GM Powertrain

What most people don't understand is how much opportunity there is to make improvements in a place like the Fredericksburg plant. A lot of the machinery is over engineered and the processes have not been evaluated for efficiency. But, the biggest issue is not in identifying opportunities for improvement, it's making them happen. You can't just tell people to do their job a new way, you have to do a lot of convincing, too. If people believe you are doing the best thing for the plant, they will go along with it.

—Joe Hinrichs, February 1997

On February 19, 1997, Joe Hinrichs drove to work excited about the progress that had been made at the General Motors (GM) manufacturing plant in Fredericksburg, VA. The Fredericksburg plant had been involved in a major process improvement effort targeted at its over-engineered, inefficient processes. When Hinrichs, a recent graduate of the Harvard Business School, arrived as the new plant manager in February of 1996—only a year earlier—it was clear to him that the plant was performing at a level that would not allow it to meet its 1996 budget; performing well seemed out of the question. At 29, he was the youngest plant manager at GM, and he was well aware of the challenges he faced.[1]

To make matters worse, less than a month later a major strike had been initiated in GM's Dayton, OH brake operations. This caused a ripple effect among the GM plants leaving Fredericksburg without any customer orders and seemingly no choice but to shut down for the duration of the strike. Facing this difficult situation, Hinrichs had surprised both the managers and the workers at GM by coming up with a plan to keep the plant open during the strike, avoid laying off workers, and even begin to make up the Fredericksburg plant budget loss during that time.

In the year since then, Hinrichs had devised and launched a comprehensive initiative to make a wide variety of changes at the Fredericksburg plant. Improvements included installing more efficient machinery, redesigning employee job responsibilities to reduce worker idle time, and

[1] Hinrichs had been employed by GM since 1989, including his two years at business school. In his first three years at the company, he had been a project engineer, a production supervisor, and a sales and engineering coordinator and liaison between GM and a Japanese manufacturing facility. After attending business school as a GM Fellow, Hinrichs went to GM Powertrain's Romulus Engine Operations, where he worked as a lead coordinator and was quickly promoted to area manager before moving to the Fredericksburg job.

Research Associate Mikelle Fischer Eastley prepared this case under the supervision of Assistant Professor Amy Edmondson as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

documenting processes to attain QS 9000 certification. Hinrichs' most important project had been to install new worker "cells" in the assembly area, and, even though only two out of eight had been installed so far, much of the preparation including design, equipment purchase, and worker buy-in had been accomplished for the rest of the conversion to cells.

Hinrichs' thoughts turned to the current status at the plant. Piles of work in progress cluttered the floor. Several old machines were half dismantled. New machinery sat lined up against the walls waiting for the old machines to be cleared out. He mentally compared this state of flux with the carefully engineered plans and drawings that specified how the plant layout and operations would look when all of the changes were completed. He wished he could move the process along more quickly.

He thought about the time it was taking to make these changes. It seemed that for every planned improvement, there was an unexpected machine breakdown or personnel problem that impeded rapid progress. Part of him wanted to make the transition as quickly as possible, so that he could show GM management how well the Fredericksburg plant could perform. But he knew this was risky. Getting the union to agree to changes that might require greater productivity from workers could be difficult. As a result, Hinrichs had made changes slowly, taking care to talk openly with union leadership, supervisors, and workers as a way of building trust. He was most successful when he laid out the plans several weeks in advance. He would get the reaction and initial backlash before the changes were made. He also took care to spread the changes throughout the plant. If he were to make too many changes in one area, and not enough in another, workers might think he was being unfair.

There had been many small victories in the past year, but also many struggles, and this morning was no exception. The 1500-ton press, one of the most important machines in the production process, had just broken down.

GM Powertrain Group

The Powertrain Group consisted of engine, foundry, and transmission operations for General Motors. These areas were formerly three separate divisions; however, in 1991, GM management brought them together to take advantage of potential synergies across the closely related areas. In 1996, GM Powertrain employed 57,072 salaried and hourly workers in 24 plants worldwide. The average plant within the Powertrain Group employed approximately 2,400 employees.

The Fredericksburg plant, located in Spotsylvania County, VA (40 miles south of Washington D.C.), produced the Torque Converter Clutch (TCC), a dinner-plate size component in the heart of the torque converter (see **Exhibit 1**). The torque converter was the component of the transmission that transfers torque from the engine to the wheels; as a car accelerates and changes gears, the torque converter allowed the engine to disengage and re-engage the drive shaft. The TCC created friction that allowed torque transfer. The Fredericksburg plant was a major producer of TCCs for GM's automatic transmissions worldwide (see Customer Information in **Exhibit 2**), earning an average of sixteen dollars for each TCC. Fredericksburg shipped TCCs daily to four Michigan transmission plants and weekly to one plant in Strasbourg, France; timely delivery of these components was critical to the success of GM's transmission manufacturing operations.

Originally built by Westinghouse in the early 1970s, this plant was purchased by GM's Delco Moraine Division in 1978. GM renovated the existing building and added over 183,000 square feet of floor space to total 277,000 square feet, making the Fredericksburg plant quite small relative to most plants in the GM family. The small-town environment marked a contrast for many employees, especially those who were transfers from other GM plants in the Detroit area. In this small community, it was not unusual for members of the same family to work side by side in the plant. For example, Roy Jones, an influential leader in the local union who held one of the more challenging jobs in the plant (heat treatment), worked alongside his wife's mother, a process inspector in the same area.

In January 1993, the Fredericksburg plant was merged into the Powertrain Group, and in 1996, the facility employed 273 hourly workers and 34 salaried employees in the management and production of the Torque Converter Clutch. In 1996, approximately 22,000 TCCs in 26 different models were produced at the plant each day, over three shifts.

During the 1980s and early 1990s, the Fredericksburg plant had made little progress in becoming more efficient, and for several years GM had considered closing the plant and outsourcing TCC production. However, as a result of a technology breakthrough, the plant had not only been kept open, it had been targeted for improvement.

In 1995, engineers at GM's Ypsilanti research facility developed a new friction material and bonding process for the TCC. They replaced the thin disk of particle board that was bonded onto the pressure plate inside the torque converter clutch with a new carbon fiber material. The new material created substantial performance advantages, saving fuel and reducing engine "shudder" in the transmission, a performance issue that was especially important for trucks. This new technology won the prestigious President's Council award within GM and was quickly protected by patent to prevent other truck and car manufacturers from copying it.

