When Management Strategies Change: Employee Well-Being at an Auto Supplier

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Introduction

As a result of increased international competition, over the last decade or two, US manufacturing firms have made major changes in both their product strategies and their human resource policies.1 In some cases, these strategies bifurcate into a "high road" of innovative products and skilled, highly-paid workers and a "low road" of commodity products and low-paid, unskilled workers (Appelbaum and Batt, 1994). In this paper, we examine the case of a firm that manages to combine elements of both 'roads' in a profitable way: it makes innovative products with moderately skilled, low-paid workers. As we discuss below, we think that this firm may well be a bellwether for overall trends in US manufacturing, especially in auto parts.

Our firm, which we call SP (small parts), is a $600 million manufacturer of electrical and electronic products, which are sold largely to vehicle manufacturers (automakers and truck manufacturers)[2]. The oldest part of the firm was founded in 1909, and has undergone a number of changes in its markets and products over the years. In the next sections of the paper, we describe these changes, first in auto parts manufacturing in general and then at SP. These changes have had a significant impact on SP's human-resource practices, including nature of work, methods and levels of pay, and training. (We find little evidence of causality running the other way, i.e. from HR practices to productivity or product markets.) In the fifth section of the paper, we will describe the impacts of these changes on worker satisfaction, based on surveys we conducted in four of SP's U.S. plants. In the conclusion we discuss the rationale for the financial

1 For documentation of the increase in international competition, see Cooke, et al., this volume.

[2]We call the firm Small Parts under a confidentiality agreement with the company. They gave us

success of this firm, and analyze outcomes for employees.

General trends in Auto parts products and markets

Auto-parts manufacturing in the United States has changed a great deal in the last 15 years. Between the 1930s and the 1980s, the "Big Three" U.S. automakers shared a tight oligopoly. A key goal of automakers was to protect their oligopoly profits from suppliers by keeping barriers to entry in their input markets low. Suppliers did not need sophisticated product design, quality, or management capabilities; they were asked only to build simple products to automakers' blueprints, and quality requirements were not high. (In some cases, automakers asked suppliers to ship 10% extra parts to cover defects). Automakers kept large stocks of components in part as a buffer against attempts by suppliers to hold them up for higher prices. Automakers also had several suppliers of the same part, which facilitated easy switching to another supplier. This system contributed to automaker profits well above the manufacturing average. However, the rent-protection strategies led to a great deal of inefficiency. Quality was low, and costs were high, due to the costs of buffer stock, designs ill-suited to supplier equipment, and supplier inability and unwillingness to make investments in new technology. In the late 1980s, in order to compete with the quality and low costs offered by Japanese manufacturers, US automakers began to adopt many of their rivals' supplier relations practices (Helper, 1991, 1992). [3]

Below, we briefly describe changes in the automaker expectations in several areas:

Product design. Suppliers are now expected to be capable of designing the components

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proprietary information on condition that we not use their name in our publications.

they produce rather than simply building to their customers' blueprints as before. This system has led to improved quality and reduced costs, since suppliers were able to design products that fit their equipment. (Helper, 1997; Liker and Wastli).

Quality. Automakers in most cases no longer inspect parts upon receipt, but send them straight to the assembly line. Defective parts thus impose huge costs (which are often charged back to the supplier), so acceptable quality levels are now measured in tens of parts per million.

Delivery. Where once a delivery was considered 'on-time' if an amount plus or minus 10% of the contracted-for number of parts arrived anywhere in a three-day window, now suppliers are often expected to deliver an exact number of parts within a thirty-minute time frame. An early delivery is almost as bad as a late delivery, because there is not a lot of space to store additional parts.

Globalization. Automakers increasingly want suppliers who can supply them just-in-time in all of their plants around the globe. This demand means that suppliers must have plants (or warehouses where final assembly is done) around the world.

Subassembly. Automakers no longer want to receive individual parts from suppliers; they want the suppliers to assemble several parts together. There are several reasons for this. Some are efficiency-based (a plant producing a few parts can focus on quality more than an assembly plant, which may be overwhelmed with 5,000 separate parts coming in the door; a supplier may have expertise that the automaker cannot match). But another key reason is labor-cost savings, since assembly workers earn almost $20 per hour with generous benefits, while supplier workers earn $8-14 per hour, with few or no benefits. Labor-cost savings alone have proven illusory,

[3] There remain key differences. Japanese firms trust their customers more (Sako and

since they are offset by modules' increased size and fragility. However, suppliers that combine lower labor costs with improved design have been quite successful in winning work that used to be done in assembly plants.

These subassemblies can have just a few parts (as when a stamping firm welds together several separate pieces), or can be quite complex (as when a supplier delivers an entire seat or instrument panel to the assembly line). If the subassembly has only a few interfaces with other parts, and can be tested as a unit, it is known as a 'module' (seats and instrument panel are examples.) (Sako and Murray, 1999.)

Price pressure. Contracts from automakers now often contain promises that prices will fall 3-5% per year (Luria, 2001). As a result, input prices in this industry have fallen.

In order to meet these new requirements, suppliers have changed strategies. Here are some examples:

Become a module supplier. –supply a geographically contiguous chunk of the car, such as an instrument panel.

Develop functional expertise. – in stamping, or plastic molding, for example.

Become expert in a particular system. Especially good if product is relatively new (e.g. electronics), so automakers aren't experts, and don't want to invest in becoming an expert.

Move manufacturing to rural and/or southern US, or to a foreign country. While total employment in auto parts (SICs 3714 and 3496) has been relatively constant at about 100,000 since 1980, the location of these jobs has shifted dramatically toward southern and rural areas,

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Helper 1998), and are less likely to produce or design modules (Sako and Warburton, 1999).

where wages are lower.

Consolidation of supplier sector. As a result of these increased demands, there have been many acquisitions in this sector. In addition, in the last three years, both Ford and GM have spun off their component divisions as separate firms, each with multiple billions in annual sales.

