Transitioning A Maintenance Culture In A Plant

by

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Submitted to the Department of Mechanical Engineering and the Sloan School of Management in Partial Fulfillment of the Requirements for the Degrees of

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Abstract

Research was performed on the topic of cultural change in a manufacturing environment. The specific area of study was maintenance operations. The author spent six months learning maintenance procedures and culture in an automotive internal combustion engine manufacturing and assembly plant, and prepared a process for cultural change suitable to the culture and environment of the maintenance operations in that plant.

Benchmark studies were performed on the maintenance operations of the New United Motor Manufacturing, Inc. (NUMMI) assembly plant in Fremont, California and the maintenance operations of the Saturn Corporation in Spring Hill, Tennessee. These benchmark studies provide a model of good maintenance practices for automotive manufacturing plants to follow.

The result of the research is a process for cultural change in a auto manufacturing or assembly plant. The process is intended to be general in nature, applicable to fabricating, machining, stamping, assembly, or other automobile manufacturing plant. Specific recommendations are provided for cultural change in the plant in which the author spent six months. These stem from the author's familiarity with the plant's cultural artifacts, values, and assumptions.

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Table of Contents

Section I:
The Importance of Maintenance

Maintenance is an important part of manufacturing. Until the machine is invented that never fails, breaks, fatigues, misaligns, and is immune to power failures, maintenance will be a necessary and critical part of the production of any manufactured product. The necessity of maintenance is not the only reason it is important, however. From a manufacturing standpoint, maintenance drives the cost in a plant in both obvious and subtle ways. Maintenance systems and procedures in a plant have a direct effect on the throughput, indirect materials costs, direct and indirect labor costs, and scrap costs.

Despite the fact that maintenance is important in manufacturing, the facilities and equipment maintenance function in many manufacturing plants has long been neglected, relegated to the status of second-class citizen in the social circles of manufacturing. In today's environment of increased manufacturing competition, when every company is attempting to squeeze the utmost of efficiency out of their manufacturing processes, it seems unusual that this attitude toward maintenance would persist, but it does. This section of my thesis explores some reasons why this might be the case, and argues for why many manufacturing firms would do well to place higher priority on their facilities and equipment maintenance. It illustrates these statements with examples taken from several different manufacturing environments.

One major cause of the negligence that maintenance experiences stems from the fact that the career paths of people who make decisions in a plant often do not include maintenance assignments, and maintenance people often never leave the realm of maintenance to be promoted into those positions. There are two reasons for this. First, maintenance management is seen somewhat as an art, so people who are good at maintenance management generally stay in maintenance. This is compounded by the fact that to be accepted in most maintenance cultures, you need to have experience in maintenance. Someone who is good at managing maintenance has probably been a maintenance supervisor or manager for a long time, and it is unlikely that he or she will be promoted into a position where his experience will not directly come to bear in his or her work.

Second, because maintenance is not deemed a prestigious assignment, even within manufacturing circles, many people who are on their way up the corporate ladder never get any maintenance exposure. Maintenance workers are canny, and they

know when a "fast tracker" has been assigned to supervise them for a short period of time "to get exposure to the world of maintenance." They resent the fact that they are the employee guinea pigs for this person's supervisory skills, and can make a "short assignment in maintenance" turn into an unsuccessful nightmare for any aspiring manager. Because this is general knowledge, people who are not intending to make a career of maintenance tend to shy away from maintenance experiences.

There is a myth of second-rate status that goes along with a position in maintenance. Supervisors or managers who are working in maintenance are sometimes looked down upon as employees that were "not good enough" for other jobs. This myth comes about because of the schedule that most maintenance departments follow, which is very demanding. Because the need for maintenance is especially high during times when the machines are not being used productively, maintenance workers and their supervisors often work long hours. While some people enjoy the large amounts of overtime pay this work can generate, some find that giving up their nights, weekends, and holidays for scheduled maintenance work is too much. The myth stems from the belief that the best people, the ones who can choose where they want to work, and who would otherwise be excellent maintenance supervisors or managers, are scared away from positions in maintenance because of the hours, leaving those assignments to the second-rate supervisors and managers.

Another factor that contributes to the negligence of maintenance in many of America's manufacturing facilities is the accounting system that companies use in which maintenance activities are considered overhead costs, or burden. Because maintenance costs, labor, spare parts, materials, scheduled downtime, even tools, are indirect costs in this accounting system they are therefore considered non-value added. By the strict definition of value-added, this is true, but a fact that is not always on the forefront of peoples' minds is that without maintenance departments maintaining and repairing the machines, there would be no production to which value could be added. It is very easy to see the expense of maintenance, but very difficult to see the benefits.

Some people think that maintenance cannot make money for a plant. Certainly by observation, it is difficult to see the results of increased maintenance spending. This is true because there is a time lag between a change in maintenance spending and the effects of the change on the production system. This effect works two ways. It creates an incentive to reduce maintenance spending to meet short-term budget commitments, and it provides a disincentive to increase the maintenance spending to increase the availability of the manufacturing equipment.

Maintenance managers who are evaluated on their ability to meet budget will always have difficulty doing the right thing for a plant from a maintenance standpoint. When the pressure is on to reduce costs, as it is every few years in the business cycle, the first expenses to be cut in many plants are the maintenance costs. The rationale in peoples' minds for cutting maintenance spending is that machinery and equipment will be fine without high levels of maintenance for a while until the pressure to reduce costs blows over. As equipment gradually slides downhill in performance and availability the incremental losses are rarely noted, and even more rarely brought to the fore as a result of reduced maintenance on the equipment.

Once the equipment has degraded to the point where it is no longer available to meet production targets, something has to be done. At this point, it requires a huge expenditure, in both money and time, to recondition the machines to the point that they were several years before when the maintenance expenses were cut. In fact, the money spent to recondition the equipment could be more than what would have been spent to have maintained the equipment in top-notch shape all along. In addition to this large one-time expense incurred to recondition the equipment, the budget must be increased annually to allow for proper preventive maintenance of the newly-restored equipment. The total of these two increases in spending always seems large compared to the maintenance budget, and it takes a very disciplined and patient manager to approve the expense and wait for the results to show up in increased availability that leads to higher throughput and reduced production and scrap costs.

The maintenance budget and the way it is handled at a manufacturing company can have another effect on the way maintenance is performed there. At Exxon, for example, the maintenance budget for one refinery includes only planned maintenance costs. Unplanned and unscheduled breakdowns, or emergencies, are considered impossible to budget, and they are paid for without question because the expenses are necessary to the operation of the refinery. This situation creates an incentive in the maintenance department to let equipment fail, because when it fails the expense of the repair is not counted against the maintenance budget. If the maintenance department had been performing preventive maintenance on the equipment to prevent its breakdown, the expense of the maintenance would drain the budget of the maintenance department.

Even the hourly work force contributes to the problems that maintenance departments have in changing the way they do business. Many of the workers that are attracted to the skilled trades positions from the hourly work force see the job as a high-profile chance to be a hero. Whereas each production worker is tied to a process

and is no more important than any other production worker, the maintenance workers tend to be more individualistic. They perform different tasks every day, sometimes working in small groups and sometimes working alone. Many maintenance workers like the opportunity to be the hero when a machine goes down. They wait for a machine to fail that they can fix, and when it fails, people sing their praises that they were able to fix the machine.

The switch to a more proactive maintenance approach that would undoubtedly accompany any increase in the importance in maintenance operations within a manufacturing plant would mean the eventual elimination of the opportunities to be the hero in a breakdown scenario. This would be the case because a breakdown would no longer be an acceptable occurrence in a plant that valued maintenance activities. Instead of being a hero for getting the machine up again, the maintenance worker would bear the brunt of blame for the fact that it broke down in the first place.

Although many people would say that maintenance needs to be given higher priority throughout the manufacturing community, a word of caution is advised. Maintenance does not necessarily need to be a higher priority -- it needs to be the right priority. It is possible to spend too much money on maintenance, and not get good value for the dollar spent. Many highly technical predictive maintenance techniques such as thermography and infrared analysis can be extremely useful under the right circumstances, but if not used properly, or if underutilized, they can be very expensive technologies to have sit on the shelf.

Some plants spend too much money on preventive maintenance, performing oil changes before the oil needs to be changed, or swapping out critical parts before they have reached the end of their useful lives. It is important in managing preventive maintenance to have a dynamic system that is able to respond quickly to changes in maintenance schedules. It is also important to understand *why* the oil is being changed as often as it is. Without that understanding, wrong decisions about the equipment maintenance schedule will be made at some point.

Some plants spend no money at all on preventive maintenance, instead relying on "breakdown maintenance," or fire-fighting, to keep the operations running. This is often the most expensive way to maintain equipment, because it usually incurs the cost of lost production every time maintenance is performed. It should not be dismissed as the "wrong thing to do," however. In some cases, for example when equipment is in parallel operations with plenty of reserve capacity, this may be the most cost-effective maintenance strategy. What is important is *managing* maintenance, making informed decisions to do things a certain way based upon facts. Often, the way that a plant runs

their maintenance operations is more a function of "the way things have always been done" rather than of a conscious, informed decision to maintain equipment in a specific manner. Each plant has to determine what maintenance strategy is right for them for each operation.

Choosing the right maintenance strategy for each operation in a plant requires plant management that understands maintenance and the trade-offs involved between choosing various maintenance strategies. Some plants, like chip fabs, run constantly, twenty-four hours a day, seven days a week. Finding the right balance between lost output due to scheduled maintenance downtime and lost output due to unscheduled breakdowns as a result of not enough scheduled maintenance is difficult. Other plants, like paint and dye plants, have a weekly business cycle that naturally lightens the load on Fridays, allowing parallel operations to be shut down on a rotation basis for scheduled maintenance. Every plant is unique in its maintenance needs and situation.

It is true, however, that in many cases plants would benefit from increased priority on their maintenance activities. A study of oil refineries in America shows that the refineries that are the most profitable are the ones that spend the most money on maintenance. The oil refining industry is undoubtedly not unique in this characteristic.

The things that can be done within a plant to increase the importance of maintenance are manifold. The improvements must be driven from the top, however, by a plant manager that has definite expectations for maintenance. The plant manager must expect that preventive maintenance will be performed, and must follow up on the results. It is not enough to just check budget conformance either. A comprehensive maintenance management system must set goals and measure progress on many fronts, including downtime, number of unscheduled line stoppages, overtime costs, spare parts costs, and training costs.

In the effort to increase the importance of maintenance within manufacturing, it would be helpful to have an accounting system that calculated the lost production costs of downtime to charge it to maintenance. Even if this were not officially made part of the business reporting, having the information about how much cost, in lost revenues, is associated with machine breakdowns, or other line stoppages, is crucial to creating a sense of urgency about maintenance operations. At some plants, where maintenance is not a priority, people on the line do not know how much a minute of down time costs in lost revenues. At a plant such as NUMMI, where maintenance is an integral and important part of their manufacturing process, any line workers can tell you that one minute of downtime costs NUMMI about $8,000 in lost revenues.

Another factor in increasing the importance of maintenance in manufacturing is to infuse a delicate balance of pride and humility into the skilled tradespeople and maintenance supervisors. The people in maintenance must be willing to be unsung heroes, satisfied with a job they know is well done. They must be satisfied with this because often they will receive no more accolades than they give themselves for a completed job. This attitude of humble importance must infiltrate the whole maintenance culture, from the maintenance manager to the janitor. An ideal maintenance culture would have pride and dedication, but not arrogance.

At one plant, a research intern attempted to improve the PM effectiveness of the bottleneck operation on a line. It happened to be a brazing operation. A general edict had been given by plant management prior to the intern's arrival that in order to increase the throughput of the whole line, the brazing operation would be PMed for two hours once a week in the morning, during time that production could be running on the brazers. The plant manager had an understanding of what needed to happen, and even an understanding of why. What the plant manager lacked was a sense of expectation about the results of his edict.

On the morning that the brazers were down for PM, the maintenance people responsible for performing the maintenance on them would show up twenty-five to thirty minutes late for work. They would report to the brazers, which were not in use, and attempt to determine what, if anything, needed to be maintained. They turned things on and off to ensure that they were "working," and visually inspected the brazing tips to see if things "looked right." There was no communication between the operators, who were having problems with the brazers, and the maintenance people, who did not understand what was wrong with them. They would spend about forty-five minutes at the machine, and then leave.

For the price of two hours of lost production, the plant manager was getting about forty-five minutes of cursory visual inspection of his bottleneck operation. No expectations in a case like this usually means no results. Because he had not set expectations for the preventive maintenance program, he did not get any results from the program.

Seeing the opportunity, the intern began a communication campaign whereby the operators would make note of what was broken, out of adjustment, or in need of maintenance about the brazers, and this record would be passed on to the maintenance people in time for them to prepare the materials needed to maintain or repair the brazers before they were shut down for maintenance. In theory this plan worked well, but in practice it failed. The reason was lack of belief that it could work, and the fact

that the culture at the plant had erected walls between production and maintenance. The operators were reluctant to pass information on to maintenance. The typical comment was, "Why should we go to all the trouble? Those maintenance guys won't do anything about it anyway."

The maintenance people felt threatened by the written sheet of operator's comments. "If you give us a sheet like that, what's written there is all we're going to do -- nothing else!" They did not want to feel like they were being told how to do their jobs by people who had no training or expertise in maintenance.

The production supervisor did not want to be caught in the middle of a political battle and was indifferent to the idea from the start, knowing the culture and perhaps realizing that it would not fly with either the operators or skilled tradespeople. So the intern spent some time trying to push the system, and finally gave up, realizing that whatever benefit was derived from the idea would quickly pass away as soon as he left the site. The people just did not want to be helped. Their culture said that communication was not the way to conduct business.

This example demonstrates a lack of understanding about what maintenance is, what it's purpose is in the realm of manufacturing, and even what preventive maintenance is all about. People from the production operators up to the plant manager were satisfied to give lip service, and some expensive downtime, to the notion of preventive maintenance, but were not interested in learning what it really meant or what its benefits could be. The most important tool with which plants can equip all their people, whether hourly or salaried, is knowledge. Training sessions about maintenance of all kinds, reactive, preventive, and predictive, in conjunction with hands-on workshops that actually have an effect on the availability of equipment in the plant, can be a powerful weapon in the battle to increase the importance of maintenance in the eyes of the manufacturing community.

Overview of This Thesis

The intention of this thesis is to provide a methodology for cultural change that can be applied in a manufacturing plant, with a focus on maintenance operations. Because it is my observation that maintenance has been neglected in manufacturing, the idea behind this thesis is to provide a way for maintenance to get out of the doldrums in manufacturing.

Section II benchmarks maintenance operations in two auto plants that are respected for their maintenance effectiveness, NUMMI in Fremont, California and

Saturn in Spring Hill, Tennessee. The benchmark studies carried out were on the final assembly line at NUMMI and in the Powertrain facility at Saturn, although overviews of their entire maintenance systems are provided. It is my intention that these benchmark studies give the reader some ideas and points of comparison for their own particular maintenance operations. These studies can help to set the vision for the future, and provide the organizational goals that are the endpoint of the cultural change process.

Section III defines the working definition for culture that this thesis uses throughout, and explains a methodology for cultural change that will work in a manufacturing plant. This section is general, and does not apply to any one plant in particular. Comments specifically directed at maintenance are intersperced throughout the section wherever they are relevant.

Section IV presents a cultural analysis of Romulus Engine Operations within the context of the methodology given in section III. It includes specific recommendations for cultural change in the maintenance operations at Romulus.

Section II:
Benchmarking Maintenance Operations

I had available to me through General Motors opportunities to visit both NUMMI in Fremont, California, and Saturn in Spring Hill, Tennessee. The selection of these two sites for benchmarking purposes was not so much a function of intensive study that revealed these two plants as "World-Class" maintenance operations, but more a matter of their recently having had the experience of "starting from scratch" in North America to reinvent how maintenance should be performed. From this perspective, they not only had new maintenance practices, but had recently undergone the cultural development necessary to implement them. People in their organizations had been a part of the change and development of the current cultures, and would therefore be better equipped to discuss with me the processes employed in the cultural development.

The selection of these two plants was also a function of the relative ease with which I could be set loose in the facilities to study their maintenance operations. Both NUMMI and Saturn are affiliated with General Motors, and I received a great deal of help and cooperation in setting up the benchmarking trips from individuals at both places. Some of the observations that I make about the maintenance studies come through discussions and conversations with the people who took time out of their schedules to help me. At NUMMI, Martha Christopher and Ben Gallagher proved invaluable in orienting me to the plant and introducing me to the people I needed to speak with. At Saturn, Dave Bilger and Herb Charles spent two full days with our study team introducing us to the philosophies and operations of Saturn.

This haphazard methodology for selecting benchmarking targets does not mean that these two plants are not "World-Class" in their maintenance practices, but only that they were not rigorously identified as such before the process began. During the course of my studies at NUMMI and Saturn, it became obvious that both of these manufacturing facilities have lessons to teach an "old-school" plant in terms of how maintenance should be performed. It would not be surprising if a rigorous study did identify these two facilities as "World-Class" maintenance operations.

NUMMI represents the North American equivalent of the Toyota Production System at work, and from that perspective their operations concentrate on the elimination of *mude*, or waste. This is evident in their maintenance operations. Saturn represents the clean-sheet approach to manufacturing operations, and it is impressive to

see how their operations work. Their philosophy of having their workers manage their own maintenance areas just seems to make sense when you witness it in action.

As a preface to the remarks that I will make about NUMMI and Saturn, I would like to stress that everybody reading this thesis who is currently working in a "old-school" role within their plant as a hourly worker, an engineer, or a manager, will at some point feel threatened by what I will report. That is the nature of being confronted by change. The challenge to each of us is to be willing to conquer the fear, by understanding that everybody is experiencing the same uncomfortable feelings that you are within their own field. To make change work, everybody must be willing to accept the responsibility of working under a new system with new rules and new procedures. We must overcome our defense mechanisms that tell us, "That can't work!" to understand that within the context of a new system, it can work. There is no easy way to make what happened at NUMMI or at Saturn work elsewhere.

NUMMI Maintenance Study

During my week-long visit to NUMMI, I had the opportunity to view NUMMI as both an outsider observing their processes, and as a quasi-insider, participating in their maintenance organization. In those roles I was attempting to find out exactly what NUMMI does that makes them appear successful to the world, and how it was that they were able to make it happen. My goal was to learn what parts of the NUMMI maintenance way could be brought back to Romulus to help improve the maintenance organization's effectiveness.

It is very easy to jump to conclusions about why NUMMI is so successful. Those people that feel animosity toward labor unions will say, "Well, their union is more cooperative, and that is why they are successful." Those people in the union with a distrust of management will say, "Their managers understand what is important in a manufacturing environment and support those things." What the few trip reports I have read by other groups and individuals that have visited NUMMI, and the white papers that cover maintenance issues seem not to stress is that NUMMI is a total system that requires the commitment of everybody involved. No one piece of NUMMI's system transplanted into another plant will make it run as well as NUMMI does. Certain pieces can be removed from NUMMI's maintenance system, like Preventive Maintenance, Team Concept, or Kaizen Teams, and their implementation will cause improvement in maintenance cost, efficiency, or effectiveness, but to operate

with the effectiveness of NUMMI's maintenance system you must understand everything they do.

When attempting to describe NUMMI, it is difficult to know where to begin. My own personal feeling about the way that NUMMI performs maintenance categorizes their system into four critical elements, each of which is an essential part of their maintenance practices. These four elements of the NUMMI maintenance system are teamwork, continuous improvement, preventive maintenance, and management practices. During my visit, NUMMI's teamwork struck me as their greatest asset, therefore I will begin by describing their teamwork concept.

Teamwork

Every aspect of the way NUMMI assembles cars and truck relies on teamwork, but there are two areas in which the NUMMI maintenance departments excel. They excel at working with their fellow skilled-trade workers to accomplish the maintenance activities, and they excel at working with the production workers to keep the line running 96% of the time. The best way to describe their teamwork is to relate the observations that I made while working for a day with the Car Assembly Maintenance (CAM) team.

The CAM team is organized into several different smaller teams that each have responsibility for a zone on the assembly line; trim, chassis, and final, and one team that does the kaizen work for the assembly line. Team sizes range from three to five members, including a working team leader. These teams are responsible on their shift for all of the maintenance activities in their zone on the line. Their function is to keep the assembly line running by whatever means necessary, because each minute that the assembly line is down means between $8,000 and $9,000 in lost revenue to NUMMI. Everybody knows that every minute counts, so when a breakdown occurs, or an operator requests maintenance help, response is immediate. Because of the size of these zones, each skilled tradesperson either rides a bike or has an electric vehicle, and they carry a radio over which they are immediately dispatched to the problem location.

Upon arrival they will determine the cause of the problem, and in some cases it is a minor adjustment that can be made while the line is running without sacrificing quality. If the problem is major, or would require stopping the line, or would cause quality problems, the first maintenance person to arrive would request team assistance and would then begin performing the work of the broken piece of equipment or automation. This allows the line to keep running. When a maintenance team member

arrives to help, one continues to perform the production work along side the production worker while the other solves the problem, or summons more help. If the problem persists for more than two or three minutes, the team leader shows up to assess the situation. If a decision needs to be made to either shut down the line, or continue running under current circumstances, he summons a group leader and the decision is made. In any event, the teamwork exhibited by the maintenance team allows the line to keep running despite the occurrence of a breakdown in the production equipment.