After the carbon fiber was developed and fully tested for reliability in late 1995, GM approved a $30 million investment in new equipment and tooling at the Fredericksburg plant. These funds allowed the plant to purchase new machinery specifically to incorporate the new material into the TCC production process and made it possible to improve other processes in the plant as well. Hinrichs commented:

> The $30 million offered an opportunity not only to make the necessary changes for the carbon fiber, but also to make process improvements. People don't normally like it when you come up to them out of the blue and say "I am changing your job." But if there is a broader set of changes happening all around, people are more willing to do their part. So we were able to incorporate job changes and quality improvements into the changeover process.

QS 9000 certification

Along with many other US manufacturing corporations, by the early 1990s GM faced pressure to demonstrate that its operations maintained high standards of quality and reliability. Thus, one of Hinrichs' responsibilities as plant manager was to lead a "QS 9000" certification process. Modeled after the European standard, ISO 9000 (introduced by European manufacturers in the 1980s "to promote the development of standardization and related activities in the world"), QS 9000 was developed specifically for the automotive industry. It grew out of a joint initiative in which Chrysler, Ford, and General Motors together created a Requirements Task Force to develop an American version of ISO that they called the Quality System Requirements Standard (QS 9000).

QS 9000 included all of the requirements of ISO 9000 and added a continuous improvement and cost reduction requirement as well. The goal for this standard was "the development of fundamental quality systems that provide for continuous improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain." QS 9000 was a harmonization of Chrysler's Supplier Quality Assurance Manual, Ford's Q-101 Quality System Standards and General Motors' North American Operations Target for Excellence, with input from U.S. truck manufacturers.

The QS 9000 standard applied to all internal and external suppliers of production and service parts and materials. All requirements of QS 9000 were to be incorporated into the participant's quality system and described in their quality manuals. The Requirements Task Force intended that all suppliers and plants within the "Big Three" be certified by December of 1997. Thus, employees and management at the Fredericksburg Plant had been preparing for the QS 9000 certification since late 1995. They hoped to be certified for both QS 9000 and ISO 9000 in June of 1997. Hinrichs commented:

> Certifying for QS 9000 takes a lot of time and energy. Because of the small size of this plant, most of the workers here had been lax about documenting the plant's production and quality, so for us to qualify will be a big accomplishment. Only three other plants in the Powertrain Group have qualified so far, because of the detail and rigor of the requirements. We wouldn't have thought to do this on our own, so I'm glad GM asked us to. It forces an internal discipline, which is good for the plant, good for GM, and good for consumers.

Labor Issues

The workers at the Fredericksburg plant were highly skilled and motivated. Many had been working at the plant for over 18 years and had become accustomed to the atmosphere of a small plant (see Employee Profiles in **Exhibit 3**). They also enjoyed the suburban atmosphere in Fredericksburg and had through the years become rooted in the community. They knew that if the plant closed, they might have to move to one of the other GM plants in Detroit or Flint, and many believed that the most effective way of keeping the plant open was to reduce costs and make the plant profitable. Nonetheless, Hinrichs still faced resistance when he tried to make changes.

GM's contract with the UAW made laying off workers difficult and expensive, so reduction in labor needs created by process improvements were difficult to implement. Planning for natural worker attrition was one way to deal with this; therefore no additional workers had been hired since the new investment had been approved and none would be hired to replace those who retired or left. (For additional information on union rules and regulations see **Appendix A**.)

As some of this attrition occurred before planned process improvements were implemented, for about three years plant management had relied upon overtime hours to meet any excess demand for labor. During this time, the workers had begun to depend on the overtime pay as part of their expected income. (Per year base wages averaged $42,000, overtime pay averaged $18,000, and benefits cost GM an additional $32,000.) As new machinery and processes gradually replaced the old, overtime had to be cut. This created negative incentive for the workers. Their reward for becoming more efficient on the new machinery was to receive less of the coveted (and expected) overtime pay. This remained an issue for Hinrichs as he worked to install and gain acceptance for process improvements.

The Fredericksburg Plant: 1996

When Hinrichs became plant manager in February of 1996, he faced the immediate challenge of planning a way for the plant to meet the annual budget inherited from the previous plant manager. The 1996 budget assumed substantial cost improvements, setting ambitious performance targets for the plant. Managing the budget was really about managing costs, such as labor, repairs, maintenance, utilities, tooling and other expenses, because as a cost center for GM the plant lacked near-term opportunities to influence revenues. Meeting the budget was a separate issue from managing the $30 million investment.

The plant had a history of poor financial performance, having failed to meet its budget year after year, and the first two months of 1996 had been no different (see **Exhibit 4**). By March, the plant was falling way behind its budgeted performance level. Hinrichs explained:

> The budget is a commitment by the plant that we will make a certain amount of money for GM Powertrain. General Motors, like most other manufacturers, is really pushing to get cost reduction. Cost reduction is built in to the budget, so to make our targets from a cost standpoint we have to make the budget. The whole system is tied by this process. If we don't meet the budget, there is going to be a question about whether GM should have our plant any more. From a psychological standpoint, whether we miss the budget by half a percent or 5%, we still miss the budget.

March 1996—UAW strike

The budget challenge was further exacerbated by the March 1996 United Auto Workers (UAW) strike at two GM component plants in the Dayton area. The strike forced all GM plants producing automatic transmissions also to shut down, leaving Fredericksburg temporarily without customers. Hinrichs considered what it would mean to have the workers in his plant idle until the strike was over, as the usual protocol was to lay off all workers to avoid incurring labor costs and then to re-hire them when the strike was over. He knew this would undermine his efforts to create a loyal workforce and wanted to find a way to avoid laying off workers and shutting down the plant.

Flying back from a meeting in Detroit shortly after the start of the strike, Hinrichs had an idea. He decided he would not lay off his workers. Instead, he would keep the plant open, eliminate overtime, and use this opportunity to make some changes in job assignments that would reduce idle time in parts of the plant. He also invited workers to take accrued vacation leave and asked others to do required health and safety training for the year.

Hinrichs knew this was a very risky move. There was no way to predict how long the strike would last, but because of the issues at hand it looked like the concerns would not be resolved easily. Strikes were generally resolved in two or three days, but even a five-day strike was not uncommon. If it went much longer than that, it would be very difficult to make up the lost time, and in spite of the strike, the plant would still be expected to make budget targets. Hinrichs would have to continue to pay the work force while getting no products made or shipped, which had enormous implications for the budget and for his future career at GM. Plant management was evaluated on the degree to which the plant's performance met or exceeded the budget, and this move could only hurt performance in the short run.