These trends have been accompanied by changes in human resource policies, in particular a decline of unions, an increase in employee involvement programs, and a stagnation in wages (see Cooke, et al. (this volume)).

These trends—devolution of responsibility for design and subassembly; increasingly strict requirements for quality and delivery; continued price pressure, deunionization, increase in employee involvement, and wage stagnation, are becoming characteristic of much of U.S. manufacturing, even outside the automotive sector. Suppliers in agricultural equipment have experienced all of these trends, and refer to them as the "automatization" of their industry (Zeitlin and Whitford, 2002). Other examples are Dell computers (modules and delivery) and apparel (fast response) (Dunlop and Weil).

Thus it is of considerable interest to those interested in human resource management to understand how firms in this sector have changed their policies with respect to employees, and the impact of these changes on wages, job satisfaction, and profits.

In this paper, we report on one company that let us survey their workers, and spend time unaccompanied in their plants. The company exemplifies most of the trends discussed above, as we describe below.

History of SP

SP makes electrical and electronic components for vehicles, such as ignition switches and a product that indicates when a car door is ajar. Over the last decade the firm has become a functional specialist, building and acquiring capabilities in product design of electrical and electronic parts . A core competence is design for manufacturing. The firm's original business, started in the 1960s, was assembling wire harnesses for farm equipment and for a division of General Motors. This was a relatively simple task. For the automotive product, all design was done by GM, and the plastic connectors and metal terminals that SP attached to the wires were also provided by GM. The key to success was keeping costs low, and avoiding defects (since a loose connection was very difficult to find once installed in a car). The assembly jobs were simple, but very monotonous. There was little training, or effort to involve the workforce (Gillett)

According to the firm's 10-K report, in 1987 the investors who owned SP changed their strategy. In that year, they began to move away from contract manufacturing to become a designer as well as a manufacturer. In 1989, they bought a small Massachusetts firm that made sensors and actuators for cars and boats. This firm was founded in 1909 and had a long history of tool-making and design capability.

In 1997, SP went public, in order to gain access to more capital, and to allow the company's founders to take some of their money out of the firm. At the end of 1998, SP bought another firm that designed and manufactured sensors, and had a plant in rural Ohio and one in suburban Florida. During the 1990s the firm also acquired some foreign operations (Europe, Mexico, and Brazil). In 1999, the firm ended the contract manufacturing operation that had originally formed the core of its business, and focused entirely on parts it designed itself.

(Annual report, 2000; SEC 10-K filing, November, 2001; interviews). Thus the firm exemplifies many of the trends discussed in the last section: it has become an expert in the design and manufacture of electronic and electromechanical systems, it has become global, and it has grown dramatically, mostly through acquisition.

We surveyed workers in the two Massachusetts plants, the Ohio, and the Florida plant. Despite their origins in two different companies, the plants' production processes are remarkably similar. There are variations in the work force, turnover , pay, and training policies among the four plants. Below, we describe the plants in more detail. In Table 1 we give the basic workforce characteristics of the four plants we surveyed. The two Massachusetts plants had the highest percentage of assemblers, lowest turnover rates, but the largest percentage of temporary employees. The Florida and Ohio plants were similar but the Florida plant had the lowest percentage of long time employees (those with 10 or more years of experience).

Massachusetts plants

One of the Massachusetts plants was an older structure in an urban area. It was near the site of the firm's original building, which had supplied the auto industry since 1919, when it made dash lamp sockets for the Ford Model T. In the 1980s, the firm was owned by a conglomerate, which "milked it" and didn't invest. The firm also made a variety of other products, including trays for life savers, hair dryer switches and blood pumps. In the 1960s, half of its revenue came from military products. The workers were paid piece rate, as was common in manufacturing in the area at the time. In 1985, a GE-trained manager (Mr. P.) was brought in to run the plant. He and other top managers (including Mr. L and Ms. P) stayed with the plant when three years later it was sold to SP in a transaction that left the plant highly leveraged. (By 1998,

however, the operation was debt free.) In 1989, these managers built another plant in a nearby suburb that paid time rates and was more automated. In 1996, this plant was closed, and its workers (and some from the urban facility) moved to a new plant, also in a nearby suburb.

We visited each of the Massachusetts plants three times, in 1995, 1998, and 2000, and the urban plant again in 2002. Below we describe first the demographics of the work force (which changed very little between visits), then the production process (which changed somewhat), and finally compensation and other HR policies (which changed a great deal).

In the 1990s, the work force at the Massachusetts plants was composed largely of first-generation immigrants. About one-third of the work force was Vietnamese and one-third Cape Verdean. The rest was a mixture of immigrants from other countries, such as Poland, and US-born workers. About 60% was female. The work force was recruited by word of mouth rather than advertising. Many workers were related to each other. There were few blacks though the plant was in a majority-black area. At the urban location, most workers walked or took public transportation to work. Turnover was low; at the time of our survey two-thirds of the workforce had been at SP for at least four years (table 1).

At the time of our first visit in 1995, the plant was toward the end of a transition begun in the mid-1980s. It had been a low-volume plant where quality requirements were not high, and where designs were generally dictated by the customer and didn't change often. The new strategy was to become a "high-volume, precision operation', according to Mr. M, the plant manager in 1995. This transition involved changes in many areas:

Product Strategy. SP hired engineers to design products in-house, and dramatically increased the rate at which new products were introduced (50 in 1998) and retired. These

products became increasingly sophisticated, and many were patented. For example, a sensor based on the Hall Effect was written up in a technical journal.

Process flow. The older jobs were individually paced, and consisted of a single worker sitting at a machine. She would add one or more pieces to a small assembly and then press a button or foot pedal to fasten the piece via welding or crimping. She would then place the partially-completed product in a box; when the box was full material handlers would move it to workers who would do the next stage.

