



## Why Planned Maintenance is No Longer Enough

*A comparison of success at the Lima refinery and DuPont*  
By Winston P. Ledet

### Business Driver for Change

In the 1980's, the Corporate Maintenance Leadership Team at DuPont was formed and initiated a very large benchmarking study around the world on maintenance best practices. The goal was to reduce maintenance costs. All of the facilities benchmarked fell into one of three operating domains: Reactive, Planned or Improved Precision. Virtually all of the DuPont plants fell somewhere in the reactive domain, which has a range of performance.

The experience at the Lima refinery took a very different approach than DuPont. The business driver at Lima was a threat of closure of the plant. Different people came to the realization at different times but eventually everyone recognized the threat. This was a much stronger driver for the change since it affected everyone at the site as compared to the change at DuPont being focused primarily on maintenance cost. We introduced The Manufacturing Game® as part of the refinery's approach to the corporate continuous improvement initiative. The program was called "The Proactive Manufacturing Initiative" to reinforce that it was more than just a maintenance initiative.

The game was a much larger part of the Lima experience than the DuPont experience. We created the first version of the game in 1991 when the initiative at DuPont was already succeeding. In fact, people at DuPont were not convinced that they should pursue the Improved Precision Domain because the corporate earnings in 1991 were at record levels and

no one believed more improvement was necessary. It is clear today that the extra improvement was necessary as DuPont splits into two companies to revive its growth.

### Anatomy of Organizational Change

In places where we have had success in improving the reliability of an organization, we find a pattern. This pattern is called "Heroic Change" (written about in an article in the July 2003 TMG News) because it requires a lot of everyday heroes to make the change. In our experience, this type of change happens in three stages and requires three processes. For the people involved, it is a Heroes' Journey according to the pattern in many stories told throughout the ages.

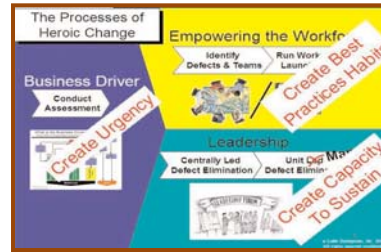
### Three Stages of Change

In our experience, the way this type of change happens is like an S shaped curve. In Stage 1, the performance improvement starts as the organization becomes more open to change. The real work is to discover a better way of working.

In Stage 2, the big change comes as more people get involved and the new work practices become widespread. This is the time to perfect the new ways of working. In the DuPont experience, the new ways of working were planned maintenance practices. In the Lima experience, the performance improvement

came from eliminating work by eliminating the many defects in the equipment, practices, and policies of the organization.

In the third stage, it is essential to institutionalize the best practices by putting in systems to support the new ways of working. Stage 3 is where the best practices learned from other organizations are installed. Unfortunately, most organizations try to start their improvement program at this stage rather than recognizing it to be the final stage of the change process. While the best practices and the systems to support them are in fact the right things to do, you can't install those until people are ready and able to use them. Stages 1 and 2 are necessary preparation for these new best practices to succeed.



### Three Processes for Change

To be successful, an organization must create three processes that compliment each other in the change effort. The first process is one to articulate the business

driver for the change.

The second process is to empower the workforce. Various tools are available. Our process for this is to use The Manufacturing Game® to help workers understand their entire system of work and how their part fits into the whole. The basic lesson of the game is that the defects in their equipment, processes and practices are the source of unreliability that leads to poor performance in their plants. The lessons of the game are applied to the real world by small temporary cross-functional on-the-job Action Teams eliminating defects. We advocate a large number of these small teams as a way to make the new work practices a habit. You need enough repetitions to make the new ways of working a habit to replace the old habits.

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## Public Workshop Calendar

Throughout the year, The Manufacturing Game® holds workshops for the general public at various universities and/or professional organizations across the country.