The other example of teamwork at NUMMI that is a departure from common practice results largely from the General Maintenance skill classification of the skilled trades. At NUMMI, there are only two skilled trades classifications; Tool and Die, and General Maintenance. Because of their skilled trades backgrounds, many of the maintenance workers at NUMMI are certified journeymen in a particular skill. If a maintenance team member finds a breakdown that is too difficult for him or her to fix, for example a pipefitter responds to an electrical problem where a PLC has gone awry, they call for help from a team member who has more knowledge in that particular skill area. About 75% of the breakdowns don't require in-depth knowledge of a particular skill to fix them. For the other 25% of the breakdowns, the team member with the right skills to do the job is requested by a team member to do the work. No team member is too proud to ask for help if it means that the line will be down and it will cost NUMMI money.

The only way that this can work, however, is in the presence of a cross-training program for the skilled trades. At NUMMI, much of the training is equipment-specific training to allow the maintenance team members to be effective at trouble shooting and fixing specific problems on the equipment in their areas. While a certain portion of this cross training is formalized in classes that are attended on overtime, often between production shifts, much of the cross training is provided on the job by fellow team members.

Each team has a goal of 100% training of their team members, and if one person finds that he cannot fix a machine, sometime when the line is running well and the preventive maintenance tasks have been completed for the week, he will call over the team member who understands the most about the certain piece of equipment and get training, usually in periodic sessions. The team leader has the responsibility to check proficiency of each team member to four different levels; 1) knows where equipment is, 2) has basic understanding of operation, 3) can fix if broken, and 4) can train somebody else. In this manner, NUMMI has taken a group of skilled

tradespeople from being constrained by lines of demarcation to being a multi-functional work team capable of fast response.

Of course, there are still some breakdowns where safety is a critical issue, or where the problem is extremely complicated, in which case the team member with the right experience handles the job. In general, NUMMI skilled tradespeople can handle any problem they come across that might keep the line from running, and in this way they minimize or eliminate downtime. This mode of operation reflects what seems to be a general philosophy about managing the process at NUMMI: the system is designed to manage the majority of the problems, and the exceptional cases will be handled individually as learning experiences. This contrasts starkly with the legalistic attitudes in many plants where every scenario must be planned for and managed; and in the process of creating the system to accommodate the exceptional cases, much is lost in the ability to deal with and handle routine work.

Continuous Improvement

NUMMI has teams throughout the plant called kaizen teams. *Kaizen* is the Japanese word for continuous improvement. These teams are responsible for creating, developing, and implementing improvements in NUMMI's manufacturing processes. The maintenance teams are heavily involved in continuous improvement at NUMMI because there are very few engineers available for this work. In fact, most of the continuous improvement projects that the maintenance teams undertake are completed without any engineering involvement.

Kaizen projects are started by identifying a need or improvement that can be made to eliminate waste, reduce cost, increase efficiency, increase reliability, or eliminate demeaning work. These ideas can start with production operators, skilled trades, or anybody working at NUMMI, and they have an excellent suggestion program that keeps track of the ideas. While the suggestion program earns the suggestor, either an individual or a team, points equivalent to dollars redeemable at Sears, the main idea behind the suggestion program is 100% participation. NUMMI wants everybody to become involved in suggesting better ways to work so that they can be continuously evolving and improving, and can stay ahead of the competition.

To help encourage those people who find the relatively paltry sums allotted for each suggestion unappealing, (the allotments I saw were in the 5 to 25 point range depending on the potential payback of the suggestion) they have monthly incentive programs. These programs add extra incentive in the form of lotteries, drawings, and

extra prizes for suggestions. The one I saw while there was the "Scratcher Ticket Campaign," where each suggestion earns the suggestor a scratch-off lottery ticket with a chance to win instant prizes, like a weekend away for two, dinner and a night on the town, a cruise on the bay, etc. Tickets that are not winners are entered into a final drawing to give away other prizes. People at NUMMI had favorable remarks to make about their suggestion program, with very few lamenting the loss of the large sums of cash previously paid for suggestions.

There are four excellent examples of kaizen projects on the assembly line that I saw while I was visiting NUMMI. I will describe them here because they help to underline another NUMMI philosophy -- preserve the dignity of human beings. In many assembly plants, there are production workers doing awful jobs -- lifting heavy objects, contorting their bodies in funny ways to install an awkward part. The job is obviously not desirable work. Yet, when the operator is asked, "Why don't you have somebody design automation that will do that job for you?" they look confused, and say, "Because I would be out of a job, then. That's why!" NUMMI's system allows the operators to complain about demeaning work, and suggest ways to eliminate it without worrying about whether or not they will be employed if they do.

The first example of a kaizen project that I saw was a device to position and lift the mounted wheel and tire assembly up into position on the car in order to eliminate the lifting strain on the operator. This device was designed by a maintenance kaizen team, and it works perfectly as an assist for the operator. The operator need only select the correct lug nuts, and get them started on the threads. He then moves a counterbalanced four-spindle electric torque wrench into place on the nuts which automatically tightens all four to the correct torque and ejects itself from the wheel. Looking at the device impressed me with the quality of the work that the maintenance kaizen team can accomplish without any engineering help.

The second example was even more impressive than the first. It was a pair of hydraulic robots that had been salvaged from scrap and used to install the front seats of the car, preventing operators from hurting their backs with the heavy lifting and awkward positioning. An added benefit was the fact that the robots, being more repeatable than humans, do not accidentally slip and scratch the paint of the car with the seat rail during installation. These totally hydraulic robots were salvaged, rebuilt, adapted to seat installation, and programmed entirely by the maintenance kaizen team. Despite the fact that they look old and kludgy, they work wonderfully well without any human help.

The third example is an automatic oil fill device on the engine dress line. This device identifies the engine it is filling to determine the amount of oil to be filled, then it delivers the correct amount every time without dripping any oil. Prior to the installation of this device, the height and position of the oil fill on the engine made it difficult to reach, and human error in fill levels and splashing of oil in the work area made the job undesirable. For these reasons it was eliminated by automation.

The last device I saw that was designed by the maintenance kaizen team is the door-on assist device, which positions the door relative to the moving car and allows for easy alignment and installation. It also eliminates the scratches associated with the operators accidentally banging the door against the moving car while trying to install it by hand.

In order to have the manpower available to create these improvements, the CAM department has a team of people dedicated to kaizen. The kaizen team works closely with maintenance and production people to identify and implement improvements on the assembly line. There are times when the response teams needs extra help in fixing a serious breakdown and they request help from the kaizen team. The kaizen team members still understand that the first priority is to keep the line producing quality cars, and they are ready and willing to help when necessary, but they are dedicated to continuous improvement work.

The way NUMMI devotes resources to kaizen is impressive, but each kaizen can eliminate operators on the line. Knowing that this is true, why do the production operators contribute and participate in the kaizen process? Because they know that they will still have a job. With the demeaning work handled automatically, they are free to help their team in another area where more help is required, or they can move to another team that needs help. It is even possible to be assigned to the general kaizen shop in the plant -- a place devoted to making operator aids, organizers, and other improvements throughout the plant.

One of the critical factors in ensuring the success of kaizen is a no lay-off policy, which NUMMI has in their contract. Having worked for nine years at NUMMI, the hourly people have seen times when layoffs were a possible option, but they were not the solution selected. Even during a period of 60% demand, all people were retained and sent through training or put onto kaizen teams. For these reasons, the people trust NUMMI to keep them employed. One of the most exciting things I saw while I was there was a brand new operator on the engine dress line. He was still trying to figure out the jobs that his team had to accomplish, and when I noticed that he was having problems with a job, the production manager told me that he had recently

been hired. An employee with thirty days seniority! It was amazing to me, coming from an organization that has not hired hourly people in approximately ten years.

Kaizen is one of the reasons that NUMMI can promise not to lay off their employees. If NUMMI is successful in continuously improving, they will stay ahead of their competition and will continue to produce a higher quality product at a lower cost. This ensures market success, and guarantees demand, which in turn guarantees jobs. It is exciting to know that NUMMI is adding two new plants to their complex in the next several years; a bumper plant, and an engine plant. These plants will add even more employment, and shows that success breeds success. Their continuous growth is a testament to their capability in continuously improving their manufacturing process.

Preventive Maintenance

In order to get to the point where they can afford to have resources devoted to continuous improvement, NUMMI had to have a good handle on their breakdown workload. In most plants, as long as breakdowns form a continuous stream of work and frustration keeping the line down and costing money, all resources will be devoted to fixing them. To free up these resources to kaizen the process, NUMMI implemented preventive maintenance (PM) to reduce the number of breakdowns and downtime to the point where a small team of three to five people can handle all the breakdowns *and* all of the preventive maintenance activities on any zone in the line.

At Romulus, preventive maintenance fizzled out quickly after it was introduced because one central location (the CSM crib) was responsible for issuing the PM work orders and for collecting them when they were completed. This was a recipe for failure because no accountability was given to each area to ensure the completion of the PMs, and nobody at the CSM crib had the authority to enforce their completion. While it seemed a good idea to have a centralized computer system to limit investment in computer and man power resources to run the PM system, it did not work, in part because it was not important enough to devote the resources that were truly necessary to make it run. There are any number of reasons why this was the case, ranging from supervision and management who did not believe in the benefits of preventive maintenance, to a shortage of funds to devote to a more comprehensive system. The software that exists to run the PM system is fully capable, but the implementation of the authority and accountability for PM was far short of what was necessary to make it work.

In order to make their PM systems work, NUMMI has given responsibility for preventive maintenance to each individual maintenance department and team. While this complicates the issues of common software and practices between the seven maintenance departments (NUMMI is currently attempting to commonize their systems), the operation of PM within each department is more effective. When a breakdown occurs that keeps the assembly line down for more than three minutes, a breakdown report must be prepared that includes the PM records for the operation in question. The team leader and group leader of the area must present the breakdown to the production manager explaining what happened, why it happened, and what countermeasures have been or will be taken to prevent recurrence of the problem. If the fault of the breakdown turns out to be a lack of PM on the operation, the group and team leaders will be sure to more strictly enforce adherence to the expectation of performing the preventive maintenance. They feel rightly uncomfortable in front of the production manager for causing the line to go down for a problem that both could have been and should have been prevented.

To ensure that the preventive maintenance is performed in the car assembly maintenance department, the group leaders print out weekly PM tasks for their areas from the department computer. These tasks are given to the correct team leaders, who in turn distribute them to their team members. The PM is expected to be performed during the week on regular working hours. Preventive maintenance that requires the operation to be down are given to the team leaders on third shift, to accomplish between production shifts, or arrangements can be made to perform the PM on second shift between 2:30 and 4:30.

Because PM is effective at NUMMI, the team members have time between breakdowns to accomplish their PM tasks. When they are finished, the PM sheets are returned to the team leaders who look them over for comments, and hand them to the group leader. The group leader marks them off on a visual management chart for quick review of which PMs have been finished, which are outstanding, and which are late. He then enters them into the computer as completed. He also notes the comments on the sheets, and schedules any repairs that are deemed necessary from the PM inspections.

NUMMI is currently in the process of centralizing their maintenance systems. This will not take away the authority and accountability that group leaders have to see that PM is accomplished, it will only attempt to commonize software and perhaps consolidate administrative tasks between the maintenance departments. Because the group leader is held responsible by the production manager for preventing breakdowns

through preventive maintenance, he in turn holds the teams leaders and team members responsible for accomplishing the PM tasks. There is never a choice between fixing breakdowns and completing preventive maintenance, as both are expected to occur during normal working hours. Of course, keeping the line up and running is the number one priority, but people understand that a lack of PM now will cause more down time later.

Management Practices

The supervision and management roles at NUMMI are different from what can be observed at an old-school plant. While NUMMI supervision and management exist to support the system and the people, who know what to do, it is often the case that old-school supervision and management exists to tell the people and the system what to do. In Romulus' case, there does not seem to be a maintenance system, or maintenance philosophy, that everybody knows about and follows. At NUMMI it is very clear what the expectations are, and the maintenance team members use their supervision and management as a resource.

To show everybody how important certain expectations are, NUMMI uses visual management techniques. Charts that indicate which PMs are completed, which are not, and which are late are prominently displayed on huge printouts hung on the maintenance office walls. Training charts that show which team members have proficiency to repair which operations, or have taken which training classes, are displayed equally as prominently. Missing PMs or slow training progress is immediately noticed by everybody.

Supervision and management also enforce discipline in themselves and their workforce very effectively. NUMMI's attendance policy, for example, is a very disciplined process because NUMMI is running so lean that missing people can really affect the quality of the product. If an employee is either late or absent (no distinction is made between the two) and they call in to inform their supervisor of their tardiness or absence they will receive one point. If they are late or absent and fail to call in to inform their supervisor, they receive two points. None of these points are grievable, and none of them are brought up for discussion until the employee receives four points in a rolling ninety day period. Upon receipt of the fourth point, a meeting is called to discuss the employee's absences. Only the fourth point incident is grievable, and sometimes it turns out to be a very legitimate excuse (like a car accident on the way to

work), and the absence is excused. Other times, disciplinary action is necessary and can range from suspension to dismissal.

Management is also disciplined about following the NUMMI process. Breakdown meetings for any breakdown of more than three minutes can be very tedious and time consuming to prepare, but the documentation is always put together because without it a relaxing of the process would allow a relaxation in the urgency to perform the countermeasures to prevent future breakdowns. Sometimes it is difficult to devote manpower to kaizen teams when there are other things that seem to need doing. The belief exists, however, that kaizen teams are a valuable and necessary part of NUMMI's system, so the discipline of keeping those people available for continuous improvement remains.

One aspect of management practices at NUMMI surprised me. It should not have surprised me, but nonetheless it did. That was the personal, individual concern of management for their employees. The production manager at NUMMI, who has production and maintenance responsibility, spends 50% of his time on the floor talking to people, listening to their complaints and ideas, and heading off problems before they can become grievances. He spent a full hour giving me a tour of the facility, and he knew everybody we bumped into by name, including a brand new employee with only thirty days seniority. His philosophy indicated that people are the link in the system that can either make it work, or not work, and he took great care to see that they were happy with the system and were working to make it work. He claims that he cannot accomplish as much in his office trying to make production as he can on the floor understanding for himself why things are working or not.

The other part of the reason that he spends 50% of his time on the floor is his attempt to not be labeled the enemy. If the only time that workers saw him was when he was coming over to discipline, or relay bad news, or look over their shoulder while they were trying to fix a problem, he would immediately be a symbol of things gone wrong. Therefore, he takes deliberate time to make conversation, and mention something that is important to the employee, like their new baby boy, or their favorite football team, or whether their latest golf score had improved. This little thing, which takes very little time, can make a difference between hostile and cooperative relations between workers and managers. If managers are perceived as real people who care what happens to the employees, it is a further step in building trust into their relationship.

The most important part of the way NUMMI is managed, in my opinion, is the accountability that goes along with every job in the plant. That accountability is part of

the expectation at every level in the organization, and it is formalized in NUMMI's Goals and Objectives (G&O) process. Every year, the president of NUMMI sets goals in response to the external environment. These will typically reflect environmental concerns in response to new CARB regulations, cost concerns, quality concerns, and output numbers to meet demand. These goals will be given to each operating division, who will have to create their annual business plan to help meet these goals. The divisions then pass the goals down through the layers of management, with each manager responsible for setting his or her own goals to help meet those of his or her department. Each person's goals are reviewed together with their supervisor, who will approve them or help to modify them. Goals must be measurable in order to be considered acceptable, and the method for measuring progress is agreed upon at the same time that the goals are set.

Half way through the year, each person reviews with their supervisor the progress that they are making toward their goals, and if adjustments are necessary they are made at that time. Come the end of the year, actual progress toward the goals is documented, and each person's performance toward their goals determines the amount of their potential annual bonus that they receive. This system provides an incentive for people to actually do what they say they will do, and makes them accountable for doing it.

Comments on the NUMMI Benchmark Study

The crucial element to being able to operate maintenance in the fashion that NUMMI does is the total concentration on maintenance's customer: production. The maintenance departments do not exist at NUMMI solely to fix things when they break. They exist to serve their customer, providing all the services necessary to meet production's needs. At NUMMI, production's foremost need is 96% efficiency. And, on average, they achieve it. What that means to the CAM team is that the assembly line can only be down for three minutes each shift, or six minutes a day. Everybody works with those numbers in mind. They know that to meet their customer's goals, they must perform preventive maintenance, even when it seems hard to do. They know they must always be ready to respond, and they must be willing to work all day.

Maintenance at Romulus lacks a customer focus. Despite the fact that I spent seven months at Romulus, I still do not know what a minute of downtime on the assembly line costs, and neither do some very key people at Romulus. It took one day at NUMMI to learn that figure, and everybody knows it. Business information needs

to be dispersed throughout Romulus' organization, because hourly workers can use that information to make the decisions they should be making about what fits their customer's needs and what does not. It should not be considered acceptable that the maintenance department can only give the machining lines somewhere between 45-55% uptime. It should not be a secret that Romulus' maintenance budget is not being met -- it should be a point of total organizational knowledge, and everybody should be working together to either adjust the budget to reflect a realistic number, or to help maintenance work more efficiently and effectively.

My observations at Romulus have lead me to believe that Romulus needs a maintenance system. Until January, 1994 there was no single organizational department with maintenance responsibility. Almost every department had some maintenance responsibility. Still missing is a maintenance management information system. There is no common and accepted dispatching system. Without these basic maintenance tools, it is no wonder Romulus is struggling with maintenance issues. Everybody seems to think, "It's not my fault things here are not right, I'm constrained by the system, or the contract, or my supervisor," but what they fail to see is that everybody is responsible for creating the system. Everybody has to take a part and be willing to make it work. Too many people are content with status quo, thinking that because they are meeting shipment targets and some cost targets now that everything is fine and will continue to be fine.

Four things that I observed at NUMMI can help an old-school plant to improve its maintenance efforts. They are teamwork, continuous improvement, preventive maintenance, and new management practices. These things are the right things for Romulus to do. They are the right things for anybody who wishes to remain competitive in auto manufacturing to do. In order to make these things work, however, people in the union, in engineering, and in management must be willing to change. They must be willing to leave the comfort of an established routine to forge ahead. And they must believe that making those changes is the right thing to do. The theory on how this change can happen is presented in a subsequent chapter of this thesis.

Saturn Maintenance Study

The intent of this section is to present Saturn's maintenance practices in their engine machining and assembly areas and to understand their maintenance operations in general. This section of my thesis is the result of a maintenance study carried out by a

team of Romulus maintenance people on November 17 and 18, 1993. Although the focus of this benchmark study is the maintenance organization, many of the policies and procedures described are common with production operations as well. When there are unique maintenance issues to describe, they will be specifically introduced that way.

This section of my thesis is broken down into seven sub-sections and a conclusion. The first sub-section describes the maintenance organization in terms of its basics - the number of people utilized and the job classifications. The sub-second section describes the innovative organizational structure at Saturn. The third sub-section talks about Saturn's shift schedule which rotates three crews through two shifts per day. The fourth sub-section introduces a foundational principle of the Saturn Corporation: Teamwork. It describes the processes that are in place to make teamwork a reality at Saturn. The fifth sub-section talks about the way Saturn thinks about and implements training for its employees. The sixth sub-section is a discussion of how the maintenance department measures its success. It talks about the goals that are set, and how they are measured to monitor continuous improvement in the maintenance organization. The final sub-section talks about culture and leadership at Saturn, and how they have turned the Saturn Vision and Philosophy into an operating workplace that fosters competitive and continually-improving maintenance. The conclusion wraps things up.

Stats on Saturn

Saturn's production complex consists of 4.1 million square feet, and is vertically integrated from molten aluminum and iron coming in to assembled vehicles driven out. It is broken down into several different areas, geographically separated into different buildings: powertrain, general assembly, and body systems. Because the purpose of this report is to benchmark Saturn's engine machining and assembly operations, nothing specific to maintenance or operations in general assembly or body systems will be discussed.

Saturn's powertrain facility is broken down into several areas: casting, engine machining, transmission machining, transmission assembly, and engine assembly. The casting areas consist of both iron and aluminum casting operations, utilizing a revolutionary lost-foam casting process which is significantly cleaner and more efficient than conventional casting methods. It produces parts which are near-net shape, so less

stock needs to be removed in machining. The casting area produces engine blocks, crankshafts, 2 different heads, differential housings, and transmission housings.

The engine machining area has three machining lines, one for blocks, one for cranks, and one for both the 2-valve SOHC and 4-valve DOHC heads. These machined parts flow to the assembly area, which consists of a head assembly area and an engine assembly area, before being mated to the transmission and conveyed to the general assembly building as completed powertrains.

The maintenance headcount for these operations is very lean by traditional standards. There are several elements of Saturn's production philosophy which enable this, but the most significant is their job classification breakdown. See Table II.1 for a headcount breakdown by area and job classification. There are only five job classifications for represented team members (all employees are "team members") at Saturn. One classification covers all production functions. Saturn calls this classification "optech" (Operator-Technician). At Saturn, this is not referred to as a non-skilled classification, because they believe very strongly in training team members to be skilled. The other four classifications represent what would traditionally be considered skilled trades classifications: electrical, mechanical, tool and die, and stationary engineer. The mechanical classification encompasses what traditional facilities would call machine repair, millwright, and pipefitter trades. Tool and die people are used in the powertrain facility only in the casting operations, and they consist mostly of pattern makers. Stationary engineers monitor the powerhouse equipment.

An additional element of this job classification system that enables Saturn to run lean is the lack of lines of demarcation. Although safety issues often require deferring a difficult job to someone who is properly trained, there is nothing that prevents a properly trained team member from helping in any way he or she can.