Management was gradually bringing in more automated assembly, eliminating individually-paced jobs. Instead, 6-8 workers sat around a circular work cell. Some stations were completely automated; at most stations a worker assisted the machine in assembling the part. When the part was finished, it would be moved (automatically or manually) to the next station. At the last station, the operator would pack the fully-completed part into a box to be shipped directly to the customer. The cell was paced by the slowest worker. At many of the cells, a lighted overhead sign kept track of the pieces made, and compared it to the pieces that should be made to meet the day's quota. Since there was no buffer between operators, inventory in the cells was dramatically lower (and lead times faster).

By 2000, these assembly jobs employed the bulk of the work force (see Table 1). There was also a small plastic molding operation, in which workers monitored machines and loaded and unload parts. In the suburban plant there were several cells that were completely automated, and monitored by technicians who had received three months of training and were paid more than the assemblers. Other blue-collar jobs included material handling and shipping and receiving.

Design for manufacturing. The key to the success of the firm, according to Mr. P, was the tight integration of product and process. At the time of the survey, the Massachusetts plants employed over 100 design engineers. They tried to design products that were not only sophisticated (many were patented), but easy to make, and whose quality could be checked automatically, rather than relying on manual inspection (which is less accurate, particularly when thousands of parts must be checked each day). Examples of design for manufacturing included molding in small bumps on the piece whose only function was to help locate the part correctly in a machine (they had no function once the part was made), and simple set-ups that tested for the presence of certain parts (and would not let the operator go to the next step unless all parts were there).

In order to facilitate this integrated approach, in 1995 engineers were re-organized into product teams, who would follow a product all the way from concept to launch. (In the traditional approach, engineers were organized into functions, such as design engineering and manufacturing engineering; when a product left one stage it was "thrown over the wall" to the next stage, with little communication between groups.

In our 1995 visit, we saw several engineers working with operators to design such "mistake-proofing" mechanisms. In several cases, the work seemed hampered by language barriers; we saw a lot of sign language being used, as the operator and engineer struggled to communicate about quality problems. We saw fewer engineers on the shop floor in our later visits. One reason was that design-for-manufacturing principles had become codified (both by SP and others), so that more of the work could proceed without input from operators. (These principles include ideas such as making sure that parts either are perfectly symmetric, so that

orientation doesn't matter, or are obviously asymmetric, so a fixture can be built that won't allow work to proceed on an incorrectly oriented part.) This move toward codification was given additional impetus by the fact that the design engineers in Massachusetts were increasingly called on to design parts for SP's other locations far away (including Europe and Mexico),.

Method of pay—time rates. Workers on the individually-paced jobs were paid piece rate from the 1960s until 1996. (Piece rates had been a common practice in the Massachusetts city in the 1950s and 1960s).

Management recognized that piece rates were not well suited to the new strategy. First, workers on piece rates wanted a large amount of inventory between stations, so that they were not constrained by someone working more slowly than they were. This practice led to long lead times and low quality, both because of the incentive to work as fast as possible and because the large batches meant that many bad products could be made before they werecaught by inspectors.

Another problem with piece rates was that new product introduction created big risks for both labor (that the rate would be set too stringently) and management (that the rate would turn out to be too easy). As Ms. P. put it in 20004, "New product development became a hurdle with the piecework system. Employees did not want to work on new product [because they would have to learn a new job, with the risk of lower pay while they figured out shortcuts]. We had a lot of turnover in the plant at this time (late1980s). There were no good standards for new product and there was no way to introduce new products unless we wanted to throw loose rates on them. This restricted us from doing new products."

4 This is a quote from a very useful document, "Progression of Pay for Performance", that Ms. P wrote for us in

Getting rid of the piece rate system was not easy. "From 1985 to the early 90s, we started to educate the employees in a series of round table meetings and business meetings that the security they felt they had in the incentive system was hurting the company and hurting them and hurting the quality of the business and that we would have to make changes to the way they made their money." (Ms. P, 2000). But some mistakes were made. "For our original steering committee, we selected [hourly] people who had trust in the plan—we didn't have the natural leaders. We had approached it as a control thing with employees," said Mr. P in 1995.

"The opportunity of expanding to a second plant in 1989 was the first chance of changing the pay system," according to Ms. P. Workers in this plant, located in a suburb, worked in cells, and were paid an hourly wage. This wage was lower than in the urban plant, since the prevailing wage in the suburb was lower. Thus, it was difficult to get people to help with the start-up, so some were given promotions as an incentive. Piece rates were also gradually phased in at the urban plant, between 1992 and 1996.

Some operators we interviewed in focus groups in 2000 remained upset about the change, though more about the outcome than the process of the change. Almost all operators worked faster than the standard at which the piece rate was set. Management recognized this by setting the base time wage at 132% of the piece-rate base wage. They also introduced a gain-sharing program (described below) which they thought would pay an additional 10-15%. Managers said later that they did not intend to cut pay ('except that there were some people making 200% of the base rate, which is just unrealistic", according to Ms. P in 2002.). However, management was very worried about setting the rates too high, and locking themselves into a wage that was "too

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February 2000.

high"5. (In one case, "we underestimated the impact of automating the manual O-ring assembly—it almost killed the plan," said Mr. P in 1995). The result was that management erred on the conservative side, and 45% of those who had worked under piece rates felt that they had suffered a pay cut. According to management, only about 10% of operators quit due to the transition, however. And newer workers, who hadn't yet figured out shortcuts on their job (or been assigned to a job with a 'loose' rate) benefited; 27% of survey respondents who had worked under piece rates indicated that they made more money now than before. (See Table 1a.) Workers who had been on piece rates were kept at the same hourly pay for a while. However, the fastest workers saw their hourly pay decline $4-5 per hour (40-50%) over several years. According to management, however, only about 10% of the workers quit during this period.

Wages in 1999 for assemblers were $10.48/hour in the suburban plant, and $10.60 per hour in the urban plant (there was no seniority increment). In the urban plant, this was supplemented by a VAG payout of about $1.00 per hour. The VAG was much less (often zero) in the urban plant, due mostly to quality problems and secondarily to difficulties in accounting for the time of engineers who worked on products for SP's other plants (Ms. P, 2002). This pay rate was far below the US manufacturing average of $14.40 per hour in 1999 ($15.03 for workers in industrial machinery) (Jacobs, 2000). Benefits (which included paid vacation, medical, and dental) were more generous than in the average US factory, but did not come close to offseting the low pay. In addition, the Massachusetts plants are located in an area with a very high cost of living.