When Hinrichs returned from Detroit, he held an emergency meeting with his staff and the union leadership. At first both his staff and the union leaders were shocked, having shown up to the meeting expecting to negotiate how the lay offs would be handled. After they agreed to his plan, Hinrichs held an all-plant meeting. He announced that he would not lay off workers during the strike and asked for their cooperation. To enlist the workers' support, he outlined some things that the plant needed to do to get more manufacturing business for the plant from GM in the long run. He explained that without their cooperation and effort, there was no way that the plant could support paying the workers during the strike, and certainly it would be harder to pursue long run goals. Hinrichs commented:

> It's not always easy to know in advance which actions will end up making a difference. For example, this meeting turned out to be very important in building trust because we as management showed commitment by keeping the workers employed. The idea was to use the time to make some improvements and changes, but the results ended up being much bigger.

Although the strike lasted 17 working days, the plant was able to make up for some of the lost time in productivity gains by keeping focused. Having started to implement process changes during the strike, Hinrichs turned to the process improvements that would be his focus for the next year.

The Production Process (1995-1997)

A TCC consists of a hub, four springs, two spring cages riveted inside of a plate and a friction pressure plate. Fredericksburg purchased the springs from an outside producer, but the plates were cut, hardened and assembled with the springs at the plant. **Exhibit 5** depicts the steps in the production process; the chroming process was outsourced; batches of 5500 stamped plates were shipped to a vendor and returned to the plant within 24 hours.

Evolution of the Assembly Line

Roughly 60% of the processes in the plant were being changed, most of them in the assembly process. The assembly process was a critical aspect of TCC production; a poorly assembled TCC could cause an automatic transmission to fail completely. Thus, quality and efficiency were very important to the Fredericksburg plant. Over the years, plant management had set up a series of four different assembly processes in an attempt to improve the process.

Assembly Process #1 The oldest assembly line still in existence at the plant was constructed in the early 1980s and was designed for 13 operators to work simultaneously in a traditional assembly-line lay out. The 13 operators in this worker-paced assembly line could produce an average of 3500 TCCs in a shift. Each worker had a specific task to complete in a fixed location on the line. (See **Exhibit 6** for a diagram of the assembly lines.) The number of operators could not be adjusted; if just one operator were missing, all others had to wait. Although it was generally easy to locate another employee to work in the line, critical momentum was often lost at the start of a shift, so that eight people might be waiting 15-20 minutes while someone else was pulled from elsewhere in the plant. Hinrichs explained, "it's a psychological thing; when you start out behind, you never regain that momentum and you lose the opportunity to feel really good about what you accomplish that day."

Assembly Process #2 In the mid-1980s, a second assembly line was constructed. This line was designed much the same as the first, except that it occupied less floor space and through combining some of the assembly steps required only 8 operators to assemble 2800 TCCs in an eight hour shift.

Assembly Process #3 In 1992, engineers and operators at the plant responded to pressure from GM to make the plant more efficient by constructing an assembly process based on the manufacturing "cells" concept. It consisted of three cells, each operated by one, two or three people, and with three operators each cell was able to produce an average of 1000 TCCs in a shift. In these cells, operators worked on individual, repeated tasks in a fixed location often waiting for machines.

Assembly Process #4 After his arrival in the plant, Hinrichs began working with engineers to continue these improvement efforts. His goal was to leverage GM's investment in the plant to make the assembly process more efficient and reliable in ways that would not only improve product quality but also reduce labor costs. Hinrichs also hoped to free up valuable floor space in the plant by eventually eliminating the older assembly lines, thereby enabling the Fredericksburg plant to compete for additional manufacturing business from GM.

A new kind of assembly cell had been developed by GM's engineers in Fredericksburg that utilized single-operator work stations. Each cell consisted of two separate work stations that allowed operators in the adjacent stations to share the expensive balancer machine. Each station was designed to be operated by one person assembling 500 pieces per shift; however, the stations had the flexibility to add one or two additional workers when increased output was needed with each worker still producing close to 500 pieces per shift. The operator walked around the cell instead of sitting in a fixed location (see **Exhibit 7**). This set up was both ergonomically better than the previous assembly line, and allowed each operator to access more machines than would be possible if he or she were sitting down. The first cell was installed in August of 1996.

Two key features were designed into these cells. The first was design consistency; processes and machines were designed to be the same for all of the cells. This meant that it was easier for the operators to assemble any of the TCC models because all of the machines and processes were alike. In addition, the same parts could be stocked, so inventory was cut down in the tool crib by at least half. The second key feature designed into the cell was flexibility. The tooling could be changed to produce different models. So, if volume demand went down in one area, and up in another, with minimal cost, the machine's tooling could be modified to produce another model. And because the number of operators working simultaneously in a single cell could vary from one to three, the system was flexible in terms of volume also. If demand for a certain model were to increase, the cell design made it easy to increase production volume accordingly. Finally, operators could in a moment's notice move into a neighbor's cell to produce an equivalent total number of TCCs, in the event of equipment failure in one of the stations.

The method engineers used to assess the quality coming off the end line was called Process Failure Mode Evaluation Analysis (PFMEA). PFMEA's were processes that multifunctional groups followed to assess all possible failures and put systems in place to detect problems. Possible failures included anything that might lead to from mild customer dissatisfaction with transmission performance to complete transmission failure. Engineers designed machines that would reject a faulty TCC at any stage in the assembly. For example, the Damper Spring Stuffer was designed to check for the presence of the inner springs. If a spring were missing, the partially assembled TCC would be routed to a "seconds" pile and the Damper Spring Stuffer would begin to assemble another piece.

The most important factor in achieving the cell's productivity improvement was that the cell was set up for a single operator to pace the process so that he or she would never be waiting either for a machine or for another person in the line. Kristie Gebhardt, manufacturing engineer and production supervisor, explained:

> We have been getting better productivity and higher quality parts. In the new cells we only produce three to four faulty TCCs per day. In the old cells where we didn't have error proofing PFMEA built in, we get roughly 40 rejects or more per day. The cell operators recognize when they start to have faulty pieces in their line. They like being self paced. They don't have to depend on others. On the old assembly line they were always waiting for someone else. If one of the operators had a problem, the whole line stopped. In the cells, they can say "I made 6 baskets today. That's a record. " So they are really starting to take pride and say "I can do this".

Many of the workers did not want to move to the new cells. They were reluctant to be walking and standing instead of sitting. Hinrichs kept the workers very involved in the installation of the machinery by inviting them to examine the cells while they were being installed and give him their reactions. This piqued the interest of some of the higher seniority workers who began applying for jobs on the cells. When the first cell was installed, two senior workers requested to be assigned to it. They were excited about the opportunity to control their own output and be involved in a new process. Linda Butler, one of those workers, commented:

> In the cells, if there is a mechanical problem with a piece of my equipment (besides the balancer), I can go over and help my partner on the other side and we can produce just as many together as we could using our own separate cells. This makes me feel like I have control over what I do instead of just waiting on machines or others all of the time.