### TMG Public Workshops

**Houston Business Roundtable**  
November 3-4, 2004  
Houston, TX

To Register or for more information call  
(713) 645-0923

### Conferences of Interest



**International Maintenance Conference (IMC)**  
December 5-7, 2004  
Naples, FL

To register or for more information visit:  
[www.imc-2004.com/registration.htm](http://www.imc-2004.com/registration.htm) or  
call (239) 985-0317



**Offshore Technology Conference**  
May 2-5, 2005  
Houston, TX

To register or for more information visit:  
[www.otcnet.org](http://www.otcnet.org)

Additional workshops for 2004 may be announced at a later date. To register or for more information please visit our website at:  
[www.ManufacturingGame.com](http://www.ManufacturingGame.com)



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The third process is a leadership process that supports the change effort. This process is needed to ensure that the changes to the management systems are coordinated with the work change efforts and support the empowerment of the workers. An interesting thing is required when you get to the third stage of the change effort. A switch from a leadership-focused process to a management-focused process is necessary. The distinction made here is that leadership is about change while management is about maintaining order. This did not happen at DuPont, and as a result they have lost their performance improvement over time, while Lima, having made this transition, continues to sustain their improvements.

#### Change Effort at DuPont

At DuPont, the change was started with a corporate push to cut costs in 1985 – this was the business driver. In Stage 1, we installed the CMMS systems as the way to change to planned maintenance work habits. This was rather slow because it was not possible to purchase a CMMS system like you can today so one had to be created. There was a large training effort to teach people the planned maintenance work practices. The Corporate Maintenance Leadership Team (CMLT) was created to lead this change. It really helped in Stage 2 as people at the sites learned to share these new practices with each other.

This led to a substantial improvement in the maintenance cost of the whole corporation in the early 90's. However, the cost then turned back up several years later.

The failure to sustain this improvement can be traced to the failure to switch the leadership process to a management-focused process. Since the CMLT was an ad hoc group to lead this change, the leadership

disappeared as the CMLT gradually went out of existence. This failure could have been avoided if a management-focused process embedded in the line organization had been created before dissolving the CMLT. We did make an attempt to establish a leadership initiative at the time but did not understand what was needed.

#### Change Effort at Lima

The Action Team process was introduced at Lima to concentrate on defect elimination as a means to pursue the Improved Precision Domain instead of the planned maintenance work practices. At the time, we were not sure that skipping a domain was possible. As it turned out, not only could the Planned Domain be skipped, pursuing the Improved Precision Domain directly was easier than pursuing the Planned Domain. One reason for this is that the Planned approach only makes work more efficient but does not eliminate any of the work. In the Improved Precision Domain, the amount of work that needs to get done is actually reduced by eliminating the root causes of the losses, which are the defects that lead to lost production, waste, and/or health, safety or environmental incidents.

The improvements at the Lima refinery were much more extensive than the cost cutting at DuPont. There was an annual improvement of \$45 million for this single plant as compared to DuPont's savings of \$300 million for about 50 plants. Lima also showed significant improvement in safety and environmental performance during this same period. At DuPont there were no claims of safety or environmental improvements to go along with the cost reductions.

The unique thing that was created at Lima was the leadership process. They used Continuous Improvement Forums. These forums were monthly meetings of any and all people at the site who were in leadership positions. While these forums normally did not have the hourly workers included, they would have been welcome.

#### Institutionalizing the Change

All of the performance improvements were accomplished in Stage 2 of their journey. This led to the sale of the refinery by BP to Clark Refining instead of closing it, as was planned, in November of 1998.

This, as it turned out, was the beginning of Stage 3, where the refinery needed to stabilize the changes to sustain the higher-level performance. In the transition from BP to Clark, about 100 of the 458 employees chose to leave the refinery. Included in that group were many of the change leaders who had been the heroes

Process	DuPont	Lima
Business Driver	Cut Cost	Survival
Empower Workforce	Planned Maintenance Training	The Manufacturing Game
Leadership	CMLT Leadership to None	Leadership Forums to Line Management

Recap of DuPont versus Lima

## Faced with tool storage and access problems, two different BP assets at the Grangemouth facility in Scotland found different solutions with equally successful results!