5 It seemed that "too high" meant wages more than 15% above the average for unskilled manufacturing workers in the area. (For example, Mr. P said in 1995 that if gain-sharing exceeded 15%, then it was time to cut prices to customers (rather than continue to increase compensation to workers). It is not clear how the 15% figure was arrived at.

Method of pay—gain-sharing. Under piece rates, individual operators had a strong incentive to figure out how to do their jobs as quickly as possible. This led to a sustained 2-3% annual productivity improvement over the decades, according to Mr. K, the older manager. But piece rates did not promote the teamwork necessary to meet customers' new demands for just-in-time delivery of high-quality products that changed frequently. Increasingly, jobs were automated. Automation increased precision, but frustrated the efforts of those workers who wanted to work fast.

Management did not want to lose the incentive aspect of piece rate pay, so they implemented a "Value Added Gainsharing (VAG) Plan" beginning in 1992 with the help of a consultant. The VAG was calculated on a plant-wide basis; everyone (except the top 3 managers, who were in a corporate incentive plan) got the same percentage of their pay as a bonus. The bonus pool went up with productivity, and down if there were defects or delivery problems.

When we visited the plants again in 1998, it was clear that VAG was the centerpiece of management's strategy to make workers more aware of their impact on plant performance. Management put a lot of effort into figuring out what they considered to be a 'fair' formula (one that would yield a 10-15% payout if things went well). If the payout was too small, workers would be demoralized, if it was too big workers would be getting too much money. Managers also felt the formula needed to change if conditions changed, and so spent a lot of time explaining the changes and justifying them. Initially, the bonus pool was a function of the difference between current productivity and 1991 productivity, with deductions for defects and bad deliveries. The bonus could not exceed 15%. In 1998, Mr. P told us that they would soon

need to revise the benchmark year ("raise the bar") so the company could meet the commitments it had made to Ford that it would reduce prices in exchange for a long-term contract. Materials and capital costs were not included in the formula, he said, because they were not under the control of most workers.

Several mechanisms provided workers the opportunity to increase the bonus pool for everyone, and recognition for doing so. Among them were "The Last Chance Club" for workers who had caught a defect just before it went out the doo˜ One example of a response (in 1995) was a flood of volunteers willing to sort through 80,000 parts to find the 5% that were defective in the 90 minutes before the customer's truck came, on their own time. (This action avoided a $1 per part air freight cost.) Members of the Last Chance Club get their names on a plaque in the lunchroom; those so inscribed (including management) seemed genuinely pleased at the honor. (The culprit in the case above turned out to be a vendor that shipped defective parts; this firm was put in SP's continuous improvement program, in which someone from SP sits down every week with the firm's president to monitor progress.) The gainsharing also played an important role in changing engineers' incentives; 'it used to be like pulling teeth to get engineers to leave their new products and solve problems on the floor. We need to leverage our 30% overhead as well as our 5% direct labor, " said Mr. P in 1995. (All employees at each plant, except the top three managers (who are eligible for a corporate bonus plan) receive the same percentage of their pay in the gain-sharing plan. However, Mr. P observed in 199 that the VAG seemed successful in getting on-time delivery, but not quality.

There were several mechanisms for management to communicate to employees. These built on some management communication initiatives started in the 1980s. Union avoidance was

the initial motivation for these initiatives, according to Mr. K., a semi-retired manager now in his 80s who had worked at the plant since the 1950s. (There had been several organizing drives in the past, but none since about 1987, a development he attributed to Mr. P's efforts to address problems quickly.) There are quarterly meetings with supervisors, monthly meetings with hourly workers (these are attended one or two representatives from each department, chosen by management) and quarterly meetings to discuss the gain-sharing results.

In 1998, management decided that materials and capital costs should be included in the VAG formula, so as to avoid the problem that the company might owe a large bonus even though it did not make any profit due to large investments or materials price increases.6 (In contrast, Lincoln Electric, another firm with a large incentive pay component, borrowed money to pay the bonus in a year when high worker productivity was combined with materials price increases and losses on acquisitions). The VAG formula became so complicated that "only three people in the company understand how it is calculated, " said Ms. P. . However, almost all shop workers had a basic understanding that low productivity, defects, and delivery mistakes would cost them money. (However, especially in the early months of the program, some of the efforts made by workers seemed to go far beyond the individual monetary benefit they received (a defective part would cost each worker about $1).

In 1995, there were continuous improvement teams in which 10-15% of work force participated. These were not in evidence in later visits. Instead, in 1998, the plants focused on obtaining ISO 9000 quality certification; there was some involvement by workers in writing their own job descriptions. In 2000, the plants undertook a Six Sigma initiative, which was still going

6 The 15% cap on the payout was also lifted at this time. (It was never a binding constraint.)

on in 1992. This program involves training supervisors and management as "Six Sigma black belts" (or green belts in the case of supervisors); they learn techniques for reducing inventory and lead time, and for analyzing quality data. Operators join with supervisors and engineers to improve line layout, but according to one supervisor I talked with, they contribute very few useful ideas. Overall, the improvement efforts have helped the urban plant to reduce costs by 3% every year since 1986. (Interestingly, this figure is similar to the 2-3% productivity improvement that Mr. K said that operators on piece rates achieved.)

At the time of survey, the plants seemed to be placing less emphasis on suggestions to change the process, and more on training to take over supervisory functions, and avoid mistakes. This last is in response to quality problems that have meant the VAG payout in the suburban plant was zero in the year preceding the survey. (The urban plant continued to average 7-10%).