Maintenance Classification	*Foundry*	*Engine Machining*	*Engine/Head Assembly*	*Total Per Crew (Shift)*
Tool & Die	2	0	0	2
Mechanical	7	7	4	18
Electrical	5	5	4	14
Total	14	12	8	34

Table II.1: Maintenance Headcount (Represented Team Members) for Engine Production

Organizational Structure

All Saturn team members are organized into teams. Teams at Saturn consist of 6 to 15 team members who are self-directed. Further information on team structure and responsibility can be found in the section on teamwork. Each team has an elected Work Unit Counselor (WUC) that is a represented team member, who is sworn into office for three years to uphold the Saturn values, mission, and philosophy. That person works like every other members of the team in addition to running the team meetings, and representing their team to the next level of the organization, the module. The WUC is not given any additional pay.

The three teams in engine maintenance, foundry, machining, and assembly, each have one (1) WUC that is a working member of their team. The WUC performs the functions that would traditionally be covered by a first-line supervisor, and acts as a communication link to the next level of the organization. Together, these three WUC's communicate with one non-represented (salaried) Work Unit Module Advisor (WUMA) and one represented WUMA who provide them with resources and help. At the WUMA level and above, all leadership roles are a partnership between represented and non-represented Saturn team members. Pairs of WUMA's work together as partners in business, covering many of the aspects of the business that would be handled at the general foreman level in traditional manufacturing facilities. The WUMA's also provide a communication link to the next ring in Saturn's structure.

These two WUMA's, together with the WUMA's from the transmission operations and the 3 WUMA's (1 non-represented, 2 represented) that advise the tool room, gauge lab, central shops, and indirect materials teams, communicate with the maintenance coordinators for powertrain, one represented and one non-represented. Saturn's maintenance coordinators are approximately the equivalent of superintendents in a traditional facility. These coordinators sit on the Maintenance Core Counsel (MCC) which has the responsibility of reviewing maintenance performance in several key areas of the maintenance business, which will be discussed in a subsequent section of this report. The MCC also reviews supplier delivery and quality performance on a quarterly basis. The MCC has representatives (and their partners) from financial, training, and other functions, as well as maintenance operations present.

The next level of Saturn's maintenance organization is the communication link between the MCC and the Manufacturing Action Counsel (MAC). The MAC consists of vice presidents of Saturn and representatives from the operations, personnel, financial, and sales/service/marketing organizations. The vice presidents form the link

from the MAC to the Strategic Action Counsel (SAC). It is at this level that strategic plans and long term goals for Saturn are set. This is the highest level of Saturn's organization, and it is attended by Saturn's president, who forms the communications link directly to General Motors.

Rotating Production Schedule

All production and production support jobs are assigned to one of three "crews." Crews are similar to what a traditional manufacturing facility would call a shift, except that the crews rotate their working hours during the course of the year. The number of hours that each crew works on the day and night shifts (Saturn has two ten-hour production shifts each day) are made equal during the year, and shift rotations typically occur after 6 days on one shift. Six days of work are followed by two to five days off before a crew returns to another shift. The schedule averages out to six days on, four days off for each crew. A copy of Saturn's 1993 Capacity Utilization Calendar has been appended to this section of the thesis as Appendix II.A.

Because Saturn production runs in two ten hour shifts each day, the maintenance teams must be flexible with their time in order to cover all twenty hours of production and the four hours of scheduled downtime. The production crew that is assigned to the day shift runs from 6am until 4pm. The crew that is on nights comes in at 4:30pm and leaves at 2:30am. It is up to the maintenance teams to decide how they want to flex their hours so that their crew can cover 12 hours on a 10 hour shift, providing for 24 hours per day maintenance coverage between the two working crews (on any given day, two crews are working and one is off). Typically, half of the crew will come in two hours early to do PM or other planned maintenance during the scheduled downtime. Although this is an extremely complicated system for scheduling work, it is equitable to all and prevents people from wanting to switch crews for scheduling or monetary reasons.

There are maintenance engineers that rotate with the crews so that maintenance team members can interface with engineering through one person with whom they are accustomed to working. The process engineers, and managers from WUMA's up, are on a more traditional schedule (five-eights, Saturn calls it) and interface with whichever crew is on day shift in any particular week. Each crew has equal time and access to the process engineers, and the plant management, because of the rotating schedule. To make process engineers more accessible to maintenance team members, the engineering

functions for each area (powertrain, body systems, and general assembly) are located centrally in their area in the plant.

Within the powertrain facility, indirect materials, tool repair and regrind, gauge repair, and facilities maintenance are all centralized functions. Although each team is responsible for getting their own indirect materials from the crib through a kanban system, the indirect materials team manages all relations with suppliers. Suppliers are expected to have a 24 hour delivery time on any part ordered, and their on-time delivery performance is one basis for a risk-and-reward payment system. Because the kanban system is expensive to maintain (each kanban order costs $2.00 to process), the indirect materials team purchases and distributes free of charge such low-cost, high-use items as fasteners, lens cleaning tissues, and batteries so they can be ordered in bulk. Other than those exceptions, each team is responsible for ordering their own materials and parts and paying for them from their budget.

Teamwork

The previous section on organizational structure describes the physical structure of teamwork at Saturn. The very nature of their organization requires that people work together to accomplish their goals. This section will concentrate on describing how Saturn makes teamwork work -- on their expectations for teamwork and the support that they provide for its growth in the organization.

The foundations of the Saturn Corporation are laid on the principle of teamwork. The original "Group of 99" that conceived Saturn was comprised of a joint team of UAW and salaried people that had a vision for how General Motors could build cars better than anybody else in the world. The teamwork between union and management that began there has been carried forward, and is reflected in the way Saturn does business and makes decisions. The teamwork concept has even resulted in a special contract with the union. The UAW and General Motors worked together to produce a contract that supported the principles of teamwork espoused by the Group of 99 that is one of the key enabling elements of Saturn's success today. The details of Saturn's contract will be described later in the section on organizational culture and leadership.

Teamwork is a concept that affects every level of the organization, not just the production workers or maintenance crews. Traditional plants will tell workers to work in teams, make consensus decisions, and act as a unit, but their supervisors have singular authority to do as they please. The situation becomes, "Do as I say, not as I

do," and teamwork quickly dies because it is not supported fully in management. I have observed that Saturn has overcome this obstacle to the implementation of teamwork. They have accomplished this by requiring *everybody* to work as a team. Each manager at Saturn has a union partner that participates in decision-making and represents the interests of the represented team members at all levels of the organization. Even the president of Saturn has a partner, who is president of the local union. This structure contributes to management's understanding of what it means to be a team player, and to make consensus decisions. The empathy that they have for the situation on the plant floor because of this helps them to better support teamwork throughout Saturn.

Teamwork is very strong on the production floor at Saturn. Each work unit is a team of individuals who are given total responsibility for running their area of the business, and they are expected to do so by following the guidance of Saturn's work unit functions. Each work unit is responsible in their area for what Saturn calls the "30 Work Unit Functions" (WUF's), which are attached to this section of the thesis in Appendix II.B. The following list of the 30 Work Unit Functions (without their descriptions) gives an idea of the sorts of things that maintenance teams are responsible for at Saturn:

Saturn's 30 Work Unit Functions

1. Consensus decision-making
2. Self-direction
3. Making their own job assignments
4. Resolving their own conflicts
5. Planning their own work
6. Designing their own jobs
7. Controlling their own scrap
8. Controlling their own material and inventory
9. Performing their own equipment maintenance (specifically for optechs)
10. Performing their own direct and indirect work
11. Scheduling their own communications within and outside the group
12. Keeping their own records
13. Making selection decisions of new members into the work group
14. Constantly seeking improvement in quality, cost, and the work environment
15. Performing to their own budget
16. Integrating horizontally with business unit resources
17. Reflecting synergistic group growth
18. Determining their own methods
19. Scheduling their own relief

20. Scheduling their own vacations
21. Providing their own absentee replacements
22. Performing their own repairs
23. Performing their own housekeeping
24. Maintaining and performing their own health and safety program
25. Producing quality products to schedule at competitive costs
26. Assisting in developing and delivering their own training
27. Obtaining their own supplies
28. Seeking resources as needed
29. Scheduling and holding their own meetings
30. Initiating the initial consultative procedure for self corrective action

To highlight just a few things from this list, Saturn makes the maintenance people (and the operators) within a team responsible for budgeting their team's business, hiring new team members, covering for absences, vacations, and training within their team, and helping team members who are not performing up to standard to seek counseling.

In addition to the functions listed above, the teams are responsible for planning and getting approval for their own overtime when it is necessary. In order to have overtime approved, they must have a complete plan including details on what needs to be done, why it cannot be completed during normal working hours, who will be required, and what parts are necessary. They are responsible for carrying it out as they have described it when it is approved, including getting their own equipment and materials prepared to do the job.

Saturn team members even log their own work hours (by exception) on the computer system that is available to all of them. If their hours are normal working hours, a team member does not have to log his time, but if they take vacation or work overtime, each team member is responsible for logging the exception hours into the computer. If a team member forgets, he does not get paid for the extra hours. In addition to logging their hours, maintenance team members are responsible for working out flexible hours with other members of their team to ensure that their team, which runs on a 10 hour shift, can cover 12 hours. These hours outside of the "normal" shift hours are not considered overtime. If a team member comes in two hours early, he leaves two hours early, unless overtime has been approved for a particular task.

Because many of the 30 WUF's require resources that do not exist within the team, Saturn has a system for helping the teams get their jobs done. Each team will appoint a "point person" for each of the 30 WUF's to coordinate necessary resources or schedule necessary help on that issue for their team. Saturn has resource people

whose jobs are to help the teams do their jobs. As an example, there is a dedicated financial analyst that resides in the powertrain facility to aid the team with budgeting concerns and other financial decisions. If a team needs help, the point person for the budget will contact this analyst and schedule a time when he or she can meet with the team.

To compensate for the fact that the 30 WUF's require additional work of the production and maintenance teams that most other manufacturing facilities worldwide do not require, Saturn allows for what they call the "30 work unit head." Basically, this is an extra person on the team beyond what is necessary for the team to accomplish the direct work involved in maintenance or production. Be careful to note, however, that this person is not responsible for all of the 30 work unit functions -- responsibility lies with every member of the team -- but is present to relieve the extra workload that the 30 WUF's put on the team. As the workload of the team decreases with continuous improvement, the team may choose to outplace a member to another team who needs extra help.

In general, switching teams is not an accepted practice. Saturn values the knowledge that team members gain in working with their fellow team members and the specific production equipment in their area, and they do not encourage team members to rotate to new teams. If a move is made by a team member because he has applied for an available partnership position with management, or because there is a personality conflict within the team that cannot be resolved by counseling, the team will not be left short-handed. Saturn does not allow a team member to leave his team until a new team member has been brought in and has been fully training to perform the duties of the member that is leaving. Because this process is very slow, moves between teams at Saturn are infrequent.

Training

Saturn believes so strongly in the importance of training that they have based the company's pay system on meeting training goals. Team members at Saturn have put 7% of their base pay at risk, pending the completion of 92 hours of training per year for every single team member employed by Saturn. This system works on a quarterly basis by comparing the average number of hours of training attended by every team member to the cumulative annual training goal for the year. In the first quarter, if the average team member has attended 23 hours of training, every team member gets a check for that quarter. In the second quarter if the average training

hours per team member is at or above 46, everyone gets a check. At the end of the fourth quarter, the system works on an individual basis. Any single team member who has not had the full 92 hours of training will affect the check of every other team member working for Saturn.

This system is extremely effective at creating peer pressure to attend training. Team members encourage each other to take training, and work to help cover for their absence in order to not be financially affected themselves by a negligent team member. Team members do not gripe if a cohort wants to take a training class to help him do his job, or to increase his job-related skills. Not only will having a more highly skilled team member benefit the entire team at work, it will also help them along toward meeting their training goals.

It is important to Saturn that team members take training that will impact them in their job, thereby impacting Saturn's efficiency, effectiveness, quality, or cost. The intent is for training to relate to a team member's current job, not to build skills for a team member's "next" job. In this way Saturn is able to derive the maximum benefit from their training. In order to ensure that this intent is carried out, every team member at Saturn has an Individual Training Plan (ITP). Each team member's ITP is personalized to their own job, skills, and needs. The ITP will include government mandated Right-To-Know training, required annual safety training (evacuation procedures, fire extinguisher use), physical location training, and task specific training including on-the-job training.

With so much emphasis placed on training, it is important for Saturn to have adequate training facilities, and they do. In fact, Saturn's training facilities are extensive. Their training department is split up into two areas, one in Michigan for team members employed there, and one in the Northfield building at the Saturn manufacturing complex in Spring Hill. Classrooms are set up to meet the needs of particular classes. Some have computers at every desk for computer training. Some have mock-ups of the control hardware and software used on the production equipment in the plant for training operators how to use it, and maintenance people how to maintain and repair it.

In Spring Hill, Saturn has a large high-bay area called the Workplace Development Center where competitive vehicles are torn apart to learn how they are designed and assembled, and where continuous improvement ideas for Saturn's production system are developed and tested before being implemented in the plant. In this area is a robotics training room with equipment identical to what is being used in their production system. They even have a retailer training center (Saturn calls their

dealers "retailers") which looks just like a Saturn retailer showroom where retail partners are trained. All of the information that must be processed to keep this extensive training program operating resides on a centralized computer system that keeps class schedules and tracks team members' completed training. It is available on-line to any team member who has been trained on how to use it for the purpose of enrolling themselves or their team mates (if they are the training point person for their team) in classes. Also available on-line are individuals' year-to-date training records for keeping track of who is due for more training.

Saturn's training is competency-based. The intent of competency-based training is to ensure that the training delivered is meeting the needs of the team members who are taking it. A test is given at the beginning and end of each class to understand how much information was imparted to the student during the training. The end of class test may be a hands-on final project that shows application of what was learned. An example of this would be a welding class, where the final project could be the creation a welded structure. Approximately six months after the training is given questionnaires are sent out to the team members who took it asking for feedback on whether it met their needs, whether it was useful or helpful in their job, and how the training could be improved.

Every year Saturn has training in a particular focus area in addition to the normal training held on a regular basis. For 1994, the training focus will be Leadership and Quality. The special focus program puts additional emphasis on areas where Saturn is making a strategic thrust at improvement. It gives team members the information they need to concentrate on areas critical to Saturn's success. One last thing which is interesting to note regarding Saturn's philosophy on training is that all training is considered productive time. In their calculations of efficiency, productivity, or cost, Saturn considers the time their team members spent in training as time on the job.

Maintenance Goals

This part of this benchmark study should be sub-titled, "*What gets measured gets done.*" This is one philosophy which drives Saturn's maintenance operations. As a corporation, Saturn is good at benchmarking, setting goals, and then working to meet them. One glance at the J.D. Powers top ten lists for the last few years will attest to that fact. Saturn's maintenance operations are no exception.

Maintenance operations at Saturn are given a budget separate from production. They continually monitor performance-to-budget in the MCC meetings held every week. The maintenance organization measures items which are key to their success against goals which they have set. Three of the most prominent goals are set for cost, training, and performance of PMs.

Saturn monitors maintenance cost as a percentage of total production costs. The maintenance organization has set a goal at 2.5%, which they feel is a world-class target. Of course, all of Saturn's maintenance team members are scheduled for 92 hours of training per year on their ITP, but Saturn's maintenance organization also feels that 80% of the training delivered to maintenance team members should be technical in nature, because the job of the maintenance teams is very technical. Saturn also keeps tabs on the completion of their scheduled preventive maintenance, measuring the percentage of PM tasks that are completed within the scheduled week. PM tasks which are not completed are either backlogged for future scheduling or deemed unnecessary and eliminated. Their on-time performance is impressive, yet they are still striving for improvement.

Saturn feels that they can never relax the standards they have set. Between 1992 and 1993, Saturn improved customer satisfaction in every area of the sales and ownership experience. Their customers were more satisfied with owning a Saturn in 1993 than in 1992. Despite this improvement, Saturn's standing in the J.D. Powers ratings fell between 1992 and 1993. Saturn learned the lesson which all companies must learn. To be successful, you not only must improve, but you must improve faster than your competition. To be comfortable with the way things are done is to be stagnant in the pursuit of improvement.

Saturn Culture and Leadership

The most notable thing about Saturn's culture is that there are no differences in goals or priorities between represented and non-represented team members. Every team member at Saturn shares the same values and assumptions surrounding Saturn's business. Perhaps this is a function of Saturn's infancy in that not enough time has passed to allow subcultures to develop within the organization. It may be a function of Saturn's relatively small size, although there are smaller companies in existence that have developed subcultures. I propose that it is instead a function of Saturn's mission, one that involves every member in formulating the tactics of business that allow Saturn to compete with the world's best auto makers on quality and cost.

An important part of Saturn's ability to allow every member to participate in the business decisions lies in the union contract. An interesting philosophical difference in union-management relations between GM and Saturn can be noted simply by picking up Saturn's contract. Whereas the contract governing union-management relations at GM is a document of 597 pages, with each local union having a local agreement in addition (the one at Romulus is another 174 pages), Saturn's contract is in total 27 pages, and it is called a memorandum. The same jobs are performed at Saturn that are performed elsewhere at GM, yet it takes 744 fewer pages to describe how they will be performed and administered at Saturn. This fact is stated first in this section on culture and leadership to indicate the level of trust and mutual respect that exists between represented and non-represented team members at Saturn. This trust is apparent in the quality of work that is performed at Saturn, and it contributes to the high morale of the workforce.

With only a 27 page memorandum governing the relationships between represented and non-represented team members, many people might expect that Saturn's team members would lack direction or a sense of security in their jobs. This is not the case, however, as every team member of Saturn is governed by the same mission, philosophy, and values. To quote from the inside cover of the memorandum of agreement:

> **SATURN MISSION**
>
> "The mission of Saturn is to market vehicles developed and manufactured in the United States that are world leaders in quality, cost, and customer satisfaction through the integration of people, technology, and business systems."
>
> **SATURN PHILOSOPHY**
>
> "We believe that all people want to be involved in decisions that affect them, care about their job and each other, take pride in themselves and in their contributions, and want to share in the success of their efforts.
>
> By creating an atmosphere of mutual trust and respect, recognizing and utilizing individual expertise and knowledge in innovative ways, providing the technologies and education for each individual, we will enjoy a successful relationship and a sense of belonging to an integrated business system capable of achieving our common goals which insures security for our people and success for our business and communities."

The values contained in these statements are not only espoused, but also practiced at Saturn. These statements provide the guidance that team members need in order to make decisions for the company. In every decision they make, team members are instructed to follow the philosophy and remember the mission.

Job security is not an issue with Saturn team members because every represented team member is guaranteed a job with Saturn by the contract. Saturn employs several strategies to ensure that even during economic downturns or other reductions in demand for Saturn vehicles none of their team members will be laid off. Their first strategy is lean staffing. Saturn represented team members generally have the attitude that *less* represented team members is better for their job security. This contrasts the feelings of union members at more traditional plants where they believe that more employees means more job security for them. Saturn is different because job security is not based on seniority at Saturn. Everybody is equally guaranteed a position at Saturn. For this reason, the represented people are not trying to pad the organization with new hires who serve little productive purpose other than to buffer the higher seniority people from layoffs when they come.

In fact, the pressure at Saturn is to reduce the number of people to reduce costs. This pressure stems from the fact that all team members at Saturn have an honest profit sharing system that rewards them when Saturn becomes profitable. Team members understand that the cost of extra people will erode the size of their profit sharing check. An example of this philosophy in action was the addition of the third production crew. Rather than increasing the size of their workforce by 50% to staff the third production crew, Saturn team members volunteered to move from one of the first two crews to the new third crew, leaving vacant positions in their old teams that the teams agreed to leave empty. This had several positive effects on Saturn's workforce. First, it provided a strong incentive for the team that had lost a person to learn how to work leaner and more efficiently, and second, it allowed the third crew to get started with some experienced people to ease the transition into production and increase product quality.

The second strategy that Saturn employs to ensure job security to their team members is a large contract work force. Contract workers do many of the jobs at Saturn that union members would perform in a more traditional production facility. Contract employees provide janitorial services, grounds keeping services, food services, shipping yard work, and other services at Saturn. The agreements with these contractors have clauses that allow Saturn to take back this work should they need to place some of their team members temporarily into those jobs during a period of slow

demand. These contract positions are a safety net for team members to fall into if there is a downturn, and this safety net provides a sense of security for team members.

The third strategy that Saturn uses to ensure job security is a psychological one. Many of the represented people at Saturn like to say, "they hired my mind as well as my body." Saturn makes people think. They think about how they do their job, how they can improve their job, even how they can eliminate their job. They think about business issues, and they have responsibility to run their area of the business in the way that makes the most sense. Saturn's strategy is to value people for all of their contributions to the company. When Saturn values people's thoughts, opinions, and ideas and allows team members to act upon their own ideas, they understand that they do make a difference at Saturn. Each team member feels valuable, each feels like Saturn needs them to keep improving the business. This psychological safety allows the employees to share ideas and to want to improve the business, even to the point where they could eliminate their job. Contrast this with a traditional plant where employees hoard their improvement ideas because "one of the engineers will take all the credit for it to impress management," or where improvements in the process mean that less people are necessary, and it would be unthinkable to cause a co-worker to be laid off. If all you do all day is turn a bolt, or place a gasket, and nobody pays attention to your ideas, it is all too easy to believe that you can be replaced in an instant.