*BP Grangemouth is a Star Site with 12 different assets conducting upstream, downstream and chemical operations. Read the stories below to find out how two different assets in this large facility formed two different Action Teams to tackle a similar problem and how Chemical's succeeded by merging tool stores while Hydrocarbons was successful by improving access to existing maintenance workshops.*



### Multiple Tool Lockers Merged into One Main Tool Store

During a Manufacturing Game® workshop at BP in Scotland recently, an Action Team was created to address the many issues with tools at the KG Ethylene Cracker facility (Kinniel Gas). Team members, Gary Morton, Neil Lawson and David Duffus wanted to resolve the problems they were having with the many separate tool lockers at the facility. The tool lockers were messy, incomplete and employees were frustrated because they were frequently unable to locate the appropriate tools for various jobs. The problem was then complicated further by the simple fact that employees were hiding the best tools in their own shift tool lockers thus making them unavailable to other shifts. For example, one shift had ten 1.5" wrenches in their tool locker and another shift had zero. Employees were even becoming territorial and going so far as to hide certain desirable tools in their own personal lockers. This "selfish" culture was leading to excessive spending to replace tools that were erroneously thought to be lost when in fact there were many throughout the facility.

The team decided that tightening the control of facility tools and also tightening the tool purchasing process was vital. They determined that creating one main walk in Tool Store was the answer but knew that the key factor to accomplishing this task would be to change the culture and make employees realize that one main Tool Store would benefit them all.

Gary Morton and Neil Lawson, from the day team, were able to find a suitable room in which to set up the main "Tool Store". The room was set up with properly fitted racks and hangars with clearly marked labels, making it easy to find the right tools. Then the team, knowing that it could be a source of contention, obtained authority to gather all tools from each separate tool locker to store in the main Tool Store. Fortunately, everyone agreed to cooperate and access to all the separate tool lockers did not have to be forced. They also assigned the Day Team to look after the Tool Store and make all the tool purchases in order to centralize the process.

Once the new main Tool Store was set up, stocked and organized, they were amazed by the amount of tools. They were surprised that they actually had 95% of the tools that are required, whereas before, they were constantly ordering extras. This enabled them to focus on buying quality tools, rather than many poor quality ones. They now have all the right tools available and know exactly where to find them. All of the employees are cooperating and returning tools to the one main Tool Store. The Action Team determined that due to the new Tool Store and the new culture of sharing, they have saved at least 10–15 minutes per man, per day looking for tools. With 22 people per day, 365 days per year, that translates to roughly 2,000 man-hours per year that is currently not being wasted. The Day Team has a much better awareness of what tools are needed and what tools have been ordered eliminating duplicate orders and saving money on unnecessary tool purchases. The team is now spending the extra time saved on finding and eliminating other defects.



### Maintenance Time Saved By Improving Access

In a Manufacturing Game® workshop at BP Grangemouth recently, an Action Team was formed to address the frustration employees were having because of wasted time driving around the large facility in search of tools. There is a 3 to 4 mile distance from one side of the facility to the other and the drive through the docks area is fraught with many speed restrictions and traffic hazards, compounding the frustration of employees.

Members of the Action Team, consisting of Michelle McCormick and Sean Desmond discussed how there was a definite separation between the two different sides of the Heritage site separating Chemical employees from

Refinery employees. This lack of sharing between the two Heritage areas was not only creating frustration among the employees, but also wasting time, which translated to money. Chemical employees working in the Refinery area who did not have keys to the area's workshop, thus no access to tools, were forced to make the 15 minute drive back to their own side of the site to pick up tools from their own workshop, and vice versa.

Michelle and Sean felt that "history was getting in the way of common sense". They resolved to solve this problem by changing the locks on all the workshops and providing all maintenance employees with the keys so that

each member of the maintenance team would have access to either workshop, no matter which side of the site they were from. They also resolved to purchase new tool chests to ensure that everything could be stored properly and there were enough of the right tools to go around.

