institutions, state-level manufacturing technology centers, and other intermediary institutions such as trade and professional associations — but their impact on supplier modernization, either alone or in combination, has yet to be fully clarified.

Workforce Effects

Because any observable effects are best understood within the specific context of firm-level strategic decisions, this report has depended on interviews with key figures in supplier firms, giving an *overall* assessment of the impact of the Supplier Training Program on participating firms. However, as was suggested in one of the interviews, it would also be useful to gather more detailed information on the *direct* use of training by shopfloor personnel, as well as more information about the composition — production, skilled trades, or supervisory — of those trained. The interviewee suggested that WMEP inform participants that a small percentage of those who attend classes would be contacted for a brief follow-up interview 6 months *after* having undergone training, when new ideas and concepts have been fully digested and either worked themselves into (or out of) workers' routines. Such detailed information will provide feedback to course instructors, and will give greater understanding of the impact of STP training on workforce skills.

Benchmarking STC Experience

The final recommendation for further research (as also suggested in *Common Problems and Collaborative Solutions*) is that the WMEP STC be compared to similar organizations elsewhere, both in other states and in other advanced economies abroad. In particular, there should be systematic comparison with company-led supplier development initiatives, with collaborative ventures between public entities and single companies, and with other multi-firm consortia in other states. The involvement of the John Deere corporation in varying types of supplier development programs in different states could provide an especially useful point of entry to such comparison, as could Ford's contract with CAMP (Cleveland's Manufacturing Technology Center) to provide training in quality improvement and inventory reduction to its northeast Ohio suppliers

Internationally, useful lessons could be learned from comparison with CONSAF, a sub-supplier training consortium around Turin. It was created by Italian OEMs seeking solutions to many of the same problems that led to the STC. 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 conjunction with scholars from Ohio, Illinois, and Michigan, COWS hopes soon to receive national funding for the establishment of a research consortium to address these questions, among others. The Advanced Manufacturing Project (AMP) will be dedicated to investigating the determinants and possible policy supports of improved performance in manufacturing, focusing for research purposes on 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. They form the supply base for 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. Underlying the formation of AMP is the belief that the positioning of component manufacturers in the supply chains of so many end-user industries means that the strategic choices of these small firms will have a huge impact on the future of U.S. manufacturing generally. It is vital to understand the determinants of the incredibly varied performance of firms in this sector on such key outcomes as productivity, profits, wages, technical advance, and environmental sustainability, as well as the relationship of good performance on these outcomes to the production recipes these firms use. Here there is again enormous variation of practices with respect to inventory and quality management, capital intensity, employee involvement and training. These differ greatly even when supplying similar products to similar customers.

The AMP project takes one of the key determinants of these practices to be precisely what COWS has focused on in these two studies of the STC, viz. suppliers' relationships with their typically much larger OEM customers. 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.

Clearly, there is a significant overlap between the AMP research agenda and a research agenda that could improve the performance of the Supplier Training Program, inform OEMs seeking to implement collaborative supplier management strategies, and provide the WMEP with information vital to gearing its own service agenda to the firms that form the core of Wisconsin's manufacturing economy. A final recommendation, then, is that, should AMP take flight, research on the latter questions largely be addressed through the broader and more capacious research effort.

Summing Up

The fundamental story of this report is relatively simple, but important nonetheless. OEMs rely increasingly on their supply base as they adjust their strategies to better react to competition, market volatility and short product life cycles by focusing on core competencies in design, marketing and final assembly. This opens new opportunities for small and medium sized firms that have historically served largely as a capacity buffer, but many of these are not up to the task. They are unused to meeting the high standards of a global marketplace in which quick response times, extremely low defect rates and regular cost reductions are the norm from OEM suppliers who must depend on continuous improvement for their profitability. Those who do meet these exacting standards, however, can hope to engage in partner relationships with their powerful customers and stand to benefit from more reliable orders and involvement in new product development. It is impossible to discern the *exact* contribution of a particular training intervention on the performance of a firm, especially since the firms that had made the most use of the training are also those who are in the process of revamping their strategy to better fit with a decentralized, lean, quick-response manufacturing paradigm. However, in the interviews, several suppliers made it abundantly clear that the Supplier Training Program has served them as an important external training arm for both managerial and production staff, and that it played a role in upgrading and restructuring projects that have led to measurable performance improvements. So long as the OEMs reward firms gearing their operations to be partners to their customers, the Wisconsin Manufacturing Extension Partnership's Supplier Training Consortium can be a valuable tool for suppliers upgrading their operations.

We are in an era when firms demand continuous improvement of themselves, and there is no reason the Supplier Training Program should be immune to such demands. Based on interviews conducted for this and previous reports, COWS believes that the recommendations made in this report can provide a basis for such continuous improvement. Customers and the WMEP should use their ability to act as "strategic catalysts" to push suppliers to undertake upgrading projects. The consortium should actively seek to encourage cross-supplier interaction and to incorporate supplier voice into STC governance. Perhaps most importantly, customers should go beyond the rhetoric, "walking the walk" of collaborative supplier relations to genuinely reward firms that take risks to restructure their operations to a new reality. Finally, to ensure that future improvement is genuinely "continuous," the WMEP STC should capitalize on the likely funding of the Advanced Manufacturing Project to collaborate on future research that can accurately map the tiering structure of the Wisconsin supply base, understand the determinants of success in small supplier firms and the factors that push them to modernize, provide direct analysis of program effects at the level of the workforce, and benchmark the STC with supplier development efforts in other states and countries.