Another interesting point about Saturn's contract is that no job-related privileges are based upon seniority. In a traditional plant, when a job becomes available it must be offered to the most senior person who is theoretically capable of performing the job first, and if he declines the job the offer is made to the next senior person. This allows the company no freedom in terms of matching skills, attitudes, or capabilities between a job and the employee who will perform the job.

At Saturn, all openings are posted and team members must apply for open jobs. As with the initial hiring of team members, all applicants for an open position are put through a selection process and the most highly qualified individual is selected to fill the position. Saturn's selection process is based on scoring points in certain areas of skill or knowledge required to perform the job, and therefore does not rely too heavily on human judgment, which can be biased by personal interests or favoritism. In the case where a position is open to join a maintenance or production team, the team makes the final decision on who will fill the opening. Such a system provides incentives to increase their skills to all team members who have aspirations of moving into new

positions. Saturn's system rewards technical and interpersonal competence rather than longevity.

From a maintenance standpoint Saturn's contract is particularly interesting. No different or special privileges are granted to the maintenance team members such as plant-wide overtime equalization, or job rotation rights. The same rules that govern the optechs at Saturn govern the mechanical, electrical, tool and die, and stationary engineer trades. All job transfers are handled through the selection process, and all overtime is handled by teams who will decide amongst themselves how they want to handle their own overtime.

The fact that each team performs their own overtime is significant, because people who know the machine that needs to be repaired or maintained will be the ones who perform the maintenance or repair. This means that less time is necessary and better preparations can be made for the job to be done right the first time. The person who knows the most about the machine will be the one selected by his team to do the job. This system is more efficient than what would happen at a traditional plant, where many people who are low on overtime hours may have to be brought in (to do what?) to get the guy who knows the most about the machine to come in and work on it. While this traditional system is "fair" to everybody in terms of the number of overtime hours they are offered, it is inefficient and costly from a business standpoint.

One of the leadership philosophies which appears to be operating at Saturn is one of "eliminate management by fear." This philosophy is apparent in the attitudes that encourage people to try new ways of doing things, even if there is a risk of failure. It is also apparent in several policies which reward success and do not punish failure. Saturn's "disciplinary" system, which they call the Consultation Process, is one example, and their pay system is another.

At a traditional plant, the shop rules include a list of actions that warrant disciplinary measures and what discipline is necessary. Discipline can range from the balance of the day off without pay to dismissal, and discipline up to a specified point is at the discretion of the supervisor subject to a "paragraph 76" review with a union committeeman. At Saturn, the behavior of team members is monitored by the whole team. If a team member is not performing the required work, or is behaving inappropriately, it is the responsibility of the team to inform the WUMA of the situation. The team member in question is brought in for a counseling session with the WUMA where they jointly review the facts of his behavior. The WUMA tries to understand the root cause of the behavior, which may stem from family or marital problems, or perhaps drug or alcohol abuse.

If the WUMA finds that a behavioral problem does exist, he will place the team member on what is called "amber" status. Together the WUMA and the team member in question will draw up an agreement which indicates the intent of the team member to seek appropriate counseling and/or to correct the behavioral problems which have been noted. The team member voluntarily signs the agreement if he has good intent to seek help, and he goes back to work. Every couple of weeks the team member and the WUMA have a coaching session to determine the team member's progress. If no more problems arise, he is removed from amber status and the process ends.

If the behavioral problems continue, however, and the contract written under the amber status is not followed, the team member is brought back to the WUMA who reviews the facts to decide whether or not the team member still has a problem. If he decides that the team member still has a problem, he is put on what is called "red" status and the case is referred up to the UAW VP and a People Systems representative. People Systems will dictate a contract for behavioral correction that the team member must follow, which may include mandatory counseling and coaching sessions. If the team member is able to correct the problem at this point, the case is reviewed and the team member is taken off of red status.

If the team member cannot comply with the terms of the agreement, he is given a "decision day." Decision day is actually three days off of work with pay for the team member to remain at home and decide whether or not he wishes to comply with the contract. Upon his return, if he has decided to abide by the contract and follow Saturn's philosophy and mission, he is allowed to return to work. If he has decided not to abide by the contract, the team member has deselected himself from employment at Saturn. A diagram of how this process works is included in Appendix II.C at the end of this section of the thesis.

In a traditional plant, the incentive for success is the risk of failure. We are accustomed to hearing about layoffs, and we have come to accept that they are the result of inadequate performance. The problem with this system is that it only ensures the minimum effort required to survive, not the effort required to succeed and improve. At Saturn, because job security is not an issue, and the fear of layoffs is not presented to people as a reason to change their behavior, a system has been designed to reward success in an increasing fashion. This system puts the emphasis on achieving higher levels of performance so that the rewards will be greater. Saturn's pay system is a "risk-and-reward" system that is tied to the key performance indicators of their business.

The percentage at risk has already been described in the previous section on training. If every team member at Saturn has 92 hours of training in a year, an equivalent of 7% of each team member's salary will be paid to him or her in quarterly payments. The details of how this works are in the training section. This system puts a tremendous common emphasis on training and skills enhancement that is supported by every team member at Saturn.

The reward part of Saturn's pay system comes in several parts, the first of which takes on the form of periodic payments for meeting product quality and production schedule goals. There is a chart which has quality results from a CAMIP audit on the horizontal axis, ranging from 0 defects per vehicle up to 4.0 defects per vehicle, and bonus payment on the vertical axis. Various percentage of production schedule lines run through the chart for easy reference of bonus payment amount from the other two metrics. The lump sum payment made equally to all team members depends on the periodic results of the quality audits and production schedule adherence. (As an example, 0.5 defects per car at 98% production schedule might give a bonus payment of $535.00 to each team member at Saturn.)

The second part of Saturn's reward system is a monthly profit sharing system. In the first month in which Saturn turned a profit, every team member in the company received a bonus payment to celebrate their success. Each subsequent month in which Saturn turns a profit, a certain percentage is set aside for payment to team members. The total of these bonus payments can accumulate to a substantial amount during the course of a year.

Another leadership philosophy that is apparent at Saturn is the belief that people who are trained in what to do and given the right tools to do it will do the right thing. Team members at Saturn are responsible for making decisions in their areas on how they run the system, and in order to do this properly Saturn provides numerous hours of training (see the section on training). They also provide a tool that helps team members at Saturn to break down specific goals into implementation plans in a way that everybody involved will understand their role to help the plan succeed. This tool is called RASI.

RASI stands for Responsible-Approver-Supporter-Informed, and is a matrix model for understanding who does what in the implementation of a particular plan. All Saturn team members are given training on how it works and how to put together a RASI model. A RASI model consists of a matrix with each specific task required in the implementation of a plan written in columns across the top, and each person who has any involvement in the implementation of the plan down the rows on the side. The

matrix is then filled in with an R, A, S, I or left blank for each person/task combination in the matrix. This completed RASI matrix defines the flow of work in the implementation of the plan, and helps everybody to understand who is doing what to help. It helps define what approvals are necessary and who needs to know what to do their part of the job. Although it may seem like a simple information organization tool, in use it is actually a very effective method for sharing information and helping people to understand their roles in conjunction with the roles of their team mates.

Comments on Saturn Benchmark Study

There are places that talk employee empowerment, that talk teamwork, that talk about quality as their focus, but few succeed at actually implementing these ideals with the success of Saturn. Saturn's employee empowerment covers every aspect of their jobs, including decisions on how to budget their department's money. Saturn's teamwork between the line workers and management is exemplified by the 27 page memorandum that is their contract, and the fact that all employees from bottom to top are called "Team Members." Saturn's quality is reflected in their J. D. Power's rankings, which have been in the top ten (most in the top three) since the company sold its first car in 1990. Their quality comes from happy employees, who believe in their company, taking individual responsibility to build the best car they know how.

What Saturn has successfully managed to do with its business systems, in my view, is to align the goals of the business with the goals of the individual. By doing this, people are able to do the right thing for the company simply by looking out for what is best for them. Because every human being has the natural ability to look out for themselves, this alignment of goals provides the power that Saturn team members need to do the right things for Saturn. Their risk and reward pay system and incentive structure is an effective tool for encouraging people to keep the quality high, to meet the production schedule, and to watch their costs so Saturn can be profitable. Saturn's business systems allow people the information they need to make the right decisions for Saturn because within the total organization they are managing their own area of the business.

Saturn's philosophy does not lead to the belief that failures are bad, instead failures are viewed as learning opportunities. People must learn from failures to never let them happen again. Saturn has equipped their team members with tools, training, and business systems that encourage correct behavior and allow each team member to make their maximum contribution to the whole of the corporation.

Not everything is perfect at Saturn. They have had serious breakdowns on critical equipment, like their laser welding machines, they have difficulty coordinating three different crews running the same area of the business, and they have machines that they would like to redesign to make them easier to maintain. What Saturn has done very well, however, is create a dynamic system that allows them to respond to their imperfections and constantly improve upon them. This section of my thesis fails to capture that dynamic nature of Saturn's organization which allows it to adapt to new internal and external integration forces. It represents only a snapshot for today, describing Saturn's maintenance operations, but because change and improvement is Saturn's status quo, this descriptions may not represent tomorrow's Saturn.

1993 Capacity Utilization Calendar
Splitting On June 14,1993

	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE			JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
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— *Legend* —

A Crew = *Holidays/ =*
B Crew = *Vacation*
C Crew = *Sundays = ★ ★ ★*

Appendix II.B Saturn's 30 Work Unit Functions

WORK UNIT FUNCTIONS

(1) CONSENSUS DECISION-MAKING

CONSENSUS DECISION-MAKING WILL BE UTILIZED IN A SYNERGISTIC APPROACH WITH NO FORMAL LEADER APPARENT IN THE PROCESS. THE FOCUS WILL BE ON BOTH CURRENT AND NEAR TERM DECISIONS INVOLVING DAILY, WEEKLY AND MONTHLY ACTIVITIES. DECISIONS THROUGH THIS METHODOLOGY WILL UTILIZE THE R.A.S.I. MODEL FOR IMPLEMENTATION AND ~~ASSIGNMENT OF ACCOUNTABILITY.~~ ANY MEMBER WHO FEELS THE NEED TO BLOCK IS REQUIRED TO PROVIDE A REASONABLE AND TIMELY ALTERNATIVE SOLUTION TO THE PROBLEM. ALL MEMBERS OF THE WORK UNIT WHO REACH CONSENSUS MUST BE AT LEAST SEVENTY PERCENT (70%) COMFORTABLE WITH THE DECISION, AND ONE HUNDRED PERCENT (100%) COMMITTED TO ITS IMPLEMENTATION. THE GUIDELINES FOR CONSENSUS DECISION-MAKING ARE AS FOLLOWS:
(SEE PARAGRAPH 11 MEMO)

WORK UNIT FUNCTIONS

(2) SELF-DIRECTED

A WORK UNIT WHICH IS SELF-DIRECTED AS DEFINED IN SATURN TRAINING DEVELOPMENT PLAN UNDERSTANDS AND CAN ACCOMPLISH THE TASKS WITHIN ITS AREA OF RESPONSIBILITY WITHOUT DIRECTION. THE WORK UNIT CONSISTS OF INDIVIDUAL SATURN MEMBERS WHO ARE ACCOUNTABLE FOR THEIR OWN BEHAVIOR. THE SELF-DIRECTED WORK UNIT USES THE PRINCIPLE OF SHIFTING LEADERSHIP AND HAS ONLY COMMITTED MEMBERS WITHIN ITS RANKS. THESE WORK UNIT MEMBERS ARE CAPABLE AND EMPOWERED TO MAKE OPERATIONAL AND PLANNING DECISIONS FOR THEIR TEAM.

WORK UNIT FUNCTIONS

(3) MAKE THEIR OWN JOB ASSIGNMENTS:

A WORK UNIT THAT MAKES ITS OWN JOB ASSIGNMENTS FOR ITS MEMBERS DOES SO ONCE THE JOB ELEMENTS HAVE BEEN IDENTIFIED, AND ENSURES SAFE, EFFECTIVE, EFFICIENT, AND EQUAL DISTRIBUTION OF THE WORK UNIT TASKS TO AL ITS MEMBERS.

WORK UNIT FUNCTIONS

(4) RESOLVE THEIR OWN CONFLICT:

A WORK UNIT THAT RESOLVES ITS OWN CONFLICT RECOGNIZES A PROBLEM AS AN OPPORTUNITY FOR A "WIN-WIN" OR "NO DEAL" SITUATION WITHIN THE WORK UNIT PRIOR TO SEEKING INTERVENTION FROM THE OUTSIDE.

WORK UNIT FUNCTIONS

(5) PLAN THEIR OWN WORK:

A WORK UNIT THAT PLANS ITS OWN WORK FULLY UNDERSTANDS ITS PURPOSE, AND THE SATURN PRODUCTION SYSTEM, AND PROVIDES AN ANALYTICAL ANALYSIS OF ITS TASKS AND RESPONSIBILITIES. THE WORK UNIT SETS PRIORITIES WITH THESE TASKS AND RESPONSIBILITIES THROUGH A SEQUENTIAL BREAKDOWN OF THE ACTIVITIES. THE WORK UNIT ASSIGNS TIMELY RESOURCES FOR THE ACCOMPLISHMENT OF ITS PURPOSE TO ITS CUSTOMER(S) WHILE MEETING THE NEEDS OF PEOPLE WITHIN THE WORK UNIT.

WORK UNIT FUNCTIONS

(6) DESIGN THEIR OWN JOBS:

A WORK UNIT THAT DESIGNS ITS OWN JOBS WILL DO SO BASED ON THE TASKS TO BE ACCOMPLISHED WITHIN THE SCOPE OF THE WORK UNIT'S RESPONSIBILITY. TO MEET THE NEEDS OF ITS CUSTOMERS THE JOB DESIGN WILL PROVIDE THE OPTIMUM BALANCE BETWEEN PEOPLE AND TECHNOLOGY AND WILL INCLUDE THE EFFECTIVE USE OF MANPOWER, ERGONOMICS, MACHINE UTILIZATION, QUALITY, COST, JOB TASK ANALYSIS AND CONTINUOUS IMPROVEMENT.

WORK UNIT FUNCTIONS

(7) CONTROL THEIR OWN SCRAP:

A WORK UNIT THAT CONTROLS ITS OWN SCRAP UNDERSTANDS THE MEANING OF SUCH, AND WILL WORK TO MINIMIZE WASTE

WORK UNIT FUNCTIONS

(8) CONTROL THEIR OWN MATERIAL AND INVENTORY:

A WORK UNIT THAT CONTROLS ITS OWN MATERIAL AND INVENTORY WORKS DIRECTLY IN A COORDINATED MANNER WITH SUPPLIERS, PARTNERS, CUSTOMERS, AND INDIRECT/PRODUCT MATERIAL RESOURCE TEAM MEMBERS TO DEVELOP AND MAINTAIN ITS OWN NECESSARY WORK UNIT INVENTORY PLAN CONSISTENT WITH THE SATURN PRODUCTION SYSTEM.

WORK UNIT FUNCTIONS

(9) PERFORM THEIR OWN EQUIPMENT MAINTENANCE:

A WORK UNIT THAT PERFORMS ITS OWN EQUIPMENT MAINTENANCE PERFORMS ONLY THOSE TASKS THAT CAN BE DEFINED AS SAFE, AND THOSE THEY HAVE THE EXPERTISE, ABILITY AND KNOWLEDGE TO PERFORM EFFECTIVELY WITHIN THE WORK UNIT TEAM.

WORK UNIT FUNCTIONS

(10) PERFORM THEIR OWN DIRECT/INDIRECT WORK:

A WORK UNIT THAT PERFORMS ITS OWN DIRECT/INDIRECT WORK WILL DO SO BASED ON CUSTOMER REQUIREMENTS. IT WILL IDENTIFY ITS NEEDS THROUGH FOUR SQUARE ANALYSIS WHILE PLANNING FOR THE EFFECTIVE UTILIZATION OF PEOPLE IN ORDER TO ACCOMPLISH THE NECESSARY TASKS IN ACCORDANCE WITH THE SATURN PRODUCTION SYSTEM.

WORK UNIT FUNCTIONS

(11) SCHEDULE THEIR OWN COMMUNICATIONS WITHIN AND OUTSIDE THE GROUP:

A WORK UNIT THAT SCHEDULES ITS OWN COMMUNICATIONS WILL BE RESPONSIBLE AND ACCOUNTABLE WITHIN THE PARAMETERS OF THE SATURN PRODUCTION SYSTEM FOR THE ESTABLISHMENT AND MAINTENANCE OF AN EFFECTIVE, TIMELY, INTERNAL AND EXTERNAL COMMUNICATIONS SYSTEM IN CONCERT WITH THE SATURN PRODUCTION SYSTEM. THE WORK UNIT WILL ALSO ESTABLISH ITS OWN EXTERNAL COMMUNICATIONS NETWORK IN ORDER TO ACCOMPLISH ITS PURPOSE IN AN EFFECTIVE, TIMELY MANNER.

WORK UNIT FUNCTIONS

(12) WORK UNITS WILL KEEP THEIR OWN RECORDS:

A WORK UNIT THAT KEEPS ITS OWN RECORDS WILL BE RESPONSIBLE FOR DEVELOPING AND MAINTAINING RECORDS THAT WILL HELP ITS MEMBER EFFICIENTLY PERFORM THEIR OWN TASKS AND RESPONSIBILITIES IN A COST EFFECTIVE MANNER. THE WORK UNIT WILL RECEIVE ASSISTANCE IN DETERMINING WHAT RECORDS NEED TO BE MAINTAINED AND WILL BE PROVIDED THE NECESSARY RESOURCES TO PRODUCE AND STORE RECORDS PERTINENT TO THEIR OWN AREA OF RESPONSIBILITY AND ACCOUNTABILITY.

WORK UNIT FUNCTIONS

(13) MAKE SELECTION DECISIONS OF NEW MEMBERS INTO THE WORK UNIT:

A WORK UNIT OPERATING IN A STEADY STATE HAS RESPONSIBILITY FOR DETERMINING TOTAL MANPOWER REQUIREMENTS USING FOUR SQUARE ANALYSIS. SELECTION AND MOVEMENT OF QUALIFIED NEW MEMBERS FROM A CANDIDATE POOL WILL BE IN ACCORDANCE WITH THE ESTABLISHED SATURN SELECTION PROCESS.

WORK UNIT FUNCTIONS

(14) CONSTANTLY SEEK IMPROVEMENT IN QUALITY, COST AND THE WORK ENVIRONMENT:

THE WORK UNIT IS RESPONSIBLE FOR INVOLVING ALL WORK UNIT MEMBERS IN IMPROVING QUALITY, COST, AND THE WORK ENVIRONMENT IN CONCERT WITH SATURN QUALITY SYSTEM.

WORK UNIT FUNCTIONS

(15) PERFORM TO THEIR OWN BUDGET:

THE WORK UNIT WILL PLAN ITS OWN BUDGET IN CONCERT WITH SATURN BUDGETARY PROCEDURES AND THE BUSINESS PLAN. THE WORK UNIT WILL TRACK AND BE ACCOUNTABLE FOR ITS PERFORMANCE TO BUDGET FORECAST WHICH WILL BE USED AS ONE MEASUREMENT OF CONTINUOUS IMPROVEMENT.

WORK UNIT FUNCTIONS

(16) INTEGRATED HORIZONTALLY WITH BUSINESS UNIT RESOURCES:

A WORK UNIT THAT IS INTEGRATED HORIZONTALLY WILL HAVE BUSINESS UNIT AND MODULE RESOURCES IDENTIFIED AND UNDERSTAND THE INTERDEPENDENT ROLES AND RESPONSIBILITIES.

WORK UNIT FUNCTIONS

(17) REFLECT SYNERGISTIC GROUP GROWTH:

SYNERGY IS THE PROCESS OF THE WHOLE BECOMING GREATER THAN THE SUM OF ITS PARTS. A WORK UNIT THAT REFLECTS SYNERGISTIC GROUP GROWTH DEMONSTRATES A CLEAR UNDERSTANDING OF ITS GOALS AND DISPLAYS THE ABILITY OF ENHANCING GROUP KNOWLEDGE AND EFFECTIVENESS.

WORK UNIT FUNCTIONS

(18) DETERMINE THEIR OWN METHODS:

THE ULTIMATE RESPONSIBILITY FOR THE EFFECTIVE ORGANIZATION OF WORK RESIDES IN THE WORK UNIT. THE WORK UNIT IS RESPONSIBLE FOR DESIGNING THE JOBS OF ITS TEAM MEMBERS CONSISTENT WITH THE REQUIREMENTS OF THE SATURN PRODUCTION SYSTEM AND COMPREHENDING THE NECESSARY RESOURCES (LAYOUT, TOOLS, EQUIPMENT, ERGONOMICS, ETC.) AND WORK BREAKDOWN REQUIRED (BALANCE) WITH FLEXIBILITY FOR CONTINUOUS IMPROVEMENT.

WORK UNIT FUNCTIONS

(19) SCHEDULE THEIR OWN RELIEF:

WORK UNITS WILL PROVIDE FOR THEIR OWN SCHEDULED AND UNSCHEDULED RELIEF TAKING INTO CONSIDERATION THE NEED TO BALANCE PEOPLE, TECHNOLOGY AND THE SATURN PRODUCTION SYSTEM.