Location policies. In 1989, Massachusetts management built a second plant in 1989, and then closed it in 1996 and moved to a larger factory nearby. In both cases there were long discussions with SP's board, which was based in Ohio, about the location of this operation. The board did not want a plant built in such a high-wage area far from the automakers in the Midwest. However, the local manager, Mr. P, prevailed; he refused to move even to New Hampshire only an hour away. He argued that that labor costs were only 6-7% of total cost, and said that it was important to have the new plant close enough to the old one that most of the current work force would stay. "I don't want to save 20 or 30% on labor cost by going somewhere else, and then lose it all due to carelessness on the part of an employee who doesn't care," he said in 1995.

Although management wanted to keep the same work force, they also wanted to keep wages low by national standards, as discussed above. This dual desire seems responsible for much of the difficulty in implementing the new system.

Ohio plant

The Ohio plant was located in a rural part of the state, about 30 minutes from a medium-sized city where most of the managers lived. The company was started in the mid-1960s by a man universally known as Jack, who had innovative ideas for electronics products and a paternalistic management style. Layoffs were done on a voluntary basis, and Jack was often seen on the shop floor until he semi-retired and moved south (where he opened the Florida plant).

Both the Ohio and Florida plants were acquired in 2000 by SP for $370 million. According to Mr. P, the firm had excellent market positioning, but Jack had not invested in the business in recent years, and operational effectiveness was slipping. Both Mr. P and local managers felt that Jack had negotiated a very good deal for himself, leaving behind a financial burden for the Ohio plant to overcome. There was growing tension between the Ohio managers and SP top management. In contrast to Mr. P's perception, the Ohioans felt that their company was making a good profit, but being dragged down by accounting charges made to reflect what SP felt were its managers' contribution to the business, and financial problems caused by SP's other plants

We visited SP several times in 2001 and 2002. The workforce was very different from the Massachusetts plants. Everyone seemed to be native born, and all but a handful were white. The average age was 44, higher than in Massachusetts; about 20% appeared to be over 60.

(Management explained that many of them worked to supplement retirement benefits obtained from working on a previous job.) Although there was a core of experienced workers (see table 1), turnover was very high; 30% of those hired in 2000 had left by the end of the year (quit or were fired). In 2001, the starting wage for an assembler was $6.85 per hour; after one year this increased to $7.80; after 3 years to $8.27. After 12 years, one assembler reported that she made about $9 per hour. This was supplemented with an annual check that was called "profit-sharing". The owner allocated a pool of money (based on the past year's performance) which was divided among the work force based on seniority and wages; the payment was typically equal to about two weeks' wages. In contrast to the VAG, management did not emphasize the role of workers in affecting the payment, and the size of the payout was subjectively determined.

The Ohio plant's production processes were remarkably similar to that of the Massachusetts plants, consisting of some plastic molding and semi-automated team assembly. The main improvement activity at the time of our visits was the "War on Waste" program (WOW). This program was led by an engineer (Mr. S.), who was truly an evangelist for lean production. In 1994, he had gotten the plant enrolled in a program sponsored by the Toyota Supplier Support Program, even though the plant had no Toyota business. Several Toyota engineers had helped the plant with projects to improve the flow of product through the plant. According to Mr. S's calculations, WOW has saved the plant 2-3% of sales in the two years since its inception. Almost all of the ideas seem to be generated by technicians and engineers. "We don't involve operators enough. We do it hardly at all—this is a failing." Mr. S did what he could to encourage participation, believing that "People want recognition, not more pay. You could increase pay and still have dissatisfied employees." Participation in small ways is

rewarded; about 10% (by rough estimate) of operators were wearing a WOW T-shirt or using a WOW pencil on the day we conducted the survey.

Florida.

The Florida plan had many similarities to the suburban Boston plant. I t was relatively new, about 15 years old, and was capital intensive. Unlike Boston, the workforce has a large number of retirees who moved to Florida, and found that their retirement income and saving were insufficient. Consequently, the age of production employees was higher in Florida than at the other plants.

The plant manager in Florida Mr. Z said that the plant was built to serve as a semi-retirement location for the founder of the company. Consequently, the plant and the major offices for top management were in separate buildings. The manufacturing plant and its offices were plain with Spartan amenities. The main office complex had carpeted offices with windows, and were generally larger. The corporate meeting rooms and cafeteria were in office complex rather than in the plant.

Although most of the jobs involved watching and adjusting controls on machines and checking for defects, there were many difficult and tedious jobs. These included packing parts, loading trucks, and putting small round sensors into a hole the size of the eye of a needle. There was an emphasis on training with several rooms in the plant and office complex devoted to training production workers and engineers. We attended a company meeting where the emphasis was on the costs to the company of defective parts. The key message was that small numbers of defects can lead to large costs that harm the VAG bonus to production employees. The emphasis

during the meeting was for employees to attempt to catch mistakes, rather than think of innovations.

Changing HR practices

Using our understanding of the product market and history of the company, in this section we analyze the impact of the change in pay policies on both the firm and its workers. As we have shown the auto parts industry is a highly competitive one, so a key perceived element of survival is the ability to increase employee productivity.

In second part of this section we examine the impact of changes in HR practices on overall satisfaction of employees in these production establishments. As noted above, the policies were different in the different plants. The urban Massachusetts plant changed from piece-rate pay to value-added gain-sharing; the suburban plant changed from time rates to value-added gain sharing. (Many of the workers at the urban plant had also worked at the urban plant). In addition, in both plants the work changed from individual and manual to group and automated, and formal training programs were instituted, especially in the suburban facility. In their Florida facility the change was from a time rate method of pay to a value added gain sharing approach; the nature of the work did not change much, but some formal training was implemented. (In the rural Ohio plant, no change occurred in the method of pay., and there was little change in the nature of work or training. However, in January 2000 the plant experienced its first involuntary layoff in 30 years.