Although this idea met with some skepticism, Sean provided the funds and the authority to get the job done. During the process of making the changes, they discovered the need for another workshop at the East Jetties area. They decided to use an existing store that housed basic spare parts and add a tool chest with the necessary tools. They determined that this new

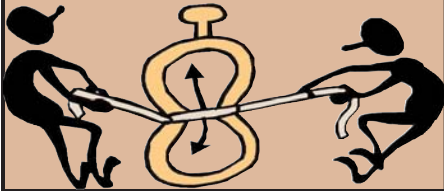


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## TMG News

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workshop would benefit both Chemical and Refinery employees by saving them from having to travel a long distance to get extra tools.  
The Action Team has documented great results from the changes that were made, and they are happy to report that a little effort makes a big difference. By changing a few locks, and adding a few tool chests, they have greatly improved the work environment for 8 employees on a daily basis. They have experienced substantial HSE benefits from greatly reduced amounts of travel by car, and large time saving benefits as well. Previously, each shift with a total of 8 employees wasted at least 30 minutes per day, 5 days a week, 52 weeks a year traveling in search of tools. This translated to about 1,040 man-hours per year that are now being used in other areas.



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up to that point. We thought that it would kill the improvements as had happened at DuPont, but it did not.  
All of the program elements of the Proactive Manufacturing initiative in fact stopped, and we thought that was the end. However, in 2003, we returned to the Lima refinery to see how they were doing. To our surprise, they are continuing to improve their performance. The heroes at this stage are not the change agents but the people who value orderly processes and great discipline. They are the rotating equipment specialist, who insists on precision work on that equipment; the operations manager, who is pushing for clear procedures and routines for operators to optimize the output from the equipment; the training supervisor, who is pursuing training on advanced troubleshooting techniques, etc. Therefore, the departure of the change agents made room for this new set of heroes to play their vital roles. This is what didn't get done at DuPont.  
To recap the differences in approach at DuPont versus Lima, first we see that

the business driver for DuPont was to cut costs while at Lima the drive was to survive, which is a much stronger drive. The process to empower the workers at DuPont was planned maintenance training along with the use of a new CMMS system while we used The Manufacturing Game® as the primary empowerment tool at Lima. The leadership process at DuPont was the Corporate Maintenance Leadership Team and when it dissolved, nothing was left to manage the process. The leadership process at Lima started with the Continuous Improvement Forums and later the job was turned back over to the line management. As we have seen, both approaches succeeded for a while. The initiative at DuPont, however, did not sustain itself in the long run while the one at Lima is still alive today after two changes of ownership and three sets of management change.

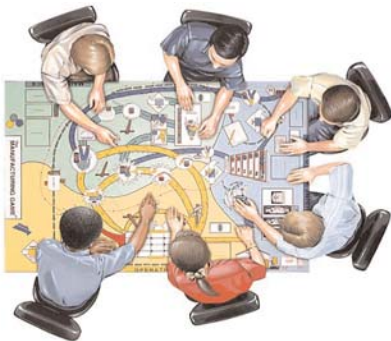


## Diavik Diamond Mines Drastically Reduces Tire Costs: *Credits TMG Workshop for Providing Inspiration in Getting the Tire Savings Plan Operational*

John DeBoer, Mine Maintenance Superintendent of Diavik Diamond Mines, a subsidiary of Rio Tinto, located in Canada's remote North, 300 kilometers northeast of Yellowknife, was concerned with problems the mine had been experiencing with tire failures. Upon reviewing the statistics for 2003, he discovered that most tire failures were not due to wear, but from cuts from rocks, impacts, and separations. Typically in Canadian mining, the average life expectancy of a tire is between 6,000 to 8,000 hours. The average cost for a tire on a large truck is \$20,000. These tire failures were requiring them to spend significant amounts of money to replace them. John was determined to increase the average life expectancy of tires at Diavik in order to decrease costs and increase safety. He was determined to have the best "tire wear" and the cheapest costs of all Rio Tinto projects. John knew that in order to achieve this goal; he would need to get Operations and Training buy in.