WORK UNIT FUNCTIONS

(20) SCHEDULE THEIR OWN VACATION:

THE WORK UNIT WILL PLAN AND COORDINATE EACH WORK UNIT MEMBERS VACATION WITHOUT COMPROMISE TO THE NEEDS OF PEOPLE AND THE SATURN PRODUCTION SYSTEM.
(SEE ARTICLE 25 OF MEMO)

WORK UNIT FUNCTIONS

(21) PROVIDE THEIR OWN ABSENTEE REPLACEMENTS:

THE WORK UNIT IS RESPONSIBLE FOR ATTENDANCE OF ITS OWN MEMBERS. IT WILL THEREFORE NEED TO MONITOR AND ENSURE PROPER ATTENDANCE. THE WORK UNIT WILL BE REQUIRED TO PLAN FOR AND PROVIDE ITS OWN ABSENTEE COVERAGE WITHOUT ~~COMPROMISE TO QUALITY~~ AND PRODUCTION SCHEDULES.
(SEE ARTICLE 27 OF MEMO)

WORK UNIT FUNCTIONS

(22) PERFORM THEIR OWN REPAIRS:

THE WORK UNIT WILL HAVE THE ULTIMATE RESPONSIBILITY FOR PRODUCING A WORLD CLASS PRODUCT THAT MEETS THE NEEDS AND REQUIREMENTS OF THE CUSTOMER. IN THE EVENT A JOB LEAVES THE WORK UNIT WITH A KNOWN OR UNKNOWN NON-CONFORMANCE TO SPECIFICATION, THE ORIGINATING WORK UNIT WILL BE ACCOUNTABLE FOR CORRECTIVE ACTION AND REPAIR.

WORK UNIT FUNCTIONS

(23) PERFORM THEIR OWN HOUSEKEEPING:

HOUSEKEEPING WITHIN THE WORK UNIT WILL BE THE RESPONSIBILITY OF THE WORK UNIT. SATURN MAY CHOOSE TO PROVIDE SOME OF THE FACILITY'S CLEANING THROUGH EXTERNAL RESOURCES.

WORK UNIT FUNCTIONS

(24) MAINTAIN AND PERFORM THEIR OWN HEALTH AND SAFETY PROGRAM:

THE WORK UNIT WILL BE RESPONSIBLE FOR THE PROPER, TIMELY RECORD KEEPING OF HEALTH AND SAFETY INFORMATION AS WELL AS ITS OWN SAFETY AND HEALTH TRAINING AND AWARENESS TO INDIVIDUAL MEMBERS OF THE WORK UNIT. THE WORK UNIT WILL ENSURE THAT HEALTH AND SAFETY IS OF THE UTMOST IMPORTANCE TO INDIVIDUAL MEMBERS. SATURN WILL COMPLY WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS AND WILL PROVIDE THE WORK UNIT WITH THE NECESSARY RESOURCES TO DO SO.

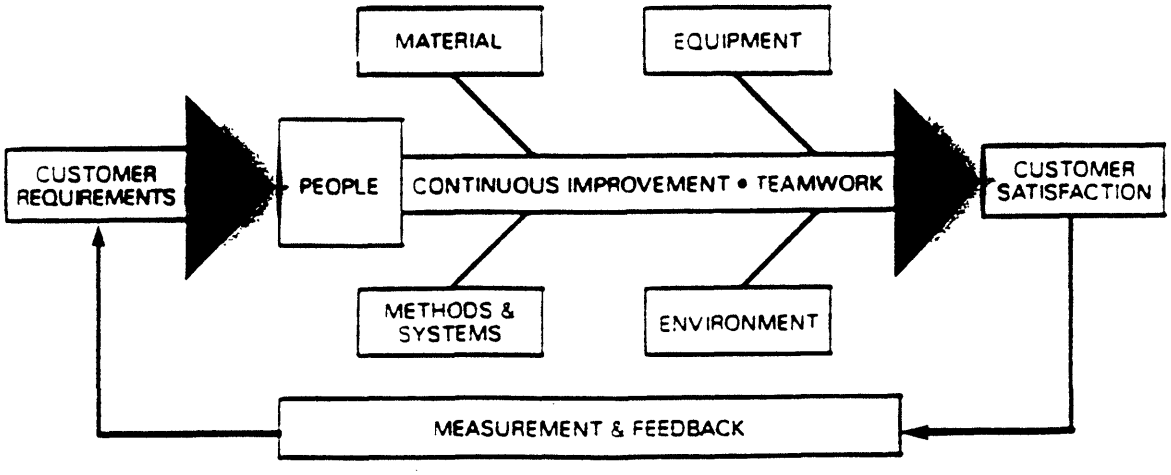
WORK UNIT FUNCTIONS

(25) RESPONSIBLE FOR PRODUCING QUALITY PRODUCTS TO SCHEDULE AT COMPETITIVE COSTS:

THE WORK UNIT IS RESPONSIBLE FOR PRODUCING WORLD CLASS QUALITY PRODUCTS TO SCHEDULE AT COMPETITIVE COSTS BY FOCUSING ON CUSTOMER SATISFACTION AND MEETING CUSTOMER REQUIREMENTS WITH EMPHASIS ON CONTINUOUS IMPROVEMENT.

SATURN QUALITY NETWORK

FOR SUPPLIERS, DEALERS, AND BUSINESS UNITS



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WORK UNIT FUNCTIONS

(26) ASSIST IN DEVELOPING AND DELIVERING THEIR OWN TRAINING:

THE WORK UNIT WILL BE RESPONSIBLE FOR ASSISTING IN THE IDENTIFICATION OF THE WORK UNIT'S TRAINING NEEDS, UTILIZATION OF THE AVAILABLE RESOURCES, AND PRIMARY DELIVERY OF THE INFORMATION OR SKILLS TO WORK UNIT MEMBERS FOR THE PURPOSE OF ENSURING WORLD CLASS AUTOMOTIVE WORKERS.

(SEE ARTICLE 16 OF MEMO)

WORK UNIT FUNCTIONS

(27) OBTAIN THEIR OWN SUPPLIES:

THE WORK UNIT WILL BE RESPONSIBLE FOR ORDERING THEIR OWN INDIRECT MATERIAL REQUIREMENTS FROM THE PRIMARY SUPPLIERS.

WORK UNIT FUNCTIONS

(28) SEEK RESOURCES AS NEEDED:

THE WORK UNIT IS RESPONSIBLE FOR IDENTIFYING AND SEEKING RESOURCES AS NEEDED THROUGH THE MODULE ADVISORS AND BUSINESS UNIT.

WORK UNIT FUNCTIONS

(29) SCHEDULE AND HOLD THEIR OWN MEETINGS:

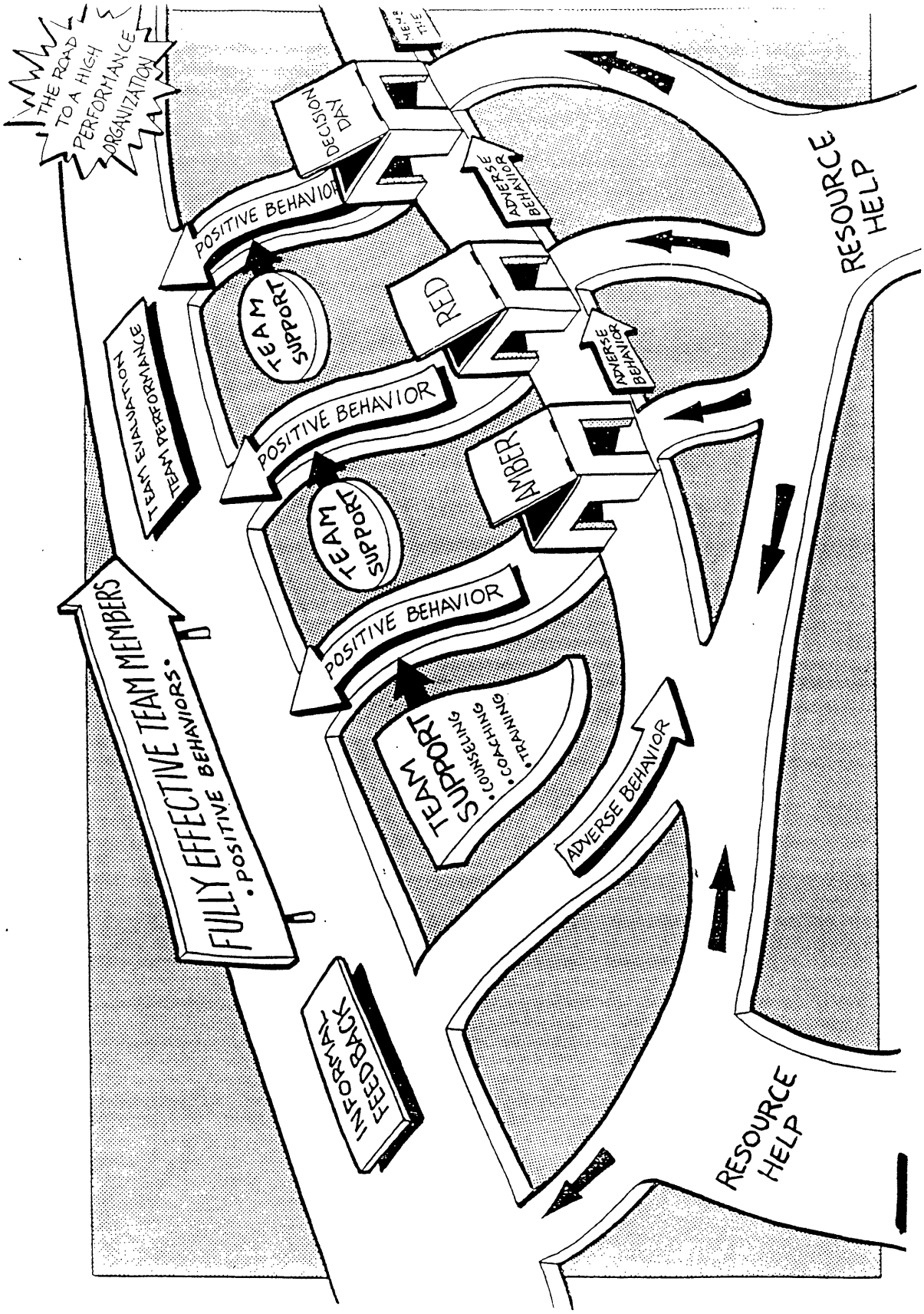
SELF-DIRECTED WORK UNITS WILL DETERMINE THE FREQUENCY AND DURATION OF MEETINGS NEEDED TO RUN "THEIR" PART OF THE BUSINESS AND PROVIDE FOR CONTINUOUS IMPROVEMENT IN CONCERT WITH THE SATURN PRODUCTION SYSTEM.

WORK UNIT FUNCTIONS

(30) INITIATE THE INITIAL CONSULTATIVE PROCEDURE FOR SELF CORRECTIVE ACTION, WITH RESPONSIBILITY ON THE INDIVIDUAL MEMBER:

THE WORK UNIT IS RESPONSIBLE FOR ESTABLISHING AND ENSURING BEHAVIORAL NORMS CONSISTENT WITH THE CONCEPTS OF SATURN'S MISSION, PHILOSOPHY, AND SHARED VALUE SYSTEM. IN DOING SO, IT IS LIKEWISE RESPONSIBLE FOR IMPLEMENTATION OF THE "CONSULTATIVE PROCEDURE" WITH EMPHASIS ON THE INDIVIDUAL MEMBERS'RESPONSIBILITY TO INITIATE SELF-CORRECTIVE ACTION WHERE NECESSARY.

Appendix II.C Saturn's Consultation Process



Section III:
Culture & Cultural Change

There is a great deal of literature published on the subject of cultural change, and opinions vary widely even on the basic definition of what constitutes a culture, let alone how one can identify, measure, describe, or change it. Denison and Spreitzer describe the situation well when they say that, "there is little agreement among organizational scholars concerning the appropriate methods for studying and understand organizational culture."[1] The purpose of this chapter is to provide a definition of culture that is useful for the purpose of cultural change in a manufacturing plant, and to use that definition to explain how culture can be changed in such an environment.

One camp of researchers who have studied the topics of corporate culture and cultural change are of the opinion that culture is a quantitative phenomenon. They subscribe to the belief that culture is something that can be measured, and they have created study methodologies and surveys that allow them to quantitatively measure aspects of corporate culture. They claim that qualitative studies of culture are merely exploratory.

The other camp of researchers believe that culture is a qualitative thing, something to which you cannot apply a yardstick and assign a number. They will claim that quantitative methods are "superficial and simple minded."[2] The meat of the matter centers around culture as a social phenomenon, involving people and their interactions. With culture, like people, you can measure certain of their characteristics, but you cannot assign numbers that completely describe who they are or what they believe.

It is not my intent to claim that one side of the argument is correct, and the other incorrect; however, it should be noted that this thesis will discuss culture from a qualitative perspective. While I do not discount the value of the quantitative scholars' work, it is of secondary value for the specific purposes of this thesis. Such a view of corporate culture is useful when comparisons between cultures are deemed necessary or desirable, but for the purposes of cultural change, a quantitative view toward culture does little to help us formulate methodologies for cultural change. From a qualitative perspective, we have a basis from which to work when attempting to formulate change

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[1]Denison and Spritzer, Organizational Culture and Organizational Development: A complex values approach, p. 7.
[2]Ibid., p. 7.

methodologies. It is my belief that the phenomena that create culture can be universally researched and classified, but the results of these phenomena are so unique to each individual group of people that only qualitative methods can accurately capture or describe a culture.

Culture Defined

The definition of culture that offers the best qualitative foundation from which to begin the process of cultural change comes from Edgar Schein. He defines culture as, "A pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems."[3] It is important to note for the purposes of cultural change that this definition involves a group of people collectively accepting solutions to both internal and external problems. It also involves the perpetuation of this culture through the indoctrination of new members into the group. This definition gives us an understanding of where culture comes from, what interactions take place to create it, why it exists as a definable entity in the first place, and how it is stabilized within an organization. With an understanding of these aspects of culture formation, we can formulate methodologies for cultural change.

Schein offers a framework for conceptually breaking down the elements of a culture that is also useful for the purposes of cultural change. This framework breaks culture down into three strata, each of which represent a different level of cultural operation. These strata build up from the lowest to the highest level to produce the culture that a particular group will share. The three levels are *artifacts*, *values*, and *assumptions*.

Artifacts are the visible evidences of a culture in an organization. Artifacts of a culture are immediately discernible by outsiders, and are contained in an organization by such observable data as accepted dress code, layout of work spaces, speech patterns and vocabulary, and the deference and respect given to authority to name a few. Artifacts are easily perceived, and provide the first clues to some of the values and assumptions that underlie them.

Values are the statements, whether written or understood, that govern the behavior of the people in a group. Statements like "Safety is our number one priority!" indicate the values of an organization. The values of a group help its members to make

[3]Schein, Organizational Culture and Leadership, p. 12.

decisions on a daily basis. It is important at this point, to distinguish between espoused values and theories-in-use. It is possible for an organization to put in use their espoused values, but this is not always the case. Espoused values are the stated values of an organization. Statements like the one given above, or like "Quality comes first," "Employees are our greatest asset," and "We listen to the customer," are all examples of espoused values in an organization. These are the values that the organization states that they hold. In actual practice, however, the culture may contradict these stated values, resulting in a theory-in-use. The theories-in-use are the true values of an organization, because they are the ones upon which action is based. These theories-in-use are always based upon the lowest level of data in a culture, the assumptions, while espoused values that are not in use are based upon factors other than cultural assumptions.

If an organization exhibits a dichotomy between its espoused values and its theories-in-use, it is usually a good indicator that management is aware that the business should be moving in a new direction, but is unsure of how to make it actually happen. Such a situation can arise as the result of poor enforcement of new policies, or disagreements between people in leadership roles over the direction the business should take. Espoused values that are not theories-in-use represent the lip service that is given in deference to somebody else's opinion of how an organization should cperate.

Assumptions are the lowest level of an organization's belief system. Assumptions are the most difficult part of a culture to identify because they are subconscious within the decision making process of the individuals in the group. Assumptions are rules that operate within the culture that form the basis for values and artifacts. An example of a rule might be "when a manager and his subordinate disagree, the manager is right without question," or "people are responsible and self-motivated and therefore do not require close supervision." It is easy to image what effects either of these two rules operating within an organization would have on the way that decisions are made, and therefore on the way that the organization operates and presents itself. Identifying and understanding these basic underlying beliefs in a culture is the key to cultural change.

The Stages of Cultural Development

Cultures go through stages of growth and development much like people do, with cultures of differing maturity exhibiting different characteristics. Schein categorizes cultures in terms of their maturity in an organization. The three types of

cultures that he describes are the young, mid-life, and mature or declining culture. Just like you would give a child a different dosage of medicine than is recommended for an adult, the recommended course for cultural change is different for each stage of cultural development. For this reason, it is important to assess the stage of cultural development that a culture exhibits before beginning the process of change.

Young cultures are the result of a startup organization. This takes place in its purest form with the formation of a new company, separate from any other entity. The characteristic that identifies a young culture is usually the existence of a very strong leader that is directing the actions and behaviors of the members of the new group. The nature of authority is very autocratic, with the leader setting the example and expectations for behavior. There is always investigation of the external environment that leads to the necessity for adaptation, and there are issues of internal methodologies and processes that need to be settled. Everything is new, and the culture is built quickly as solutions to problems are tried, and either adopted or abandoned. As the members of the team learn successful ways to solve the problems, they use them repeatedly, ingraining those solutions into the culture as the "correct" ways to solve the problems.

It can be argued that the reorganization of an existing culture can lead a culture back to its young development phase. This can be true if the leadership changes and disconfirms the existing solutions as the "correct" ways to solve problems, if the external environment shifts dramatically requiring the organization to readapt, or if the internal issues of integration change as the result of a substantial replacement of group members, vastly different business practices, or some other internal shakeup. It is important to understand that these events do not automatically take place just because the external environment shifts, the leadership changes, or the group members change. The cultural change takes place because leadership brings the organization through the crisis of new leadership, a shifting external environment, or shifting integration problems. Organizations that do not change in the face of one of these dramatic cultural forces will find themselves on a path of decline, unable to correctly adapt to the needs of the external market, or unable to resolve business practice issues.

It is possible for a young culture to be developed as a subset of a larger, existing culture. This would occur with the creation of a new group or organization within another, such as a new product team in a manufacturing firm. The culture would face both the issue of external adaptation surrounding their new product, and the issues of internal integration through the interactions of new individuals. It is most often the case, however, that the underlying assumptions of the larger organization

must still hold within the new subset, either by mandate from corporate leadership, or by default through the collective experiences of the individuals assigned to the new group. In this case, the young culture becomes a subculture of the larger culture, operating on many, if not all, of the same underlying assumptions. These assumptions may manifest themselves in values and artifacts within the subculture that differ from those of the main culture.

Mid-life cultures are those cultures that have reached the state of cultural development where the external environment and internal issues have stabilized. This means that solutions to all of the problems that the culture might face have been identified and adopted. These solutions are sometimes called "business practices," and it is a characteristic of a mid-life culture that these business practices may not be negotiable. A mid-life culture that can still understand why certain solutions were adopted will be a successful mid-life culture, especially if it is able to recognize shifts in either internal or external environments and adapt to the new environment by changing the "business practice." A mid-life organization that has blinders on, and it unable to identify shifts in the external or internal environment is on the steep slope to developing a mature or declining culture. It is easy to identify these cultures because the answer to the question, "why do we do it that way?" is often "because we always have."

Mature or declining cultures are those that are in the throes of suffering from maladaption to either their internal or external environments. A mature or declining culture has displayed a history of being unable to adapt, because had they been able to adapt the culture would not have reached the stage of decline. This stage of cultural development can result from an organization that is unwilling to scan the external environment for competitive information, or is unwilling to face difficult issues of internal integration through either weak leadership or a belief that "if we ignore the problem long enough, it will go away." A mature or declining culture may be ignoring or discounting important disconfirming evidence for the need of change. Drastic measures can be necessary to create cultural change in such an organization.

Because many manufacturing plants have the characteristics classified as mid-life organizations (although it is sad to say that many are mature or declining), this is the area for which the following cultural change methodologies will be recommended. Both Edgar Schein and Peter Senge, among other authors, recommend various change mechanisms for the different stages of cultural development, but the intent of this thesis is to create a methodology of change that will work for a manufacturing plant.

Cultural Change

Creating cultural change in a mid-life culture is a very difficult process. Remember that a mid-life culture is one that has accepted the solutions that it uses as the right way to do business, because during the formative stages of cultural development those solutions worked best to adapt externally and integrate internally. Business practices can be hard to question, let alone change, in a mid-life culture. The fact that these same solutions have sometimes worked for decades creates an attitude of invulnerability within the culture. This phenomenon can cause culture to define leadership in a mid-life organization, rather than the other way around.[4] What this means is that, in the event of an environment shift, the culture will not be prepared to adapt because leadership is entrenched in the existing cultural practices rather than scanning the environment to determine what cultural assumptions need to be addressed to adapt. Because the culture is self-perpetuating and self-confirming, organizational decline is imminent.

Chris Argyris talks about self-perpetuating and self-confirming cultures in his book Overcoming Organizational Defenses. He defines organizational defensive routines as "actions or policies that prevent individuals or segments of the organization from experiencing embarrassment or threat. Simultaneously, they prevent people from identifying and getting rid of the causes of the potential embarrassment or threat."[5]

It is not difficult to imagine how a shift in the environment in which an organization conducts business could lead members to feel threatened. An individual is part of a culture that tells him a certain way of doing something is the correct way to do it. When the environment shifts, and the "correct" way to do things is no longer the best way to do things, the individual will perceive the discrepancy. This person has a choice to make. He can either choose to tell the entire culture that it is wrong, and the "correct" way of doing things is no longer the correct way of doing things, or he can choose to continue doing things the way the culture dictates despite the fact he knows it is no longer correct.