Productivity Effects of Changing Methods of Pay

The gain sharing plan that was implemented by the company involved disproportionate weights for productivity, using a value added approach, measures of customer satisfaction using returns or defective parts, and deductions for scrap. The initial estimates were established by a consulting firm who worked with the managers and engineers in the company to establish the VAG formula, which as we have noted was not widely understood. The gain sharing pay outs ranged from zero to 15 percent during the period we examine from 1996 through 2001. For the Boston plant the average bonus averaged more than 10 percent from 1996 through 2001.

At the Sarasota, Florida facility the production employees were paid a time rate. On January 1, 2001 the plant shifted to a value added gainsharing method of pay. During the first few months of the program pay-outs were about 10 percent, but the recession which started in the early months of gain sharing program, reduced the gain sharing amounts to almost zero during the Summer months of 2001, but then rebounded during the fall to almost 9 percent.

In Table 2 we show the impact of the switch in Boston from a piece rate or time rate method of pay to one where employees are paid through gainsharing. In the second column we show the productivity impact of moving from a time-rate method of pay to one where employees are paid through a gainsharing approach. In both cases the impact was to have almost no impact on productivity as measured through sales per employee per month. In the case of the Boston plants the drop was less than one percent per year. However, profitability of the plants increased as the plant was able to become more innovative and introduce new product lines. These new product lines were more profitable than the older more established ones, resulting in higher margins, even though the worker productivity declined slightly.

What Affects Employee Satisfaction?

The basic survey instrument we used to examine employee satisfaction was the Minnesota Multiphasic Satisfaction Questionnaire (MMS). We then we added questions to examine the impact of the pay systems in each plant. The baseline questions were of a Likert-type 5 point scale. The MMS has been used by industrial psychologists for almost 50 years to gauge employee satisfaction. We also asked questions of the employees about their tenure with the company, type of job, and pay policies.

In our attempt to examine the determinants of satisfaction we distinguish between a number of factors that go beyond the effect of the policies of the company. From the research literature in psychology we know that there are individual differences that impact job satisfaction (Arvey et. al. 1991). Moreover, the specific question asked of the respondents is also of importance, the central questions about job satisfaction measure different qualities as attachment to the job, quality of supervision and other attributes. Consequently these factors should be accounted for in any attempt to examine what is under the control of the firm versus other exogenous factors. Even though the overarching policies adopted by the firm were at the plant level, group or team effects are also likely to influence satisfaction with work (Judge, Thoreson, Bono, and Patton, 2001). Finally the policies at the plant are also likely to impact employee satisfaction.

In Table 3 we show how much of the variation in total satisfaction can be explained by the more than 2000 employees of SP who responded to the satisfaction survey. Not surprisingly, the greatest part of satisfaction can be explained by individual factors, or the person effect. This explains about 40 percent of overall job satisfaction. All the other factors are statistically significant but small in comparison to the individual differences. The smallest factor is the plant

of employment, which can only explain about one percent of the total variation in overall satisfaction. Although plant level policies may be statistically important, they would be considered small by any standard metric.

The Job Satisfaction of Immigrants

At the inner city Boston and suburban plant we were able to gather more detailed information on the job satisfaction of employees. We were informed that a high percentage of the employees were immigrants from Vietnam and Cape Verde, and could not speak or write in English. Consequently, we translated our questionnaire into Vietnamese and Portuguese; respondents chose the language in which they wanted to take the survey. Thus, we are able to differentiate individuals in the plant by their degree of assimilation to English. In addition, we compare the degree of satisfaction with work with English-reading and writing individuals within the plant to persons whose main language is Vietnamese and Portuguese. Further we compare their level of satisfaction to persons in the other plants whose main language is English.

The results of the mean answers to questions we posed in the questionnaire are presented in Table 4 by language and plant. We also give a difference in means test result for persons in the four plants by language. The English speakers in the Boston facilities were the least satisfied. In six of the eight categories their responses were statistically significantly below the means of the other plants. In contrast the mean values of the Vietnamese language takers were generally above the mean. The persons from Cape Verde, who took the questionnaire in Portuguese, were usually below the mean, but the results were not statistically significant.

By probing these results more closely, we find that Vietnamese language speakers were also less likely to perceive themselves as having many labor market opportunities relative to

persons who were literate in English or Portuguese. For example for the question "It would be hard for me to find another job that provides the pay and benefits that this one does." the individuals who answered the question in Vietnamese said that they would have the most difficulty with a mean value of 3.2. In contrast persons who answered in English had a mean value of 2.7 and person who answered in Portuguese had a mean value of 3.0. Persons who were fluent in English perceived their labor market opportunities as the best among the three groups. We also examined the level of self reported "cooperation" or "getting along" among the three groups of individuals who took the survey in the different languages. The persons answering in the Vietnamese language scored a relatively high level of satisfaction in getting along with co-workers and in their higher measured respect for co-workers. For example the mean value for the 5-point scale was 3.6 and 3.7 for Vietnamese and 3.2 and 3.3 for the English and 3.2 and 3.6 for Portuguese. Similarly Vietnamese and Portuguese survey takers had higher levels of pride in working for the company. On the scale the average level was 3.6 for English, 3.9 for Vietnamese and 4.0 for Portuguese.

We also estimated a regression equation of the determinants of employee satisfaction with controls for type of job, shift worked of the employee, and time at the company. We found that English speakers in the Boston facilities were significantly less satisfied than the other two groups even after the addition of these controls. 7

7 About 10% of those who took the survey in English did so not because they were fluent in English, but because we had not translated the survey into their language. (The largest such group was from Poland; they worked through the questionnaire diligently, with dictionaries and help from co-workers.) Thus, the differential labor market opportunities for fluent English speakers are probably greater than our estimates.

Did the Change in HR practices Affect Overall Satisfaction?

As part of the effort to examine the overall effects of the HR practices on employee satisfaction we examine the change in the method of pay on employee satisfaction. Next, we examine the relative impacts of working harder and making more money on overall satisfaction.

In Table 5 we show the impact of the change in the HR practices on the change in satisfaction. For the mean employee at SP the impact was generally small. However, the satisfaction of employees who changed from time rates to VAG (ie, mean values of 3.11 and 3.03) were higher than employees who changed from piece rates to VAG (mean values of 3.04 and 2.88). This may be due to the cut in pay that persons who were under piece rates experienced after switching to the VAG formula.