An additional cell was already installed and would be in use by March 1997. Pilot tests indicated a high success rate in meeting the production schedules and very minimal downtime for new equipment, so six additional cells had been ordered and were expected to be delivered in April 1997.

Additional Changes

While Hinrichs focused his long-term attention on the major changes with the assembly lines, many of his decisions revolved around day to day issues and smaller changes within the plant. Many of these changes focused on reducing worker idle time by combining responsibility for previously separate but related jobs. One example of change was in the Ajax heat treat area. Three workers served as full-time inspectors, assigned to examine the plates for quality after they came out of the heat treat process. On his walks around the plant, Hinrichs noticed that the inspectors spent most of their time waiting for plates to be treated and that Jones and the other operators who ran the heat treating process had time to do the inspection while they waited for the process to finish. Hinrichs decided to transfer the inspectors to other jobs in the plant and to have the Ajax operators trained to inspect for quality in addition to running the heat treatment operation. This kind of evaluating and re-designing of jobs characterized much of the process improvements in the plant (see **Exhibit 8**).

Hinrichs also focused on combining processes to increase efficiency. One example was in bonding. Bonding was a particularly important step in the manufacturing process, critical to the safety and reliability of the entire TCC. Hinrichs explained:

> We can assemble (and consequently get paid for) only what we produce off the bonders (the last process before assembly). As the new bonders get converted over we will need active involvement in learning and training others how to run them. It is my belief that the bonders will be the new bottleneck of the plant. Therefore it is critical that we maximize the production of these pieces of equipment.

The old bonders—large machines installed in the early 80s—clamped the friction material to the plate using heat and pressure. These machines each required two operators, one for loading and another for unloading, who found it difficult to ascertain whether any malfunction had occurred. To ensure the quality of the TCCs, Hinrichs believed it was necessary to replace the old bonders with new equipment.

A single operator could load and unload the new bonders and simultaneously monitor production data generated by Allen Bradley computerized equipment built in to the machines. The bonder signaled when a problem occurred and let the operator know to stop and fix the process. As in the assembly cells, the operator had to stand throughout the shift to load and unload the plates, and workers initially expressed concerns about fatigue.

It took three months to install the new bonders. The first of seven was completely installed by November of 1996, and two more were up and running by March of 1997. Despite their initial concerns, after trying out the new process, several workers found that they liked it. Touring the plant one morning, Hinrichs was approached by a high seniority employee, who already held one of the most desired jobs in the plant, who told him that he wanted to apply for the bonder job.

Remembering this, Hinrichs said, "The bonders have gone beyond my expectations; they are more involved and they're learning more than I ever expected."

Finally, Hinrichs and several process engineers had been working on developing a new die for the 1500-ton press, which would allow considerable labor and other savings if they could pull it off. Technically challenging, the new die had so far failed to operate as anticipated, despite working on it for almost a year. For instance, during the last three plant shut-down periods, the engineers had worked hard to get it to work, and in December of 1996, a number of employees were brought in to help experiment with the new die during the two-week Christmas shut down.

Additional Challenges in 1997

On the morning of February 19, 1997, Hinrichs arrived at the plant to find that the 1500-ton press was inoperable. The shafts, originally installed in 1979, had broken due to excessive wear over time. The press was not only the first step in the production process at the plant but also the process bottleneck. Because of the importance of this process step, Hinrichs tended to keep about a day's worth of WIP inventory after the press, ready for slurry blast, bonding and assembly.

As he examined the inoperable press, Hinrichs considered three options:

(1). He could contact skilled tradesmen from outside the plant to repair the press immediately. This would allow workers in the plant to continue to produce the TCCs needed for today's shipments from the inventory of stamped plates. Despite this legitimate reason for hiring outside contractors, he knew the union might file a formal complaint about his failure to use skilled tradesmen from within the plant. However, also knowing that this decision would be within the bounds of contractual obligations, Hinrichs felt he would be able to explain his reasoning to the local union leadership and avoid a major problem. He estimated that it would take a full day to fix the press and that he would incur about $75,000 in repair costs.

(2). The press could be repaired using new parts to replace the twenty-year old equipment currently in place. This would require about four days of downtime to obtain the new equipment and complete the repairs and would cost an estimated $210,000; however, it would be possible to avoid the appearance of hiring outside workers as the vendors would include installation as part of the cost of the project. To avoid interrupting delivery of TCCs to GM, the plant would have to outsource the three process steps handled by the 1500 ton press; this would add $2 in production costs to each TCC. Hinrichs believed that the new equipment would make the press more reliable, which would allow him to eliminate a job that was devoted primarily to trouble-shooting from the stamping operation.

(3). Another option was to repair the press (using either new or old equipment), and at the same time to install the new, more complex die to supplement the die currently used to stamp out the plates. The new die would eliminate two steps in the process, thus allowing the 1500 ton press to accomplish three steps at once. In the current process, the first step was to stamp out the 10-inch disk, the second step was to machine the bore, the third step was to chrome the plate (this step was outsourced), and after the plates arrived back at the plant, the fourth step was to punch rivet holes. (See Plate Process Flow Diagrams **Exhibit 9.**) The new die would press the plates, machine the bore and punch the rivet holes simultaneously—followed by the chroming process which would continue to be outsourced. This option was technically ambitious and there was considerable uncertainty about how well it would work and how long it would take. Although the old die would remain in the press and continue to be operable in case of malfunction of the new die, the conversion was nonetheless expensive. The repair costs would be about the same as the other two options—depending on whether they used new or old equipment—but the new die itself would cost $250,000, and the down time during which the press would be inoperable would be about two weeks. Hinrichs estimated that running the stamping operation with the new die would use three fewer operators each shift, but because of all of the changes entailed would take at least three months to be fully operable.

In making his decision, Hinrichs had to consider his overall plan for moving forward. He thought about the improvements they had made so far. Despite unexpected problems, in general, there had been steady progress. He also had to consider the impact of his decision on his 1997 budget and performance evaluation. As plant manager, he couldn't afford to make large investments for which there was insufficient financial return. And, after deciding what to do, he also had to figure out how to get it done. How would this decision affect the roll-out plan he was following for the installation of new equipment and process changes at the plant? He wondered about the integrity and longevity of the changes he was making. Would they be long-lasting? Would the plant workers continue to increase in their excitement and pride as a result of the independence they felt while working in the new cells?

Finally, Hinrichs had to think about the longer-term future of the plant. He wondered where else he should focus his efforts in the next 18 months in order to take advantage of the energy and excitement that currently existed at the plant. He was confident that the process redesigns were financially advantageous for the plant, but he wondered what he would still need to do to create an environment where not only management but all of the workers would cooperate, create, and continuously strive for quality and efficiency.