In the first situation, the individual must face the remainder of the organization head on, challenging assumptions that they take for granted and will not easily modify or abandon. He faces the reality of being ostracized, criticized, or even fired for telling the organization that a change is necessary, particularly if the organization is

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[4]Schein, Organizational Culture and Leadership, p. 255.
[5]Argyris, Overcoming Organizational Defenses, p. 25.

facing no other disconfirming evidence at the time. It is normal in such a situation to feel threatened.

In the second situation, the individual must live with the knowledge that he is doing the wrong thing for the organization. This will cause feelings of guilt and anxiety which will be covered up by rationalizations about why it is best to do things the wrong way. These rationalizations are easy to make in a culture where espoused theories and theories-in-use are in contradiction with one another. In a culture where such mixed messages exist, an individual can justify any action by siding either with the espoused theory or the theory-in-use. This will lead to confusion about what really is the right thing to do, and this confusion causes embarrassment. Most people understand how embarrassing not knowing upon what assumptions or values to make a decision can be.

Mid-life cultures can also exhibit cynicism in the attitudes of the group members. The cynicism develops as a result of two causes. The first cause is the mixed messages from contradictory espoused values and theories-in-use which cause confusion at the individual level. The second cause is the fact that individuals have little choice in whether or not to live with the cover-ups that are necessary to eliminate threat and embarrassment.[6] The cynicism can give way to pessimism and doubt, which will manifest itself in artifactual statements from the group members like, "Nothing will ever change," "They [leadership] won't really listen," or "Next year there will be a new fad to deal with." Statements such as these are an indication that people are automatically mistrusting the organizational intentions.[7]

The organizational defensive routines in a mid-life culture can paralyze the culture, making it impossible for adaptation to occur. It is simple for people inside the culture to recognize the existence of the paralysis, but extremely to discover the root cause. The natural course of action for a group of people who want to eliminate the organizational defensive routines is to bypass them. That means they design business practices and solutions to avoid the engagement of the defensive routines.[8] This makes them unable to solve the root cause of the defensive routines because they are focusing on the symptoms of the problem.

People do not bypass organizational defensive routines because they are afraid, or because they are told to do so, but instead because human beings take the organizational defensive routines for granted. These defensive routines are part and

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[6]Argyris, Overcoming Organizational Defenses, p. 31.
[7]Ibid, p. 31.
[8]Ibid, p. 37.

parcel with the culture in a mid-life organization, they are assumed. One of the strongest assumptions operating in a mid-life culture is one about what things are discussible and not discussible. In many cultures, the assumption is made that the cultural assumptions are undiscussable, thus closing the door to cultural change. This leaves only one recourse for eliminating the organizational defensive routines. The only way to eliminate them is to confront them, by first identifying the routines that cause threat, embarrassment, or cultural paralysis, and then engaging them head on. The assumptions of a culture must be discussible and open to question at all levels of the organization before the paralysis is removed and the culture is free to change.

Assess the Need for Cultural Change

This brings us to the question of how the cultural assumptions are changed. The first step in the process of cultural change is to be certain that cultural change is necessary. Cultural change is trendy, and even if culture remains unchanged in an organizational transition, labeling it as cultural change is motivational, or at least career-promoting.[9] There is no reason to submit an organization to the anguish of cultural change if it is not necessary. The yardstick by which leadership can measure the necessity of cultural change in an organization is a cultural yardstick. Schein says that "the drive for cultural change derives from the need to solve organizational problems."[10] It is only when cultural assumptions get in the way of doing business that the issue of culture change arises. If the assumptions of a culture are undiscussable, but otherwise do not hinder the business process, there is little reason to shake things up.

Schein describes a methodology for uncovering cultural assumptions in Chapter eight of his book Organizational Culture and Leadership.. This is the best process for uncovering cultural assumptions that I have come across in my research, and I recommend it for use in a manufacturing environment. The outcome of this process will be a list of assumptions the culture holds.

After completing this process, the set of existing assumptions must be compared against a set of desired assumptions which stem from the desired new business direction. If there are any existing assumptions that would prevent the organization from moving in the direction that leadership has set, these assumptions must be changed. Hence the necessity for cultural change.

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[9]Schein, Organizational Culture and Leadership, p. 357.
[10]Ibid, p. 335.

Structuring the Change Process

The change process can be classified into three distinct parts, unfreezing, cognitive restructuring, and refreezing. Unfreezing is the process of preparing the culture to move from one set of assumptions to another. It entails removing the paralysis of organization defenses, and creating a climate of dissatisfaction with the current culture. Cognitive restructuring follows, in which the culture is changed to adapt better to the new external and internal environments. The culture is pushed in the new direction by leadership. Refreezing completes the process, when it is time to put the new culture to the test by using the new assumptions to solve the problems of the business on a daily basis.

To understand the elements of cultural change that fit into these three stages of cultural change, it is helpful to have a conceptual model for linking the elements together. The model should show how the elements of the change process interact, and how their interaction affect the success of the cultural change. To this end, Richard Beckhard, Michael Beer, Jan Klein, and Richard Walton have developed a mathematical model for cultural change. The model is:

P(Ch) = D * 1/CR * M * O * I

Where **P(Ch)**, the probability for successful change, depends on;
D, which is the dissatisfaction with the status quo,
CR, which is the career risk involved in the change,
M, which is the model, or vision, for the organization's future state,
O, which is the state of the organizational infrastructure, and
I, which is the implementation.

To eliminate any fear that this is a quantitative way to measure or create change, I must confess that this model was developed as a tongue-in-cheek equation. It certainly does not provide any useful number as a output. Its value is found in the fact that it does provide an excellent conceptual model that allows change agents to make sure they are covering all the bases necessary for successful cultural change. It also points out the importance of the interactions between the various elements. The multiplicative relationship between the coefficients shows that a low value of any single one of the elements decreases the chances for successful cultural change. A missing, or zero, coefficient will cause the probability for success to drop to zero.

Each of the various coefficients will be discussed in the subsequent sections on unfreezing, cognitive restructuring, or refreezing, depending on where that coefficient

fits into the stages of cultural change. The exceptions to this are the coefficients **O** and **I**, which represent the organizational infrastructure and the implementation of the cultural change respectively. The organizational infrastructure must be in place, or there must exist at least firm plans to put it in place, before the unfreezing process begins. The implementation of the cultural change transcends the stages of the process, being equally important in each, as well as before and after the change process.

Organizational Infrastructure

The organizational infrastructure plays an important role in the process of cultural change. Information systems, incentive and pay systems, career pathing channels, benefits and health care, employee suggestions systems and awards, and any other aspect the organization that makes up its infrastructure will send signals to the employees about what leadership feels is important in the culture. To take an example from the maintenance world, if it is the organizational objective to reduce the downtime of a particular machining line by decreasing the response time to each breakdown, and by reducing the number of breakdowns through preventive maintenance, then there must be an information system in place to track the number of breakdowns, and the response time. Without this information, there is no way to know if the organizational objectives are being met. It is equally important once those information systems are in place that management use them. If the breakdown reports are ignored by management, it will send a strong signal to the entire organization that the objective is not *really* important. Management behavior will send a mixed signal to the organization.

It is useful to have the flexibility with the compensation system during the process of cultural change to be able to pay someone for doing the right thing, and penalize them for doing the wrong. If, for example, a plant works on a piece-rate system, and one of the organizational objectives is to reduce buffer sizes between adjoining manufacturing steps, it would be a useful thing to consider eliminating the piece-rate system, or devising a way to reward people for not building inventory, and penalize them for doing so.

Suggestion systems can be powerful ways to encourage employees to get involved in the process of cultural change, but they can also reflect the cynicism of a culture in decline. NUMMI has a terrific suggestion program[11] that keeps people involved in process improvement at the same time that it most equitably distributes the

[11]See Section II in the NUMMI Maintenance Study for a description of their suggestion system.

rewards of that system. It can be a problem with traditional suggestion systems that they pay based upon the "cost savings" of the suggestion. People are not apt to put in a suggestion that does not save much cost, but makes their job easier, or increases the quality of the product slightly. People can by cynical about the "guesstimates" used to assign cost savings to any one suggestion, and the process could be biased by favoritism toward certain employees who work harder than others, or have a favor coming. Suggestion programs should not be used as incentives or rewards, but as a means to continuously improve the manufacturing process.

Career pathing also sends a signal to the organization about what behavior management will reward. If, in the process of cultural change, management promotes people out of their organization because their behavior is too ingrained with the old culture and they might be a hindrance to change, the rest of the organization will see the old behavior being rewarded with a promotion. It is in the interest of management to see that people exhibiting the correct behaviors will get promotions to enforce in the rest of the organization the fact that management watches behavior closely and rewards it accordingly. It should be clear that people with the right behaviors have the opportunity to rise to the top.

These organizational infrastructure issues must be in place, or being put in place, for the cultural change to proceed smoothly. Old infrastructural policies may haunt the change process, causing the wrong people to get promotions, or making leadership unable to track the progress that they are seeking. Such hindrances to cultural change can be avoided by making sure the organizational infrastructure gets the thought and attention it needs in advance of the change process.

Implementation

There are several attributes that factor into the implementation to create successful change. First, the change process must have clear leadership. This is important because the individuals in the organization need to know who is setting the rules. It is recommended that this leadership be a single person, one person who will play the role of change agent, although it is necessary for the rest of the managers to follow the lead of the change agent. Committees are too infrequently successful to trust the leadership of the process of cultural change to a committee or cross-functional team. This recommendation is made because of the necessity to remain absolutely consistent with goals and policy during the change process. Any one individual who is

perceived as a leader that does not completely agree with and support the methods and goals of the change process can cause the process to fail.

Second, the implementation of the cultural change process must be disciplined and consistent. All leadership and management must buy-in to the changes. They send unconscious signals to the rest of the organization if they do not.[12] These unconscious signals can destroy the changes for promoting new culture growth in an organization. Consistency is necessary because people who are not comfortable with making the changes will be looking for ways out, and they will latch onto any inconsistency as proof that "this is no different from any other management fad that we've had." Cultural change cannot be a process of mixed signals, of espoused values different from the theories-in-use, or of managers contradicting one another or giving signals that "this is not really the right thing to do."

To create consistency in the process, leadership must set the example.[13] Leadership inconsistencies will lead a group to develop a culture as a defense mechanism against the anxieties created by inconsistent leadership. As a leader, if you do not live what you believe, then you do not really believe it. If you expect other people to do as you say, you had better do it also. Schein says, "one of the most powerful mechanisms that leaders have available for communicating what they believe in or care about is what they systematically pay attention to. This can mean anything from what they notice and comment on to what they measure, control, reward, and in other ways systematically deal with."[14]

Third, the change process must be complete in its treatment of all the elements of cultural change. Remember the equation for successful cultural change which conceptually shows that any missing coefficient can drive the chance for success to zero. To be complete about the change process, it is necessary to plan it thoroughly. Set milestones, and track progress toward them. Understand the roles of the various leaders and individuals in the process, and monitor their performance. The process of change must be *managed* as well as *lead*, a key distinction. The discussion of the various stages of cultural change below should help set the milestones for cultural change, and will provide a guide for managing the process.

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[12]Schein, Organizational Culture and Leadership, p. 229.
[13]Ibid, p. 230.
[14]Ibid, p. 231.

Unfreezing

During the stage of unfreezing the culture, it is up to the leadership to supply the culture with four essential things. All four must be present to successfully unfreeze the culture thereby allowing for cognitive restructuring. These things are disconfirming evidence, a connection between the disconfirming evidence and important goals (coefficient **D** in our cultural change model), psychological safety for everybody in the organization, and an atmosphere where everybody understands that all assumptions are discussible.

There is an important warning that goes along with this last requirement, so it will be treated first. Saying that everybody must understand that all assumptions are discussible is not saying that everybody has a right to set their own direction for the organization. Leadership is responsible, before the stage of unfreezing, for setting the new organizational direction and understanding what must change to achieve that new direction. That new direction is not an assumption, it is a goal. It has already been agreed upon by the leadership. The assumptions that must be made discussible are those cultural hindrances to reaching that goal. An employee who wishes to point out inconsistent behavior in management as a cause for cultural hindrance must have complete freedom to do so, without the threat of repercussion. That same employee, however, should not feel free to change the decisions that have been made because he disagrees with the new business direction.

Disconfirming evidence is data which causes cultural disequilibrium. It is the responsibility of leadership to gather this evidence and make it accessible and readily known to everybody within the organization. In a manufacturing plant, the disconfirming evidence might be competitive information that shows how a competitive plant has reduced their scrap costs by 250% over the last year. It might be evidence that shows how product quality is failing to meet customer requirements. It could be data that shows how current overtime spending cannot continue or the plant will not remain profitable. The evidence should be multiple and varied, and it must be undeniable. The purpose of this evidence is to make the organization see that there is a need to do things differently to ensure long term survival or prosperity.

After the disconfirming evidence has been gathered, it is the responsibility of leadership to show how the data affects important goals within the organization. This is coefficient **D** in the change equation. As an example, if it is the goal of the organization to be the "highest quality" producer, as measure by J.D. Power Initial Quality Audits, then the data should show that a competitor currently holds that

position. If the goal of the organization is to be the low cost producer of a consumer good, the data should show that competitors are making the good at a lower cost. The purpose of making the connection is to help the organization to understand that current business practices are not successful at allowing the organization to meet their goals. The organization must become dissatisfied with the way things are done, dissatisfied with the status quo. Leadership must constantly remind the organization that goals are not being met. This will set one part of the stage for the cognitive restructuring of the culture to follow.

The other part of the stage that must be set is a safe landing point. If the organization sees that it is necessary to throw the culture out the window, things that they have assumed and trusted in for years, they must see that there is a net below to catch it. Without this safety, it is possible for people in the organization to deny the undeniable disconfirming evidence, because it is threatening to their whole existence.[15] It is leadership's responsibility to create psychological safety for the cultural change. The psychological safety allows the organization to view a change as non-threatening and enables them to identify with the disconfirming evidence.

One way to create the psychological safety necessary for change is to present the organization with a desirable vision for the future. No individual or organization is ever comfortable setting out for an unknown destination along an unknown path. The destination must be a known, desirable place, or there is no reason to take the trip. This is where the model of the future state, coefficient **M** in the change equation, comes into play. By this stage in the process of cultural change, leadership knows what things in the external environment have shifted, what issues of internal integration have become problems, and what assumptions of the culture are hindering the organization from adapting to those changes. It is the responsibility of leadership to know what the desired outcome of the change process will be. Leadership must have a vision for the future, one that is realistic and attainable. This model of the future must be communicated to everybody in the organization. It must become the desired state of the organization, and must solve the problems that are causing the organizational dissatisfaction created with the disconfirming evidence.

Creating psychological safety for the organization is essential to successful change. Without it people will feel uncomfortable with the new organizational direction, and will perceive it as an attack on the knowledge they have about what to do, how to do it, and why it is done that way. Without psychological safety people

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[15]Schein, Organizational Culture and Leadership, p. 300.

will not see a point in time where things will stabilize and they will be happy in their (possibly new) jobs.

Cognitive Restructuring

With these four pieces of the unfreezing process in place, the leadership has prepared the culture for the next step of cultural change, cognitive restructuring. This is the point at which the organization will be faced with changing their actions, behaviors, thought models, or all three. There are two methodologies by which this process can occur. The first is creating new learning by trial and error, and the second is based upon the imitation of role models with which the individuals in the organization can identify. By either methodology, cognitive restructuring involves the organization buying-in to the new processes, methods, and assumptions. Buying-in is the process of testing the new assumptions to see if they really do work or not. If the organization does not buy-in, no new assumptions will take root, and nothing will change.

Cognitive restructuring is the stage where resistance to change will be strongest. For this reason, it is important to understand the implications of cultural change on the entire organization. The issues that will require thought and planning on the part of leadership are discussed in this section on cognitive restructuring.

Understand the Various Implications of Cultural Change

One important factor in the process of cultural change that must be evaluated is the width of the gap between current practices and the desired practices of the future state. If the gap is large, requiring changes in the assumptions surrounding authority, power, the way to arrive at a decision, or personal responsibility, to name a few, there is likely to be a rough road ahead for cultural change. If the gap is small then the cultural change process is less likely to cause embarrassment or threat, and therefore resistance and resentment.

Despite the fact that this thesis recommends using a single change agent as the leader for cultural change, the culture in some organizations would not allow that to happen. In cultures where leadership is defined by consensus of a cross-functional team, for example, a single, dictatorial change agent would not effectively lead cultural change. It is important to understand the implications of the leadership type and style on the relative difficulty or ease with which that leadership style will be accepted in the culture. Choosing a leadership type or style that fits the culture in which the change is

to take place will contribute to a smoother process of cultural change, unless, of course, the leadership style is part of culture that will change.

It is critical to the process of cultural change that top management supports the efforts of the change agent. It is not necessary that top management *be* the change agent, but all management at any level must understand what is happening, why it is happening, and must be consistent in supporting the efforts of the change agent. Top management can make life difficult or impossible for a change agent within an organization who is attempting to change the organization without the approval or consent of the highest levels of management.

Anybody attempting to lead cultural change must be aware that the initial response of an organization to cultural change will be confusion. If the leader of cultural change has sold the idea to upper management by promising a one-year payback, things are likely to get hairy. Research conducted by Bruce Chew has shown that the initial movement of productivity as a response to cultural change is downward. Productivity will drop for a period of time as the organization learns the new rules and adapts their behaviors. This period of confusion will be followed by an upswing of productivity as the organization accepts the new rules, by testing them, and finds them satisfactory. It is important that leadership be aware of this phenomenon to head of skeptics of change at the pass.

No organization exists in a vacuum, and cultural change will certainly be affected by the coordination of business transactions between various organizations within a company, and the suppliers external to a company. In a manufacturing plant, there are direct materials supplier issues, indirect materials supplier issues, customer issues, and corporate issues that must be accounted for in the process of cultural change. Is the customer capable of sustaining a few late shipments if the cultural change necessitates them? This should be worked out in advance with the customer. Will corporate headquarters send an audit team if productivity drops at the outset of cultural change? Corporate headquarters should be aware in advance that this might happen. Will direct materials suppliers be capable of responding to new delivery schedules, or new order processes, if the cultural change necessitates them? Again, discussion in advance with the supplier will help the change process proceed more smoothly.

Everybody in the organization must buy-in to the cultural change. Remember that the definition of buying-in is testing the new assumptions to see if they really do work or not. If departments or individuals are unwilling to use the new assumptions, to test them to verify that they work, the leadership must be prepared to remedy the

situation. One of two responses may be necessary. First, the leadership may learn that the new assumptions do not, in fact, work as they had predicted. If this is the case, the new assumptions must be modified and the whole organization must undergo cognitive restructuring with the new assumptions. Second, the leadership may find that the assumptions are sound, but the department or individual is unwilling to test them. If this is the case, discipline is necessary. Saying, "Do it! Or else!" only works if the "Or else!" part is clearly defined, and strictly enforced. A softer approach may require convincing the department or individual that the new assumptions are in the best interests of, 1) the corporation, 2) the organization, 3) the department, 4) the individual, or 5) any combination of those. Perhaps they do not see the environment shift, were not convinced by the disconfirming evidence, or do not understand the linkage between the new assumptions and the goals of the change process. It is worth spending time with individuals in consultation and mentorship to be sure that the entire organization buys-in to the changes.

Leadership must be prepared to accept the physical rearrangements that may come as a result of the cultural change. Perhaps work cells will need to be rearranged, assembly lines may need to be shuffled, office space re-allocated, or information systems installed or updated. Any change at the level of assumptions will reverberate through the culture up to the level of artifacts, like an earthquake changes the surface of the earth. Being unwilling to allow artifactual change in the culture will be perceived as a mixed signal when assumptions are changing.

An extremely important issue in cultural change, that is disastrous if overlooked, is the effect that the change will have on the power structure of individuals in the organization. This is especially true in manufacturing in the realm of skilled trades workers. Imagine being a machine repair journeyman with years of seniority in your trade. Your specialty is diagnosing the failures of the machines by using your eyes, your ears, and the years of experience that you have working with the machines. You derive your identify from your ability to quickly get broken machines running again, and you are revered for your talents in the plant. How will you feel if one aspect of the cultural change is to go to new PC-controlled machines that have built-in diagnostics and a touch-screen, rather than PLCs and hard switches? If you have no computer training, the power within the organization will transfer to the younger tradesmen who have less experience, but more familiarity with computers and enough of a career left with the company to warrant receiving computer training. Your skills were just devalued, and perhaps overshadowed by the artifacts of cultural change. Will you support the change? It is unlikely that you will.

Understanding issues of power and knowledge shifts like the one above can help leadership handle some difficult situations in cultural change more effectively. It is not enough to offer the senior machine repair tradesman computer training, because that puts him on par with everybody else, stripping him of his dignity and respect in the organization. It is better to make him a "mechanical consultant" to the process, offering him a position of honor until retirement. Planning like this can make the difference between obtaining total buy-in from an organization, and having factions of dissent.

Planning for this issue correctly in advance will provide an extra measure of psychological safety for individuals in the organization. The career risk, coefficient **1/CR** in our change model, involved in the change is an important influence on the success of the change. If people see that they have a stable career at the end of the change process, they are likely to accept or embrace it. If people feel like they are being eliminated, or their talents are being devalued within the organization, they are likely to resist change. Have a clear vision of how career paths will change as a result of the cultural change, and how individuals' dreams and aspirations may be either dashed or promoted through the process of change.