In Table 6 we show the coefficient estimates from a regression equation where the dependent variable is the change in satisfaction and the independent variable is the response to working harder under the new system and the increase in pay. In all cases the values for the independent variables are statistically significant. Not surprisingly, the values for increasing pay is about five times larger than for working harder. Working harder seems to increase job satisfaction, perhaps tied to the strong view about having pride in the company, but having more pay is of considerably greater importance. Although there seem to have been small impacts of the changes to a VAG system of pay on productivity and employee satisfaction, data from the firm suggest that profitability increased, especially when compared to the industry. SP's profitability increased in part because of the firm's ability to become a "full service" supplier to auto firms, but also because the plants that were paid by piece rate methods were able to offer more diverse new products that had higher profit margins (Freeman and Kleiner, 1998). In

addition, worker's compensation costs at the urban plant were cut in half after the move away from piece rates, for a savings of $200,000 per year (an amount equal to 10% of the direct labor payroll).8.

Conclusions

Sources of SP's market success. By most measures, SP has been a financially successful company. Although the second half of 2000 and 2001 were tough years and profits were relatively low, this was true for almost all firms in the auto industry. In other years, the firm's return on equity was between 12 and 20%.

How does SP do this? It is not a particularly high-productivity operation; value added per shop worker at the Ohio plant is only $70,000, not far above the median for component producers, according to bench marking data from the Industrial Technology Institute. There seem to be several key elements to SP's success:

1. *the firm's organization*. SP combines a hands-on central office with a small number of small plants with some autonomy. This gives the firm the good aspects of a large firm (ability to invest in capabilities to develop sophisticated products and processes). However, it doesn't lose the good aspects of a small firm –eg top managers who have a deep knowledge of the business and intuitive feel for what projects make sense, and the ability to maintain some aspects of a paternalistic policy in plants (management knows workers by name). The firm's plants are located in areas where

8 According to data provided by the company, workers' compensation expenses incurred averaged $203,000 per year from 1996-99 (after the transition to gain-sharing was completed), and $413,000 from 1989-1995. (These figures are uncorrected for inflation, or the growth in hours worked over this period, similar-sized adjustments that move in opposite directions.)

engineers and management can find some amenities, yet also have access to a workforce with few alternatives (immigrants in Massachusetts, rural workers in Ohio).

2. *selective adoption of the principles of lean production.* SP has focused on inventory reduction and having engineers design for manufacturing. These efforts have allowed SP to use a relatively unskilled, low-paid work force to produce at low cost. SP has not, on the other hand, placed much emphasis (particularly recently) on broad-based participation where ideas for continuous improvement come from both line workers and engineers). There are outlets for the ambitious other than union organizing or griping, such as team leader positions and participation in programs such as WOW, or the Last Chance Club. But the 'mistake-proofing' is sufficiently successful that a moderately motivated person can do the job successfully.

3. *developing product and process expertise in a relatively unglamorous, but a growing nich*e. In contrast to firms such as Johnson Controls and Magna which have spent billions of dollars in developing or acquiring the capability to supply a large module (such as an automotive interior), SP is not now too heavily burdened with debt.

However, there are some tensions in the model, particularly with respect to the work force. Management in each of the plants is concerned about both defect and cost levels. Training efforts exist or are being worked on to exhort workers to avoid mistakes, and to train workers to take over some supervisory functions. These efforts are costly when turnover is high (as it is in Ohio (and FL?)). Over the last year, it seems that the company has begun changing the bargain

with workers (consciously or not). This is particularly true in the acquired plants. In Ohio, the work used to be moderately paced, allow one to sit down, and jobs were secure. Now pay is about to be at risk with pay for knowledge, and the introduction of work cells means that workers rotate jobs and work standing up—a drawback for the older workers that have formed a significant part of the plant's work force.

To summarize, these plants are typical of a new breed of US manufacturers today in their product, process, and HR strategies. They have succeeded in innovating, increasing quality, and maintaining productivity through clever use of engineers, without increasing pay for manufacturing workers. However, they face tensions in the model, in integrating work forces of acquired companies with different expectations, and in meeting ever-rising cost and quality demands.

The firm is unusual in several ways. The key way is in the clarity of thinking of SPmanagers, in developing and carry out their strategy, and their attention to the fit between product, process, and HR strategy. Many firms now have some form of incentive compensation for line workers, but few have placed the emphasis on it that SP has. Thus we have an unusual opportunity to watch an especially thoughtful and strategic firm explore what types of pay practices and supporting HR policies best complement its new marketing strategy as a full-service, global supplier.

The firm has been able to combine elements of both 'high' and 'low' roads. In particular, they have been able to carry out a high road product strategy of designing highly engineered products, introducing new products frequently, delivering them on-time, and (usually) without defects. The firm has agreed to take on warranty responsibility for any field failures. However,

this product strategy has not required SP to adopt all aspects of a high road HR strategy. Definitions of what this strategy entails vary9, but they usually include policies such as use of self-managing work teams, efficiency wages, training, worker participation in improvement activities—policies which SP has implemented either minimally or not at all. SP has done a masterful job, however, of implementing a contingent pay system, and of involving engineers in doing continuous improvement (in contrast to the belief in the "high-performance" literature that employees themselves are the experts and the source of the best, or at least the cheapest, kaizen).

Why does SP stay in a relatively high wage nation and metropolitan area? This has been an issue that has been thoroughly analyzed by the firm. In this industry labor costs are a small percentage of total cost (about 7%), and defects are very costly financially and in reputation capital. SP's experience with its Mexican plant has not been positive, because of many defects including engineering time to fix problems. The quality of its engineering workforce is difficult to replicate in Mexico; engineering is what SP thinks gives it a competitive advantage. The opportunity of high skilled engineers to observe the production process, and adapt the manufacturing process all in one location has helped keep this complementary matching of high and low skilled labor effective.