Appendix: United Auto Workers Union

The United Auto Workers (UAW) International Union was started in 1936, and organized the first strike at the Kelsey-Hayes Wheel Company which made brakes for the Ford Motor Company and employed 5,000 workers. From there it grew quickly and today represents most hourly workers at the Big Three auto makers.

The UAW is organized into local unions made up of members employed in the bargaining unit or units of one or more employers. The UAW Constitution requires each local union to adopt by-laws and conduct open and fair elections of officers as well as their bargaining committee (also known as the top committee or shop committee). These elected bargaining representatives negotiate contracts with the assistance of the International Union. In addition, bargaining representatives are responsible for handling member grievances and answering their questions about local and International Union policies. The local union meets regularly to discuss current issues. The union contractually precluded changes in compensation systems, making it impossible for plant managers to alter pay or benefit structures in any individual plant. (For more information see the UAW Web page: http://uaw.org/index.html)

The grievance procedure Each UAW member has the right, under UAW contract, to resolve problems with management through a negotiated grievance procedure. The grievance procedure varies across different workplaces, however, the basic steps of the grievance process are as follows:

1. When a UAW member has a complaint or problem that cannot be resolved between the member and the supervisor, he or she has the right to request union representation.

2. The union representative will discuss the member's complaint with him or her, investigate the facts, and talk with the supervisor.

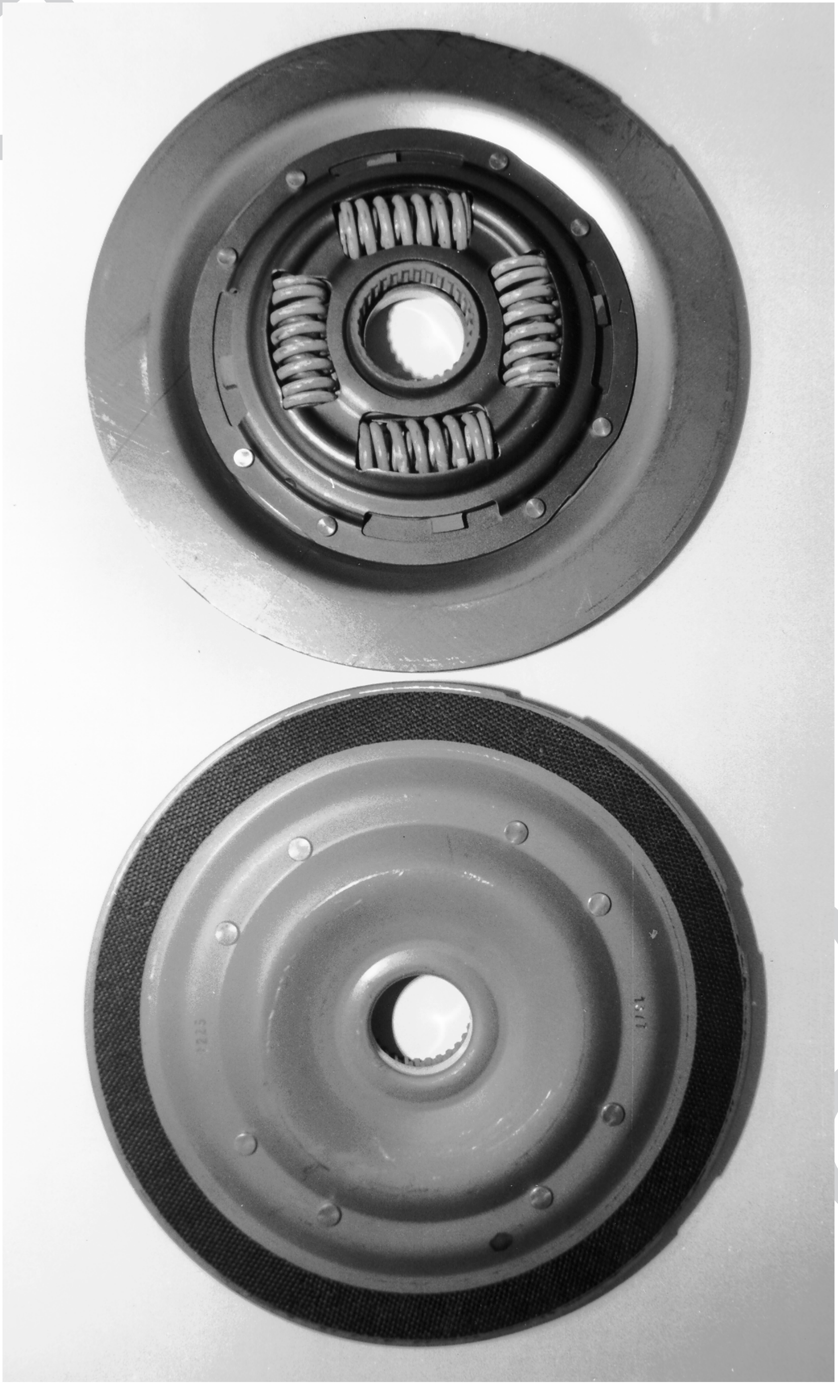
3. If the union representative and supervisor are unable to settle the issue and the grievance has merit, the committee person will put the grievance in writing and pursue it through several additional steps of the grievance procedure including outside arbitration.

Collective bargaining The collective bargaining process is a democratic method used to negotiate new agreements. The written collective bargaining agreement typically covers wages, benefits, working conditions, grievance procedures, seniority, union representation, hours of work, vacation and holidays, dues check-off, and union security.

In Fredericksburg, the UAW local union #2123 had eight full-time (president, shop chairman, 1st shift committeeman, 2nd shift committeeman, benefits representative, quality network representative, health and safety representative, employee assistance program representative) and three part-time union representatives (civil rights chairman, 3rd shift committeeman, communications/training representative). These members represented 95% of the workers at the plant. Because Virginia was a "Right to Work" state, non-union workers had the right to be hired and there were a small number of non-union members at the plant. Supervisors were not UAW members. Employee benefits in the plant included 15 holidays, 5 weeks vacation time, and full dental, vision, medical insurance.