Along with the changing assumptions and artifacts (and even values) in cultural change, the skill sets of the employees may need to change. As in the example above, people may need training on computers. People may need to take refresher courses on the product, the customer, the competitive marketplace, or any aspect of the way business will change as a result of cultural change. Because acquiring new skills can be intimidating, leadership should plan training that is as non-threatening as possible. The first step in a computer training class may not be to throw people with no knowledge of computer in front of a keyboard and screen and expect them to turn it on. the first step might be to educate the employees in how the computers will benefit the company and them. If the members of the organization are excited about the changes, and understand their benefits, acquiring the new skills necessary to bring them about will be less intimidating and more rewarding.

It is important to assess and understand the roles of the key players and leaders in cultural change. Know in advance who is responsible to implement, approve, support, or inform in the process of cultural change. Make them aware of their roles. Predict which key individuals in the organization will pose the most challenging obstacles to the cultural change, and work out in advance the plan to win them to the side of change, or move them to another organization. In general, the more planning

and thought that goes into the implementation of cultural change the smoother the process will be.

The final point is to be patient. Do not expect the organization to be able to handle twenty-four different changes at once. Change a few things at a time, gradually working toward the desired future state of the organization. If a particular gap exists that is very large between current and desired states of the culture, then handle it alone, and give it all the time and attention it needs to succeed in the organization.

Refreezing

Refreezing begins the process of living within the new culture that has been created. At this point, the entire organization has tested the new assumptions, bought-in to them, and they are now waiting to see if they will be around for the long haul. This is not the time to relax the concentration on leadership, discipline, or policy. At this point, it would be easy for leadership to breathe a sigh of relief (certainly well deserved at this point!) and kick back for a while. But in the wake of such behavior will come reversion to the old culture. Just because the organization has tested the new assumptions and found them to work does not mean that they like them better than the old assumptions. Everybody has heard organizational stories about the "good old days," and the old culture is likely to be remembered that way by employees. I found a good example of how people feel in the aftermath of cultural change through an interview I conducted with a skilled tradesman at NUMMI. When I asked him to compare the "old way of doing things" and the "new, NUMMI way of doing things" he sighed, and told me that he missed the old way. He said work days were easier, with more time to relax. There was less pressure, less running around. I asked him if he missed those days, and he replied that, yes, he did, but he knew better than to wish they were here again. He told me that if they were still running things that way, he would be on the street without a job. He knew things had to change, and he is glad they did, but in the process he had to change his working habits. Employees who make it through a successful cultural change will see that it is the right thing to do, but they will not always have the discipline themselves to do it. For this reason, leadership needs to make certain that correct behaviors continue to be rewarded, and incorrect behaviors continue to be disciplined. Remember that leadership must always set the example, and voice their policies loud and clear.

Refreezing is the time for leadership to furnish the organization with confirming evidence -- data that shows how the new way of doing things is working to meet the

new organizational objectives. The confirming evidence will be a reward to the organization, and it should be presented in jubilation to everybody. In this process, it is important to make people understand that meeting the goal is a continual effort. The objective was met, but it needs to be met continually. Do not let people think that they have made it through, and can now relax and revert to their old comfortable ways. When presenting the confirming evidence, leadership must be firm in the fact that continuing in the new behavior will continue to produce confirming evidence, and that reversion to the old behavior will not.

At the point that the confirming evidence starts to manifest itself, the culture will stabilize around the new set of assumptions and solutions to the problems of adapting to the external and internal environments. With consistent leadership, the culture should remain stable until the next wave of disconfirming evidence begins with a new shift in the environment. It is at this point that the process of cultural change begins again.

Section IV:
Romulus' Culture

Romulus Engine Operations is one of the newest plants that General Motors Powertrain Division operates. It was built in the mid-1970's to house diesel engine operations during the heyday of Detroit Diesel's success. When the Detroit Diesel business was sold to Roger Penske in the early 1980's, Romulus Engine Operations was retained as a part of General Motors light and medium duty diesel engine business. When the 8.2L diesel engine that they produced was taken out of production in the mid 1980's, the plant was sold to the C-P-C group to manufacture the 4.3L V6 engine. In 1987, when the 4.3L engine went into production at Romulus, just less than half of the floor space of the plant was occupied by this product, the other half still filled with 8.2L diesel engine manufacturing equipment lying dormant.

Most of the maintenance workers at Romulus originally came from some other GM plant. They came to Romulus in the boom time of Detroit Diesel's operation, and since that time have witnessed the transition of the plant through two new businesses. Although the plant manager has been with Romulus since the Detroit Diesel days, the other managers have come and gone, with Lansing Fiero people and Flint people both coming in waves along the way. Shortly after the C-P-C 4.3L V6 engine came to Romulus, the plant became part of General Motors new Engine Division. No longer was the plant or its employees associated with the C-P-C label. Very shortly after that, the Engine Division was merged with central foundry and Romulus became part of the Powertrain Division.

Having seen different products, different divisional identities, and different managers, the only constant thing about the business at Romulus during its nearly twenty year history has been the work force. During that time they have weathered together the hardships of lost products, the introduction of new ones, the policies of several new management schemes, and the multiple-reformation of divisional identity. They have survived these trials, these issues of internal integration, because of a strong culture that pervades, and in some cases dictates, the way Romulus' business is run.

In this section of my thesis I will describe several aspects of Romulus' culture that I was able to discern during my time there. Having made the point that Romulus' history has enabled strong culture formation, I would like to point out that this is not necessarily a bad thing. Many companies have a strong culture, and this culture provides a sense of security and identity to its employees, which enables them to work

effectively within the company. What is true about Romulus' culture is that it is in its mid-life stage, making cultural change a difficult process.

Research of Romulus' Culture

During the six months I spent at Romulus, I had several on-going projects which exposed me to various areas of the maintenance organization. Having had no previous experience in maintenance, it took me a while to get up to speed with what maintenance is all about, how it works, who does what, and why it is done in the first place. Being a complete rookie to maintenance, I learned about it from a fresh perspective, one untainted with any traditional bias or preconception of maintenance operations, maintenance practices, skilled trades workers, or interactions between maintenance and production. This worked to my advantage because I was able to ask questions from a perspective that allowed me to uncover cultural assumptions. Because I did not know what the practices were, I did not know why they were done a certain way. In asking why they were done a certain way, I often encountered dialogue which lead to revealing a cultural assumption. I will share some of the assumptions that I learned about Romulus in the next sub-section called Cultural Analysis of Romulus.

Maintenance History Database

One project which I undertook on my own initiative was programming a computerized machine history database that would allow tracking of all the maintenance and repair work on a given machining or assembly line. The desire to do this resulted from the observation that Romulus lacks an information system that maintenance management can use to manage maintenance in the plant. Romulus did not have an information system to help maintenance management understand what jobs were being performed on their machinery, whether repair, maintenance, or inspection, or to track number of breakdowns, response time, or frequencies of specific breakdowns.

The information system that was being used when I arrived was word of mouth. When a breakdown would occur, the operator would call his supervisor and they would call either a maintenance worker or a maintenance supervisor (it depended on the individual area of Romulus what type of relationship existed between production and maintenance). If they called a maintenance supervisor, it was the job of that supervisor to find one of his workers, who could be anywhere in the plant, and bring him to the job that needed repair. Response time was variable and unpredictable, ranging from immediate in some cases, to fifteen minutes in other cases that I observed.

Aware of the problem, one of the Planned Maintenance teams had devised a Machine History Card which could be used to track all maintenance operations that were performed on the machine tools. At the prompting of one maintenance supervisor, we devised a system that would use the Maintenance History Cards as a work order for tradespeople. The top half of the card contained information for area, operation, and station, the trade requested, the name of the operator requesting assistance, and a description of the problem. This information would be filled out by the operator who was having a problem (no supervisor was required), and the card would be placed in a rack under the specific designation of the trade required for repair. A bank of call lights were installed, with a different color light for each trade, and when a card was placed in the rack the appropriate call light was flipped on to indicate that a maintenance repair request was waiting for a particular trade. The light not only appeared at the rack, which was centrally located within the machining line, but also at the area where the maintenance workers had their desks so that they could see the light immediately, provided they were at their desks.

When a maintenance worker completed the requested repair, he filled out the lower half of the card indicating the problem found and the corrective action taken. The card was then placed in a finished work bin, where it was picked up once or twice a day (sometimes less often if work was light) and taken to a computer to be keyed into a database program specifically designed to accept, store, retrieve, and report maintenance history information. In this manner, all maintenance work was documented on the machining line.

The information in this database was distributed every week in several report formats. Each week an operator's report was printed, indicating all of the maintenance and repair activities that had occurred on each operation of the line. The operator for a particular operation, say Op 100, would receive a print-out of all the problems and their solutions for the last week. This information would help the operator to understand what had changed on the operation during the course of the week. Although some operators found the information redundant, since they were the ones who requested the maintenance assistance in the first place, the reports were distributed to create the habit of doing so. The information would prove more valuable as the line switched to multiple shifts in the future.

There was also a weekly trades report, distributed to each tradesperson that worked in the machining area. The report listed for each trade all the repairs and maintenance that had been performed during the previous week. This information would be useful for the tradespeople to see trends in part failures, recurring problems,

to note operator errors where they could provide additional help or training to the operators, and to note general machine reliability. I found that in general the tradespeople were indifferent to these reports. They felt that since they had performed the repairs and maintenance themselves, that there was no need to remind them what they had already done. The reports were distributed, however, in the hopes of building a system that would serve their needs when there were too many electricians in the V8 area to know what each one had done every day.

Weekly supervisor and summary reports were printed from the database as well. These reports contained statistical information about how many work orders (maintenance history cards) were used in the week, how many involved downtime, and which operations were down what number of times. The information allowed the supervisor to quickly determine which operations were trouble spots, and why. This was not new information to the supervisor, who knew everything that was going on in the line anyway, but the report provided the information in a well documented way that allowed work to be scheduled by priority.

The supervisor also got a weekly follow-up items report. At the time that each problem was entered into the computer, the person who did the key punching (that was me for the first three months) determined if the problem was a recurring problem, or if it required follow-up action on the part of the supervisor or a maintenance worker. If either of these conditions described the problem, it was marked in the database as a follow-up item. These follow-up items were printed out every week in a report to list the ongoing maintenance concerns for the line. The supervisor used them in weekly team meetings to ask questions about progress in certain areas, or to find out whether quick fixes had been properly attended to after the fact. When these follow-up items were taken care of, the final solution was noted and the data entry person would enter the information into the database and remove the tag from the entry causing the item to drop off the follow-up list.

This system is a very simplified version of many professional software packages that are available and in use in many plants today. Romulus did not have such a system, however, and from my experience with the one I created I can understand why that might be the case. The skilled tradespeople distrusted the intent of the system. They were cautious, feeling that its intent might be to track how much work they were doing in a certain amount of time so that they could be compared to their fellow workers. They felt threatened by the information. The operators liked the response the system produced from maintenance, but did not see much point to the operators reports that they received on a weekly basis from the system.

The summary information was never used at any higher a level in management than the direct maintenance supervisor of the line. Although the reports were placed on the desks of several other managers in the plant, they never generated any interest. This was the case for one or both of two reasons. Either management was indifferent to the data showing how many repairs and breakdowns the line was experiencing on a weekly basis, or they did not know what to do with the data if they were interested. Such information provides a basis for setting goals for the maintenance organization, but these goals did not exist. When I asked several tradespeople what they were working toward, what their goals were, they responded to me that they just fixed the machines when they broke. I became discouraged after running the system for six months and not having a single person *ask* me for data. I always had to offer it, and it was often accepted politely with little interest.

One of the recommendations that I have for Romulus is to have everybody take an interest in the performance of the maintenance operations. The only reporting that I saw about maintenance performance generated by Romulus' existing systems was a monthly budget report which indicated whether maintenance was under, on, or over budget for the month, and how much overtime had been used. Before the need for cultural change can be a reality at Romulus, people have to realize that things need to get better. Perhaps because the breakdown data was provided in a vacuum, and there was no point of comparison, it was not perceived as disconfirming evidence.

The other recommendation that I have, which I will reiterate later, is the need for a maintenance management information system. The one I created is not sufficient to run the entire plant, although it worked at a bare-bones level for one machining line. Too much valuable information is lost when repairs are not documented on the machine tools. When we have our cars fixed, we document what went wrong, at what mileage, and what was done to fix it. If we have the same problem again, we take our receipt back to the place that fixed it and tell them that they did not address the problem.

Maintenance is no different. It is not malicious intent on the part of the tradesperson repairing a problem if it is not fixed right -- it is usually production putting pressure on maintenance to fix it *now* because they need the machine. Having records of the recurring problems supports maintenance in their argument to be given time to fix the problem right, which is what maintenance *wants* to do, in addition to supporting production's need to have the problem taken care of. A history of maintenance in a plant is a win-win proposition from which everybody can benefit.

I felt that the area that piloted the database did a good job using the data to track follow-up work and schedule new work and overtime. The supervisor used the data to

communicate the items that needed to be worked on to the tradespeople and to the operators, and even took the information into the weekly meetings that included engineers and management. The system was not perfect, but enough good came out of it that other areas of Romulus asked to use the Machine History Cards and the Maintenance History Database to track their repairs and maintenance. At the time I left, these areas were involved in getting people to buy in to the process. I recommend that this activity continue, because it will prepare people to fully utilize a maintenance management system once one is put into place.

V8 Lead Project Maintenance Team

The second project which I worked on while at Romulus was an advisory role to the V8 Lead Project Maintenance Team. This team was a group of tradespeople representing most trade classifications at Romulus, who were given the responsibility to come up with a maintenance plan for the new V8 project. The intent of the team was to get the maintenance voice heard during the process of designing the manufacturing systems of the new V8 engine in an effort to improve reliability and maintainability of the machine tools that were being designed. The methodology that we selected for doing this was to have the maintenance people tell us how they would like to maintain the equipment, and in the process have them communicate that information to industrial engineering, tooling, process design, machine tools suppliers, and plant management.

I found this process to be difficult from the start because the maintenance people did not want to question the way that they had been performing maintenance at Romulus. They were assigned to what their peers called "cushy engineering positions" where they did not "do any work" (meaning they were not turning wrenches on the machines) and in that position they were not comfortable suggesting a new direction for Romulus' maintenance practices. I can see in retrospect that there was no psychological safety in their positions as prospective change agents. It was my job to provide some of that psychological safety, but I failed to do so.

Another facet of the difficulty was that, traditionally, a position on the lead project team meant the possibility of glamorous trips to machine tool vendors which might be in Germany or Italy. It is possible that some of the maintenance people signed up for the lead project team for that reason. Other people on the team were there because nobody with higher seniority signed up for the opening. In other words, some people could have been there for the wrong reasons, and others could have been there by default. Several of the people were really excited about making positive

changes at Romulus, but their peers made it difficult for them to voice their opinions. The team had trouble getting motivated to do the things that were being asked of them.

The final issue that caused the process to be difficult was that the maintenance people did not feel that their input was valued, or that their ideas and work would actually be implemented at Romulus. They continually repeated statements that were something like, "We could do this, but even if we do our work will be wasted because nobody will listen to us." They did not feel like they were in a position to make changes, despite the fact that their current assignment was to do just that. This was a valid concern, given what I learned about the history of lead project teams at Romulus. I will tell a story about that history that provides some background and insight into Romulus' culture.

One of the things I learned soon after starting work with the lead project team was that preventive maintenance is a dirty word with the skilled tradespeople at Romulus. The story that I heard through several sources says that the last time a lead project team suggested a preventive maintenance program at Romulus it was heartily endorsed by management. Time and effort were spent programming the system, working with the machine tool vendors to determine starting points for the maintenance schedules on the machines, setting up preventive maintenance routes, and working out schedules that fit around production needs. Preventive maintenance was supported and endorsed by all the right people, maintenance and management.

When the 4.3L V6 lines started production, preventive maintenance started with them and it worked well. Preventive maintenance was usually performed on third shift. That was the time that the lines were down, and inspections, lubes, and adjustments could be made. After a time where everything ran smoothly with preventive maintenance, the third shift supervisors started to ask the tradespeople doing the preventive maintenance to help with their "hot" repair jobs, where machines needed to be fixed for next shift. Slowly, those supervisors channeled the resources allocated for preventive maintenance into the breakdown maintenance that they needed to have done in their departments.

When this happened preventive maintenance died. The work orders for preventive maintenance that the computer system sent out ended up in garbage cans, and nobody enforced the fact that the preventive maintenance had to be done. Since the general opinion was that the resources were needed to fix the breakdowns, which at that point were still infant mortality problems on the newly designed machine tools, the preventive maintenance resources were used that way. Nobody defended the importance of preventive maintenance. All of the work the lead project team had put

into it had been wasted, and maintenance people felt that the support they should have been getting from management to do preventive maintenance was lacking.

I was curious having heard this story. I could not believe that a fully developed and functional PM system had been left to die, and had left no trace or remnant in the plant. I made it a mission to see if the story was indeed true. After searching the plant, I found two signs that preventive maintenance had actually existed at Romulus before.

The first sign was very encouraging to me. I found that the garage, where all the electric vehicles were maintained, still had a successful, disciplined preventive maintenance program running. The people in the garage had data that showed how their electric vehicles lasted much longer than those in other plants where preventive maintenance was not being performed. They knew how much money their preventive maintenance was saving Romulus every year in the cost of equipment repairs and replacements, and they talked about service and scheduling in a way that showed me they really understood preventive maintenance.

It was good to see that people at Romulus did understand the benefits of preventive maintenance, and were able and willing to overcome the hurdles that are sometimes put in the path of operating a PM system. I asked the manager of the garage if he was ever discouraged by budget cuts or pressure to not spend the money fixing something that was not yet broken, and he agreed that it was difficult at times. What kept him going, however, was the knowledge that he was doing the right thing and saving Romulus money over the long run. Sometimes, he said, they had to put off doing preventive maintenance on some vehicles past when they were due because people would not give them up, but his belief in the value of PM kept the system running.

The second piece of evidence that I found that Romulus had at one time operated a function PM system was in the CSM crib (which was a special projects crib). They still had the software that had been written for the preventive maintenance on the 4.3L V6 lines. It was, in fact, a fully developed, fully functional PM system.

In attempting to determine what had happened to PM at Romulus, I pieced together parts of the story told to me by different individuals. To the best recollection of those who told the story to me, PM had died for a couple of reasons. The first was that the supervisors did not buy into it. They did not see the need to devote resources to PM equipment that was brand new and operational, especially when they were experiencing problems due to the design of their new machine tools. They were being pushed to get their equipment running right, so they pulled the resources off of PM to

get it running right. The second reason was that management *let* the supervisors pull the resources off of PM and put them on the breakdown maintenance path. I believe, in talking to people at Romulus, that this was not a conscious decision against preventive maintenance, but instead a thought that resources could be diverted to immediate needs without adverse affect on the PM system. What was not understood at the time was the negative effect on the morale this decision would have on those involved in preventive maintenance. These people felt abandoned, and lost their trust that management would support preventive maintenance at Romulus.

That loss of trust was still evident during my stay at Romulus. Overcoming the hurdle of trusting management was too much for most of the people on the lead project team to do. While I was there, I was not able to convince the maintenance people that preventive maintenance, or any other new ways of performing maintenance at Romulus would be accepted or supported by management.

One aspect of the lead project team did prove very successful. That was the Design For Manufacturability (DFM) of the machine tools. A program was set up for the design of the machine tools with Romulus, the tier I machine tool suppliers, and General Motors, that got all three parties together to do extensive design reviews on the machine tool concepts for the V8 project. Romulus provided engineering and maintenance support to those sessions, and the maintenance voice was provided by members of the lead project team. The focus of the DFM sessions was to increase the reliability and maintainability of the machine tools, but they also provided a structured session for design review. At the time that I left, the sessions with the machine tool supplier for the block line were going extremely well, with successes reported every session. The intention was to continue the success of these sessions into DFM sessions with the other tier I suppliers.

The members of the lead project team took pride in this aspect of what they were doing because there were definite successes, hard evidence to show that they had accomplished something. I believe that many of the struggles that I went through with the lead project team came as a result of not defining what would be a success, not having a goal to reach. I would suggest as a specific recommendation that everything expected of maintenance, whether in a lead project team, or during normal everyday operation, be set forth as a goal with a specific target that represents success. I had begun to believe that the tradespeople had been hardened by twenty to twenty-five years of work and that their cynicism had overcome their sense of accomplishment. Seeing the results of the DFM sessions, however, not only in terms of the money saved in the design, but also in the excitement and attitudes of the maintenance workers,

encouraged me. I know that if properly incentivized, and given a chance to succeed, the maintenance people at Romulus are capable of running, and being proud of running, a world-class maintenance operation. This is evident from their success in the DFM sessions.

I have another specific recommendation for future lead project teams at Romulus, which relates to an issue that I brought up earlier. That is to clear with the union, in advance of creating the lead project positions, the ability for management, with union approval, to select the members of the lead project team. This would remove the hurdle that faced the current team which was the differing attitudes of the team members toward what they were to accomplish as lead project team members.