Points of hope? What are the benefits of SP for workers? One way to characterize them is that "workers at Hi-Stat do fairly well compared to their alternatives".

An optimist would emphasize the "do well " part, pointing out that SP's wages are high by world standards, and that SP's worker satisfaction levels are not much below national

9 See Jones, et al (this volume).

averages, and that many SP workers stay there for a long time. From the perspective of SP employees, it seems there are several reasons why many stay. First, the firm pays good benefits, including health care, pension, and paid vacation. The extra pay provided by the VAG is important. In the Massachusetts suburban plant applications for openings fell dramatically after the VAG pay out fell from almost 7% to zero. Second, the firm has found work forces that perceive themselves as having few labor market options. The firm hired many immigrants in Massachusetts, retirees and other rural workers in OH, and older workers and retirees in Florida. Third, in both Massachusetts plants the sense of community provided by working with others of the same ethnic group, and sometimes the same family, in a plant that is perceived as well managed provides many first generation Americans a sense of economic and cultural security .

A pessimist would also agree that "workers at Hi-Stat do fairly well compared to their alternatives"—but would focus on how bad the alternatives are. In this view, the worker satisfaction measures capture mostly that workers don't feel they can do much better.

Even with the VAG, SP pays well below the standards of a "living wage" adopted by many American cities. The VAG bonus pool is calculated very carefully by management, and many safeguards are put in to avoid too large a payout. However, the entire annual expenditure for the VAG incentive for the 200 shop floor workers in the urban plant is about $200,000—the salary of one top manager. From this point of view the impact of the changes in product and HR strategies is to give managers and stockholders more new products without paying a higher wage (and in the case of the urban plant, paying a lower wage). Workers report that they work harder, and now that they work for a public company rather than a paternalistic owner, they are subject

to layoffs. However, at least the firm survives, offering a fairly high probability of continued employment.

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Table 1: Production Employees Characteristics at SP

	N	% assemble	% Temp	% less 1 year	% 1to 4 years	% 4 to 6 years	% 6 to 10 years	% more than 10 years
Mass. Urban	233	63	17	12	27	14	12	36
Mass. Suburban	285	71	13	12	33	26	13	**16**
Ohio	634	54	0.6	4	35	17	20	25
Florida	482	46	1.1	17	37	18	22	7

TABLE 1a:

Urban Massachussets

Making more money under VAG	**%**
Strongly Disagree	26.21
Disagree	22.76
Neither agree or Disagree	25.52
Agree	14.48
Strongly agree	11.03

Suburban Massachusetts

Making more money under VAG	**%**
Strongly Disagree	20.23
Disagree	21.97
Neither agree or Disagree	28.32
Agree	17.92
Strongly agree	11.56

Table 2. Productivity Effects of Changes in HR practices

	Method of Pay	*% change in Productivity after change in HR practices (sales per employee)*
Massachusetts	*Piece-rate to VAG*	*-0.72% per employee*
Florida	*Time-VAG(2000)*	*+0.2% per employee*
Ohio	*No change*	

ıble 3. Impact of Working in the Establishment On Employee Satisfaction

	% of Satisfaction Explained by the following factors
ERSON EFFECT	40%
JESTION EFFECT	4%
EPARTMENT EFFECT	3%
STABLISHMENT FFECT	1%
NEXPLAINED VARIATION	51%

ble 4: Explaining Satisfaction By Assimilation Type for
ssachusetts and other Plants

	Number of Employees	Supervisors	Employment Security	Meaningful jobs	Company Practice	Pay	Working Conditions	Co-workers	Overall Satisfaction
io NGLISH)	615	3.54 (1.35)	3.81 (1.12)	3.56 (1.25)	2.73 (1.15)	2.44 (1.25)	3.57 (1.21)	3.40 (1.28)	3.47 (1.19)
rida NGLISH)	463	3.41 (1.34)	3.99 (1.02)	3.65 (1.23)	2.95*** (1.18)	2.75*** (1.24)	3.37 (1.17)	3.43 (1.28)	3.60 (1.09)
ss. NGLISH)	160	3.36 (1.33)	3.62* (1.32)	3.16*** (1.35)	2.89** (1.28)	2.47** (1.33)	3.04 (1.34)	3.21* (1.27)	3.13** (1.25)
ss. ETAME)	168	3.33 (1.27)	4.10 (0.95)	3.77 (1.17)	3.29 (1.16)	2.78 (1.34)	3.12 (1.21)	3.58 (1.20)	3.56 (1.05)
ss. (Cape rde)	164	3.65 (1.38)	3.42*** (1.43)	3.35 (1.32)	3.16 (1.28)	2.77 (1.43)	3.12 (1.32)	3.21* (1.40)	3.33 (1.40)

andard Deviation in Parenthesis. Tests of means by groups
conducted. * if p-value<0.1; ** if p-value <0.05; *** if p-
ue<0.001;

ble 5. Impact of Change in Method of Pay on the Change in Satisfaction

	MEANS	STANDARD DEVATION
rida	3.00	1.06
ss.suburban (LOC2)		
rom Piece-rate to VAG	3.04	1.29
rom Time-rate to VAG	3.11	1.21
ss. urban(LOC1)		
rom Piece-rate to VAG	2.88	1.40
rom Time-rate to VAG	3.03	1.24

tes:
r Massachusetts it is variable, Q47a/b; For Florida, it is a variable, Q37. All of these
iables indicate the change of satisfaction after changing the plans. No such a question
sked for Ohio

ble 6. Effect of Changes in Work Effort and Pay Levels on Changes in Satisfaction

lependent Variables: orking harder; Making more oney	Change in Satisfaction		
	Mass, From Piece Rate To VAG	Mass., From Time-Rate to VAG	Florida, from Time-rate to VAG
orking Harder	0.14	0.11	0.25
aking More Money	0.55	0.55	0.40

tes:

1. All variables are measured in Likert scale from 1-5.

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