Source: United Auto Workers Web Page: http://uaw.org/index.html

Exhibit 1 The Torque Converter Clutch



← Inside

← Outside

Exhibit 2 GM Powertrain (GMPTG) Fredericksburg Customer Information: October 1996

Direct Customers of GMPTG Fredericksburg	
GMPTG Flint Components Plant	Flint, MI
GMPTG Willow Run Plant	Ypsilanti, MI
GMPTG Strasbourg Plant	Strasbourg, FR
GM Service Parts Operations	Flint, MI
Eaton Corporation	Marshall, MI

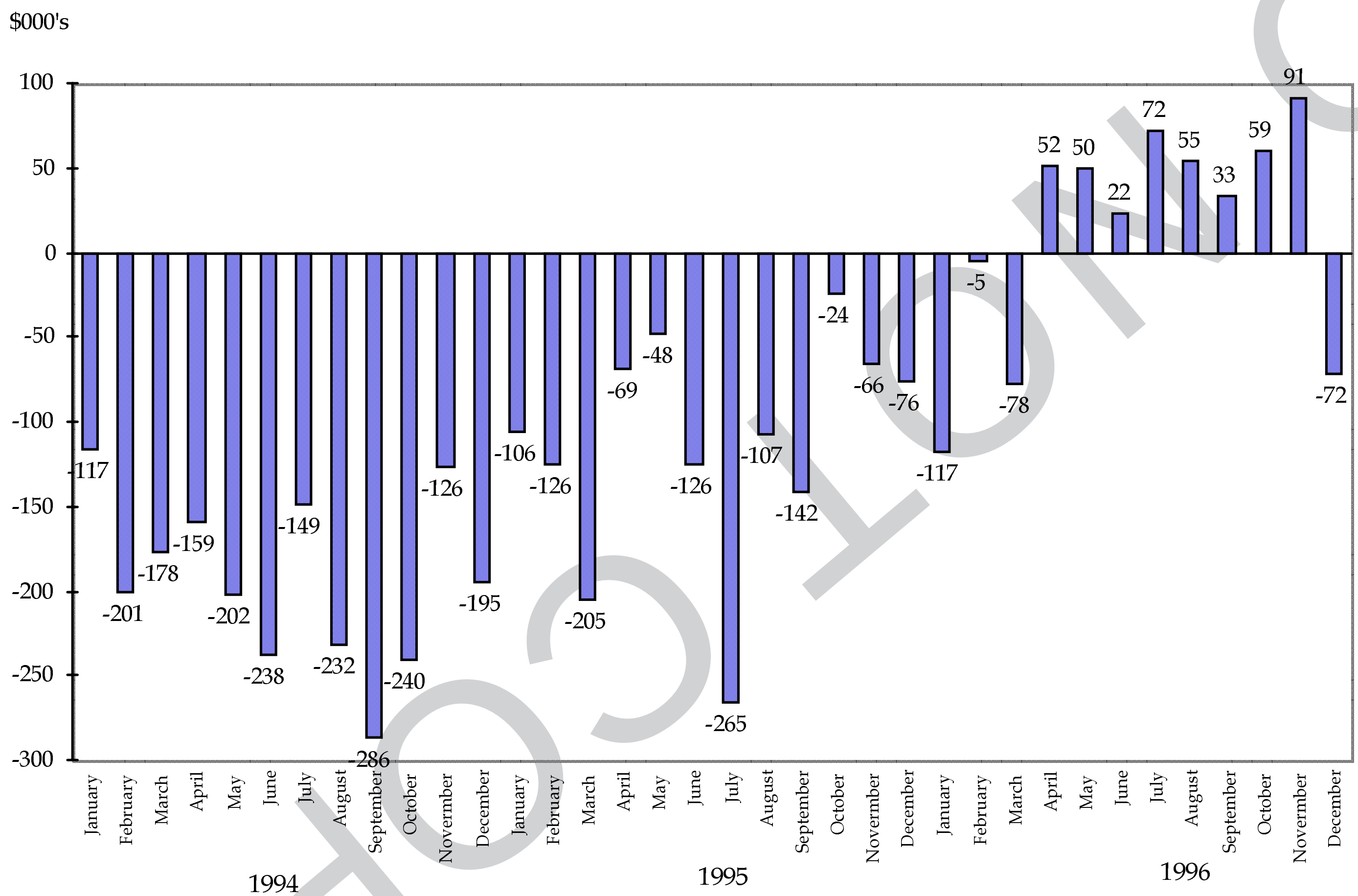
Vehicle OEM Customers Using GMPTG Fredericksburg Components	
AMG	Isuzu
Aston Martin	Jaguar
BMW	Oldsmobile
Buick	Opel
Cadillac	Pontiac
CAMI	Rolls Royce
Chevrolet	Suzuki
Daewoo	Vauxhall
GMC Truck	Volvo
Holden	

Exhibit 3 GMPTG Fredericksburg Employee Profiles

Hourly Employee Data	
Average Age:	45 yrs., 9.5 mos.
Average Plant Seniority:	8/17/82
Local Hires:	165
Transfers:	108
Projected Retirees by 2000:	52

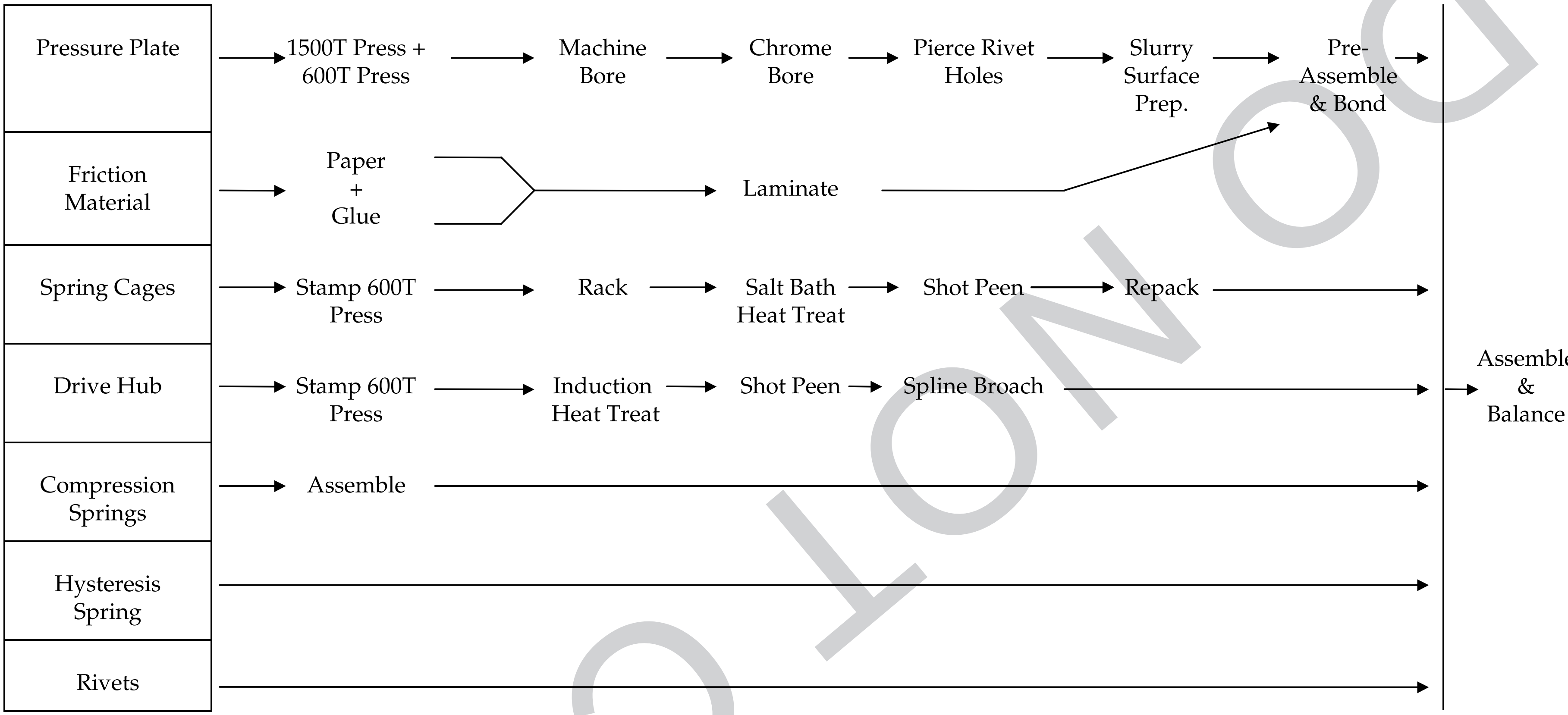
Salary Employee Data	
GM Employees:	34
Average Age:	41 yrs., 8 mos.
Average GM Seniority:	18.1 yrs.
Contract Employees:	12
# of Engineers:	12
Transfers:	13