Cultural Analysis of Romulus

Of the many ways to describe a culture, the methodology that I believe provides the most insight is one suggested by Schein. I will relate two situations, in story form, that took place during my time at Romulus that contain valuable cultural data from which to extract values and assumptions. The stories themselves are artifacts of Romulus' culture: they were told to me first- or second-hand and are tangible indications of the culture. These stories, I believe, show behaviors that allow us insight into the culture in place at Romulus, by extracting from them theories-in-use about the values of Romulus' culture. From these values, I will extract cultural assumptions.

The cultural assumption that these stories will uncover do not represent all of the assumptions that are working in the culture, but only a small fraction of them. While there are certainly assumptions in Romulus' culture that are beneficial to the business, this analysis will concentrate on those assumptions which, in my opinion, should be changed at part of the process of changing the maintenance culture at Romulus. Again, that is not a claim that these are the only assumptions that should be changed. Using the process detailed in the previous section of my thesis, the leadership will have to evaluate the desired future state of the maintenance organization before deciding which assumptions should be changed and which reinforced.

The two stories which I am about to relate are fictionalized accounts of actual incidents that occurred at Romulus. The situations, settings, and people have been altered to prevent identification of the individuals involved, but the cultural assumption that underlies what actually happened has not been altered. It is also necessary for me to fictionalize these accounts to prevent readers who might be familiar with the real

occurrences from thinking that the problems lie in the individuals involved, rather than in the culture in which they acted. In both of these stories all the people acted in a way completely consistent with their values, and in a sense were not doing anything that had not been done that way before enough times to ingrain it into the culture as the proper way to conduct business.

Cultural Story One

During his first few months at Romulus, a rookie supervisor had taken a group of his maintenance workers on a plant trip to evaluate competitive maintenance practices that were being used there. In the morning the group toured one area of the plant, and then took a break for lunch. Upon returning from lunch, their tour guide was nowhere to be found, so the group stayed put while the rookie supervisor went to find out what was going on. He came back having found out that their group was supposed to reconvene after lunch at another building in the plant complex, but could not find out where. He told the group of maintenance workers to wait while he attempted to sort out the situation. As the afternoon pressed on, and the problem was not resolved, the group of skilled trades people chose to go back to their hotel rather than wait for the resolution of the problem. When the rookie supervisor returned to find them gone, he was upset.

He was not only upset that they had disregarded his order to wait, but that they felt they could leave during time that they were being paid to learn. At the hotel that night, he decided to stop the time of the maintenance people who had left early that day and only pay them for the portion of the day that they were actually at the plant tour. In his estimation it seemed a reasonable thing to do, to pay people for the time they actually worked. When he informed them of this, their complaints of being bored and having their time wasted while they waited around fell on unsympathetic ears. The rookie supervisor felt strongly that because they had not worked that time, they should not be paid for it, regardless of whether the plans for the day had unraveled.

Upon returning to Romulus, the maintenance people submitted a grievance to the union, claiming that they had waited in good faith for the problem to be resolved, and had waited until it became unreasonable to assume that the rest of the day would be productive, and at that point had decided to leave because their time was being wasted. The grievance was settled by a manager in the plant who told the rookie supervisor to give the maintenance people their pay back.

Cultural Story Two

The second story again involves a maintenance supervisor, and a group of maintenance workers. Over a week-long holiday during which Romulus Engine Operations was shut down, crucial maintenance work, a partial rebuild, had been scheduled on one of the bottleneck operations on the V6 block line. The machine tool company's people were called in to assist in the operation and provide support, but they were only available during the normal working week. If they were required on the weekend, Romulus would have to pay their overtime, which amounted to a substantial sum.

Because Romulus maintenance workers were on full utilization at the time, the maintenance people that were handling the job would be in the plant over the weekend, regardless of how long the machine tool rebuild work took, so there was little incentive for them to finish the job during the normal working week. It was still early in the week, and the supervisor of the crew doing the job, a veteran supervisor at Romulus, had an idea to help motivate the workers to get the job done before the weekend. He promised the maintenance people that if they could get the job done by Friday, he would not give them any work to do over the weekend when they came in to work. In other words, if they worked hard during the week, they would be rewarded by being allowed to do nothing on the weekend, but still be paid time-and-a-half on Saturday and double-time on Sunday.

Apparently this motivation appealed to the maintenance workers, because the job was finished on Friday and the machine-tool company people went home. All seemed well until Saturday morning, when another supervisor happened to be the supervisor covering the shift this group of tradespeople were on. The veteran supervisor who had made the deal with them was not in the plant that day, and the other supervisor assigned these workers jobs that needed doing on the V6 assembly line. At first they did nothing, remaining where they were, relaxing as their supervisor had promised them they could. When the other supervisor reiterated his assignment, they resisted the work, excusing their obstinance by saying that the assembly line was not their area. The other supervisor explained to them that on overtime anybody could be assigned wherever there was work to be done because the overtime equalization pool included every skilled tradesperson in the plant.

The matter became heated before the workers finally admitted that their supervisor had made a deal with them, and they felt they had been promised they could do nothing for two days. The other supervisor, surprised to learn this, apologized to

them that someone had promised them something which, in his estimation, violated business ethics, and he ordered them to work. You can imagine how this made the maintenance workers feel.

Analysis Based Upon These Stories

These two stories of conflict between supervisors and the workforce show the norms and practices of Romulus, and help us to make observations about the values and assumptions that are operating within the maintenance culture at Romulus. Comparing the expectations of the Romulus maintenance people and management with the expectations of the supervisors in these stories helps us to identify what things make Romulus unique in how they run their business.

The first story helps to illustrate an assumption that management makes about union-management relations at Romulus. The assumption is that management's relationship with the union is fragile, and that protecting their relationship with the union is more important than enforcing discipline in individuals. This assumption is supported by stories that I heard while at Romulus, from union workers and supervisors alike, about supervisors who were having breakdowns on their lines having to call a popular local bar and grill to summon the maintenance workers back from a two hour lunch. The fact that these actions take place at the individual level, that the organization knows about it down to the detail of who is where out of the plant, and that the situation is or was tolerated indicates that management is protecting a fragile relationship with the union by trying to avoid conflict.

Story One supports this assumption by means of comparison with common business practice. In most firms, people would not be paid for leaving work early against the direct order of their supervisor. Discipline would be the most likely course of action a company would take against an individual that would do such a thing. In the case described here, however, the action was condoned, not verbally, but in practice, by reinstating the workers' pay in an effort to avoid conflict with the union. The management at Romulus would never espouse the value that "workers can take time off on us if they want to," but that is the theory in practice in this instance. Something at the cultural level, more powerful than the stated values, was operating to create the outcome of this situation. That is the position of an assumption in a culture.

Story Two leads me to believe that another cultural assumption is working in the maintenance organization at Romulus, one that helps define the nature of how work is arranged. I believe that there exists an assumption that the union has a right to

negotiate anything, including a job that a supervisor contractually has every right to assign to a worker. This assumption gets at the idea that negotiations are the right way to do business, no matter what the business is. To support this assumption, I would like to relate another story that I heard.

I was told that it is a consistent, albeit not frequent, occurrence for a supervisor who asks particular employees to do a job, any job, to have a grievance written against him or her for harassing the worker. The background to this story lies is discussions that I had with many people at various levels in the organization. The common claim amongst the skilled trades workers when the complaint is raised against them that they do not seem to *want* to work effectively or efficiently, is that about 5% percent of the work force really *is* like that. They say approximately 5% of the people are just coasting into retirement courtesy of General Motors, and that they are not motivated to do anything. The other 95%, they claim, are motivated to want the business to succeed, and to want to contribute to that success. From my observations in the plant, I can neither agree nor disagree with this assessment, but I can illustrate an example on the basis of this story that supports behaviors on the part of supervisors and maintenance workers that I witnessed.

If a typical maintenance supervisor has 8 or 10 skilled trades people working for him, probability allows that one in two supervisors will have one of the 5% of non-motivated workers under him. This supervisor, then, has nine motivated, hard-working employees, and one that is impossible to get to do anything. Most of the time the supervisor will go to one of the nine when there is a job that needs doing, because it is easy. There is no argument, no checking up, and no distrust that the work is done right if the supervisor chooses one of the nine, so that is what happens most of the time. This has a demotivational effect on those nine workers, however. They are working hard, earning their pay, and they see their co-worker sitting idle, or sleeping at his workbench, and getting paid the same amount they are. So they feel like they should also be allowed to slack off as well, in the interest of fairness. They are unhappy that the supervisor expects them to work hard, and always comes to them when work needs to be done, and just leaves the lazy worker alone, ignoring the situation because it is easier that way.

Eventually, this dissatisfaction gets back to the supervisor, and he is sparked into realizing that to keep his troops from mutiny he needs to get the unmotivated employee to do some work. He grudgingly finds an assignment for the worker to perform, and then approaches him in a confrontational manner, pointing out that the worker generally does little to nothing, and would he please do this assignment for

once. The unmotivated employee, who has played this game before, and knows it all too well, simply goes to his committeeman and complains that the supervisor is harassing him. The committeeman, who has also played this game before, holds a meeting with the supervisor, explaining that he does not "confront the other employees to get them to do work, and that the singling out of this employee for such treatment constitutes harassment."

Of course, the grievance never sticks in the end, it is always thrown away as a negotiation tool in the interest of maintaining good relations between union and management. The result of this process is that the unmotivated employee does not have to perform the assignment, or if he does, he does so grudgingly and requires constant supervision to get the job done. Whatever actually turns out to be the case, the extra effort and trouble required to get the work done discourages the supervisor from approaching the employee with an assignment again until the cycle starts over. I have witnessed the end result of this process when I see supervisors walk by maintenance workers who are sleeping at their desks, or at their workbenches, without stopping, waking them up, or even showing any outward sign of being perturbed by the occurrence. They have accepted this fact as a part of the culture at Romulus.

This fact supports the existence of an assumption in the maintenance culture at Romulus that work can be negotiated. Story Two also supports this assumption because of the behaviors of the veteran supervisor, and the maintenance workers involved. The veteran supervisor approached the situation knowing that he would get results negotiating something that he wanted by offering something that the workers wanted. He knew this negotiating method was more effective than issuing a direct, and unpopular, order to "get the work done by Friday" which would likely cause the workers to take all weekend to get the job done just to show that they did not feel the proper method of assigning the work had been used. The workers also felt strongly that this was the correct way to get the work assigned because they resisted so strongly the notion that their agreement was not a binding, or ethical, contract when the other supervisor explained that to them.

I believe that both Story One and Story Two illustrate an assumption that maintenance workers hold about the "ownership" of time at Romulus. Skilled trades people at Romulus believe that time belongs to them, even when the company is paying for it. This assumption is further supported by stories from within the organization about how phone privileges for maintenance workers have to be closely monitored because of past problems with people making long distance personal calls during business hours. I do not personally know whether this practice has or does go on at

Romulus, but the fact that the story exists is a signal that people think that the time they are on the job belongs to them.

In Story One, the fact that the skilled trades people felt their time was being wasted is an indicator of ownership. If they felt that they were on company time, it seems to me they would have obeyed the direct order of their supervisor to wait because "the company," in the form of their supervisor, wanted them to. Even if they had not stated the problem using those terms, their actions support the hypothesis that they felt they had better things to do with their time that what they were being asked to do. They questioned authority because their assumption about who controls time led them to believe that the authority was telling them to do the wrong, or counter-cultural, thing.

In Story Two, the people felt that they deserved to be rewarded by controlling their own time as a result of a hard, but still fair, week's work. They did not work unpaid overtime hours during the week to finish the job, but expected remuneration for the effort they had exerted to do their jobs. Arguably, they felt that their normal control over their time had been infringed during the week in which they diligently worked on the machine tool rebuild, and therefore they deserved the pendulum to swing back in their favor for the weekend. When they did not receive the control that their culture led them to believe they had earned by their hard work and negotiation, it is no wonder they felt cheated.

This cultural analysis is based upon the artifacts and values of Romulus' organization as they are expressed in organizational stories and illustrated in observed behaviors. The assumptions that have been drawn from these stories and behaviors are biased by my perception, and even by the fact that I was partially assimilated into the culture during my stay at the plant. According to Schein, however, from this perspective I am most effective at being able to analyze the culture. Understanding the rules and norms requires the perspective of an insider, being able to single them out as unique, different, or unusual requires the perspective of an outsider. I feel that the assumptions above are in operation at the Romulus plant. They are by no means the only assumptions that are operating, and I do not have enough experience with the business to make any unbiased statement about their relative influence on the overall operation of the plant.

The relative influence of these various cultural assumptions is something that people working during the period of cultural transition will have to determine. Issues of ownership of time, control in the workplace, and how work is supposed to be assigned are all extremely important issues that a plant must face. If some assumptions

operating in a culture do not align with the future direction of the business, it is important to begin the process of cultural change. If other assumptions within the culture do not hinder the business, but instead provide a sense of identity, or even an advantage, to the business, then it is important to reinforce those assumptions. Schein suggests that these positive assumptions be used as a rallying point around which a group of people can find its identity while changing other of its underlying assumptions. The fact that only part, not all, of the assumptions are hindering change will help to provide the sense of psychological security that is necessary for successful cultural change.

Some of these valuable and positive assumptions should be reinforced during the process of cultural change at Romulus. The assumption that I believe is the most valuable for Romulus to preserve is the assumption that business decisions should be jointly discussed between union leadership and management. This assumption could even be the rallying point around which cultural change is based. If skilled tradespeople see that their elected leadership is jointly deciding with management that certain parts of the way that Romulus conducts business should change, they will be less inclined to believe that the changes are a management plot to take advantage of them. This structure of joint leadership works well at Saturn building trust between the hourly workers and management, and management's belief at Romulus that the union should have a say in business decisions is an important step toward building trust between two forces that are traditionally at odds with one another.

Another assumption which should be reinforced at Romulus is the assumption that people can and will take pride in their work. Although there are some people who choose not to do their best job at work, the number of those people is small compared with the number I met who are hard workers, attacking problems with the intent to do their best. One advantage that Romulus has is the seniority of its maintenance work force. Although some may describe this as a disadvantage, the experience and knowledge that the skilled tradespeople at Romulus have is tremendous. When they bring this experience to bear in fixing machines or planning repairs, they have the ability to do an excellent job, and they should be proud of their work.

An example of how Romulus currently leverages this experience to their advantage can be seen in the SWAT teams. The SWAT teams are composed of people at Romulus who seek out problem areas, and are given full responsibility to plan and implement the solutions to those problems. The skilled tradespeople like this format of doing their work because they are not "given a job that somebody without maintenance knowledge designed, and that won't work." In other words, because they are allowed

to plan their own solutions they can implement those solutions in the ways that make the most sense to them, knowing that they will not run into any unplanned details that will cause difficulty, or even impossibility, in the work. Because they are responsible to identify the problem, plan the solution, and implement the plan, they fix problems right the first time, faster than if by normal channels, and they take pride in what they accomplish.

The drive to get skilled tradespeople involved in the up-front design of the machine tools and maintenance systems is another excellent practice at Romulus. The fact that this has happened in the past and is happening again with the new V8 equipment shows that Romulus understands the value that maintenance experience can add to the design process. I encourage management at Romulus to continue this policy, and support the people who are on the lead project team. Understand that they are in a tough position with their peers, respect their decision to want to contribute to Romulus' future success, and give them every opportunity and encouragement to do their best.

Specific Recommendations for Romulus

The following paragraphs are written as specific recommendations to Romulus regarding some of the issues of cultural change that were discussed in section III. They are a result of my observations there during my internship between June of 1993 and January of 1994. Because they are specific in nature, they may not apply to other plants looking into the process of cultural change. The discussions do not cover every area of the cultural change process, but only those where I have specific comments or recommendations to make for Romulus.

Discussion Concerning Organizational Infrastructure at Romulus

Before Romulus can begin the process of cultural change in its maintenance department, several infrastructural issues should be attended to. Romulus made the first move toward infrastructure changes when, in January, 1994, they appointed a maintenance manager with responsibility for maintenance operations at Romulus. This was a change from the previously decentralized reporting structure of their maintenance departments, which had maintenance authority spread out to the point where the plant manager was the only person with authority over all of the maintenance operations in the plant. This centralized structure will provide Romulus with needed consistency in maintenance decisions and maintenance policy, and represents a big step in the right direction for maintenance at Romulus.

The next step that Romulus should take before undergoing the process of cultural change is to put in place a maintenance management information system that allows the tracking of downtime, repair histories, number of breakdowns, maintenance costs, and other maintenance metrics. The particulars of the system are not as important as having one that maintenance management will consistently use to set goals for maintenance and then to track the progress toward those goals.

The skilled trades workers will initially have difficulty accepting any system with such capabilities, therefore it is important for management to stress that the purpose of the system is not to track individual workers with the intent of disciplining them if they are poor performers, but instead to track macro issues such as number of breakdowns per month, or average time to repair. In the pilot of this system that was performed in the 4300 V8 crank module, it was initially a benefit to not have the tradespeople put their names on any document or entry that would allow tracking of individual maintenance performance. This gives them the security of knowing that management will not abuse the system, using it for individual disciplinary purposes.

In time, when they come to trust the system and the way that management is using it, names can be added to the entries to allow faster organizational memory in the event of future failures. This is beneficial because a computerized maintenance history database will only contain as much information as was typed in at the time the maintenance history was made. The tradesperson that actually made the repair will remember much more about a repair that he or she made, so it is beneficial in the event of a recurring problem to have the ability to go to the tradesperson who initially made the repair to understand what course of action to take.

The suggestion system is another part of the infrastructure that should be looked into as a possible driver for change. The general attitude of the workforce toward the suggestion program is that it is used to reward people who work harder than most. The perception is that, due to the lack of any other way to reward outstanding performance, the suggestion system is used to do so. Whether this is true or not, I cannot confirm, but it is important either to make changes to the suggestion system that eliminate this perception, or to make it clear that the suggestion system is not used in such a way.

For the amount that Romulus spends every year in suggestion payments, 10 cars and trucks could be raffled off in a system like the one that NUMMI has. Perhaps vehicles with Romulus-built engines could be purchased, put on display, and promised to be raffled off at the end of the year, thus creating excitement and a sense of pride in the workforce. Each suggestion that is made and implemented would earn the

suggestor a ticket in the raffle. A suggestion program such as this would encourage suggestions for suggestions' sake, making participation in ongoing plant improvement more important than the suggestion's value, the worker's ability, or favoritism on the part of management toward certain individuals.

Discussion Concerning Unfreezing Romulus' Culture

During the process of cultural change at Romulus, disconfirming evidence will be hard to find. This is because of the exceptionally high demand for product that Romulus is currently experiencing, and because of the new product that has been given to Romulus. The work force must feel as though they have been doing everything right to have deserved such high demand and the reward of a new product. The plant is profitable, and as long as it is profitable it is difficult for management to make a case for needing to change.

I recommend that Romulus take with the maintenance department the approach that there is a problem with maintenance costs and overtime costs. These two parts of the budget, which currently contribute negative variances, need to be brought into the black to contribute to greater profitability for Romulus. Overtime costs will be difficult to cut because the maintenance workers are used to having as much overtime as they would like. In addition, during the time that the V8 modules are being installed, the full utilization clause in the contract will make it difficult to reduce overtime. There needs to be a gradual process of weaning the people off of their dependence on overtime to reduce costs in this area. It is important to turn these high costs into disconfirming evidence for the process of cultural change.

Discussion Concerning Cognitive Restructuring of Romulus' Culture

The loudest complaints that I heard from maintenance supervisors while I was at Romulus was the lack of discipline in some members of the maintenance work force. Apparently, a small number of skilled trades workers will show up late for work, take long lunches, and/or leave early. There must be a lack of accountability for these workers to allow such conditions to exist, and during the process of cultural change that lack of accountability must change to a genuine responsibility on the part of the maintenance workers. If workers felt that their jobs were rewarding, interesting, or important they would likely not show up late and leave early. There may also have to be individual action taken to ensure that the small number of workers who do get away

with breaking plant policy do not draw down the morale of the remainder of the work force.

It will be important during cognitive restructuring to enforce a policy of discipline, and to provide a sense of urgency and importance to the maintenance function. As a caution on this point, however, this problem of discipline and accountability must be treated as a symptom of a larger problem, not as a root cause the solution of which will solve Romulus' maintenance problems. It is equally important to understand that this lack of discipline exists for two reasons, only the first of which involves the attitudes and work ethics of the maintenance workers. The other reason is that management has turned its back on the problem, or has left it unchecked. As part of the cultural change, Romulus maintenance management must put a foot down, and stand firm in enforcing a policy of disciplinary action for absenteeism or tardiness.

Closing Comments

This cultural snapshot of Romulus represents my experiences there during the second half of 1993. The analyses are based upon a snapshot, which does not represent or convey the dynamic nature of any culture or organization. During my stay there many improvements were made in maintenance policies, practices, and systems, and I know that those improvements continued after I left. In fact, with the reorganization of the maintenance department under one person responsible for it all, I believe that the rate of change in the maintenance organization should have increased dramatically. Each maintenance victory, each well-planned and executed project, shows steps toward rebuilding the maintenance culture. By encouraging the people when they succeed, management will build upon successes with new successes. The "right way" of doing things will be reinforced.

I wish the people at Romulus the best of luck with their new V8 program, and continuing success for the 4.3L V6. I know that for Romulus the process of cultural change will be a difficult road to follow, but I also know that it will be rewarding in the long run. General Motors needs strong manufacturing to compete in the very competitive automotive market. Cultural change at Romulus, to improve their maintenance efficiency and effectiveness, will be a major contributor to future manufacturing success for Romulus' products. It will also provide job security for Romulus workers and their children in an industry where job security is an envied commodity.

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