Exhibit 4 GMPTG Fredericksburg Budget Attainment



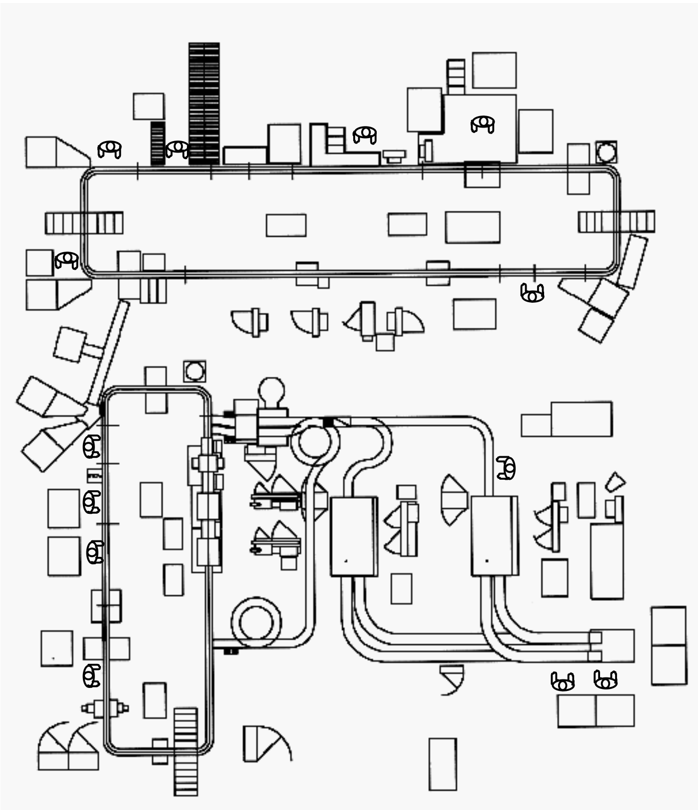
*All numbers have been disguised.

Exhibit 5 Generic Process Flow for the Torque Converter Clutch

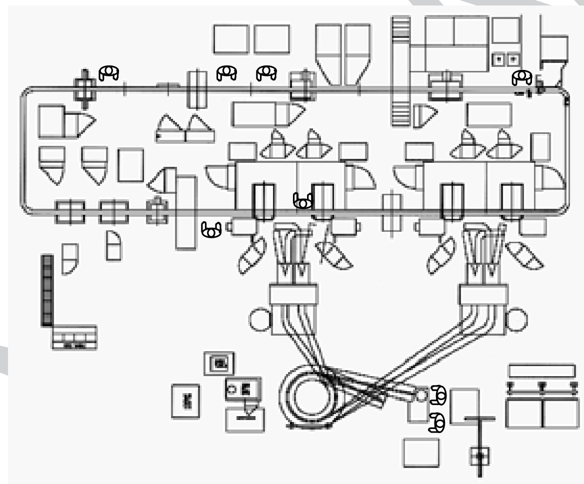


The steel for the plates comes in to the plant in large rolls. The presses stamp the pressure plate and the spring cages, and the drive hub. The pressure plates go through a machine bore, and chrome bore. They then get rivet holes pierced. The plates are then put into a slurry blast. The slurry blast roughs up the surface of the plate so that the glue that attaches the friction material to the plate will hold it sufficiently. The friction material is cut from a roll into puzzle pieces 1/4 of the size of the circle out instead of cutting a ring and wasting the inside circle. The Spring Cages are taken to the Ajax heat treatment area where they are hung on racks and the racks are lifted by machine into a hot salt bath. The cages are then taken to shot peen where they go through a further hardening process. The drive hub goes from the press to the heat treat area, then to the shot peen and finally to the spline broach where grooves are punched in the hub. The parts are taken to a "supermarket" where they are sorted and re-packaged into smaller batches for assembly.

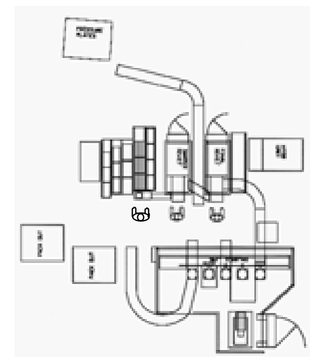
Exhibit 6 Assembly Process #1, 2, 3 Top Down Layout



Assembly Process #1

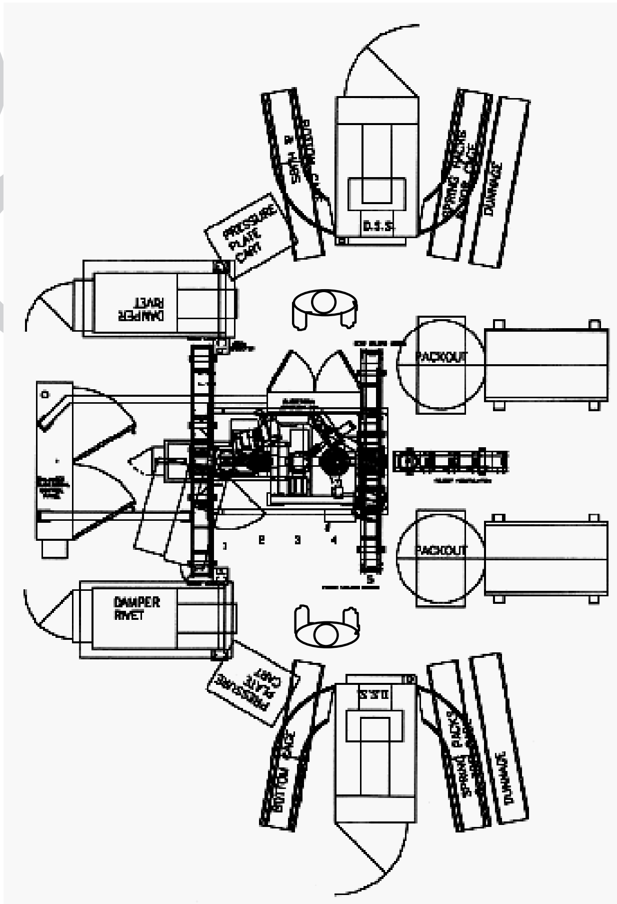


Assembly Process #2



Assembly Process # 3

Exhibit 7 Assembly Process #4 Top Down Layout



The first machine in the assembly cell is the Damper Spring Stuffer. It takes individual components for the spring packs and assembles them into the spring pockets. This machine was put in not only to help out with the timing but also to address some ergonomic issues. In TCC assembly, putting the spring packs into the spring pockets by hand puts stress on the wrists and arms.

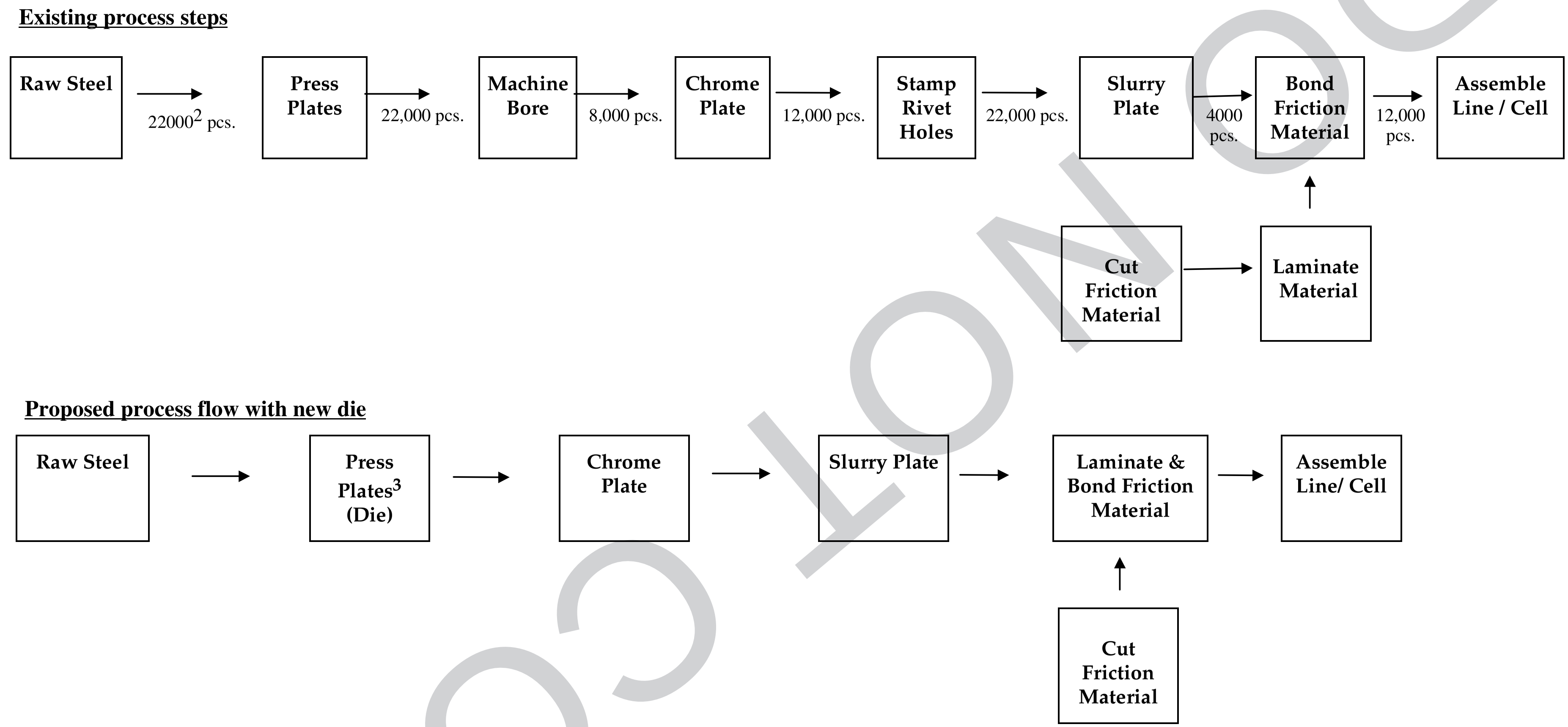
The second machine is a Rivet Upset Press. The operator takes the completed damper from the damper spring stuffer and adds a pressure plate and rivets.

The last machine is the balancing gauge line. It is a completely automatic machine which automatically loads the plates from the rivet upset, into the balancer. Next, it spins the TCC and punches grooves out of the perimeter until the weight in the unit is completely even. Then it gauges for 7 different parameters: flatness, high and low concavity, and max. and min. bore readings. If the plate is within given parameters it unloads the clutches to the bin; it sends unsatisfactory plates down a different chute.

Exhibit 8 Productivity Improvements: 1996 Job Reductions

Area	Description	Number	Date Completed
Viscous Bonding	Relocation and redesign of cell	-1	April 1996
310 6-Lobe Assembly	Relocation and redesign of cell	-2	January 1996
Ajax Inspection	Trained operators for self- inspection	-2.5	July 1996
4-Lobe Assembly	Automatic Spring Stuffer installed	-2	January 1996
Receiving Inspection	Receiving Inspection eliminated	-1	July 1996
InductoHeat	Outsourced Heat Treating hubs	-3	October 1996
Laminator	Bonder Cells have lamination in-line	-1	December 1996
	Total	-12.5	

Exhibit 9 Stamping Operations Process Flow



2 Work in progress numbers for February 19, 1997.

3 The first hit of the press would cut the plate, the second hit forms the edge currently done by the machine bore step and the third hit would stamp rivet holes.