*Open for two months each year, the ice road is the mine's resupply artery.*



The Manufacturing Game® turned out to be the right tool at the right time to get his plan operational. At a Manufacturing Game® workshop, John recruited Bill Carter, Operations Superintendent, and John Drizimotta, Senior Equipment Trainer, to be a part of this cross-functional Action Team. They started work on achieving the tire failures improvement goal. They had talked about this problem many times but had not come up with a way to deal with the issues from their different perspectives. The Manufacturing Game® provided them with a common language and vision of what could be achieved.

The team believed that by working together, they would be able to make a large impact. They determined that the problem with tire failures was two fold - lack of training in operators to avoid large rocks, and the way the roads and dump areas were managed. First, they implemented a daily tire inspection procedure. Then, the team created a detailed PowerPoint presentation for John Drizimotta to use for his new, more detailed, training package for all equipment operators. The presentation, entitled "Tire Care Is Everyone's Responsibility" focused on everyone taking responsibility. It detailed how operators should operate equipment and how the loading areas should be kept clean and cleared of rocks. Roads were to be better maintained to designed widths, dumps were to be graded, and haul road berms were to be kept neat lined. Also, ramps were sanded to prevent breakage of traction. The presentation also addressed operator cornering, taking wider turns in order to reduce sidewall flexing and cutting. More lighting was installed in the dump areas so that drivers had better visibility and could more easily avoid rocks.



*Diavik Haul Truck*

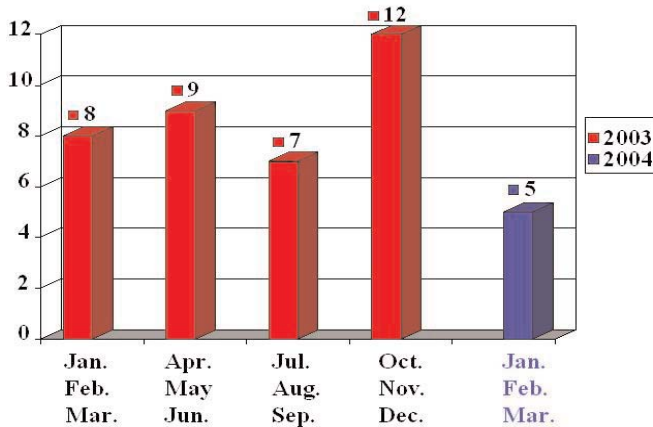


The team felt that the new training program along with better road and dump maintenance was making a substantial improvement in tire failures, but knew the effort needed to be sustained. In order to sustain the new program and to make continuous improvements, Bill continues to attend toolbox meetings to reinforce the message and to make sure proper equipment is being issued on roads and dumps. John continues to train operators with the more detailed operator-training program, and John DeBoer continues to review the tire management systems and monitor and report on all the statistics. Every month a meeting is held and tire issues are resolved.

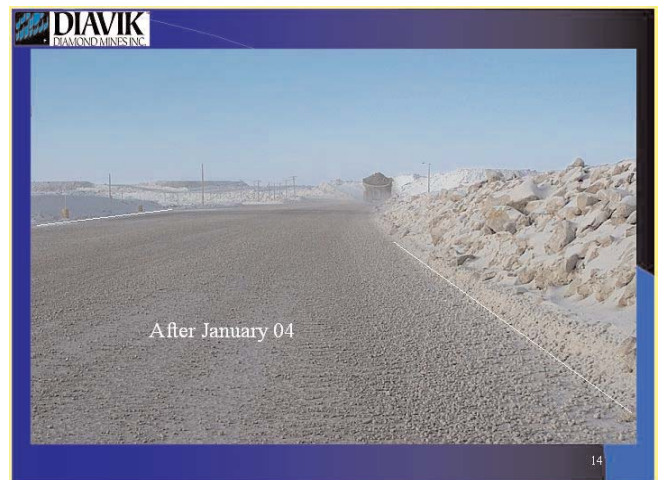
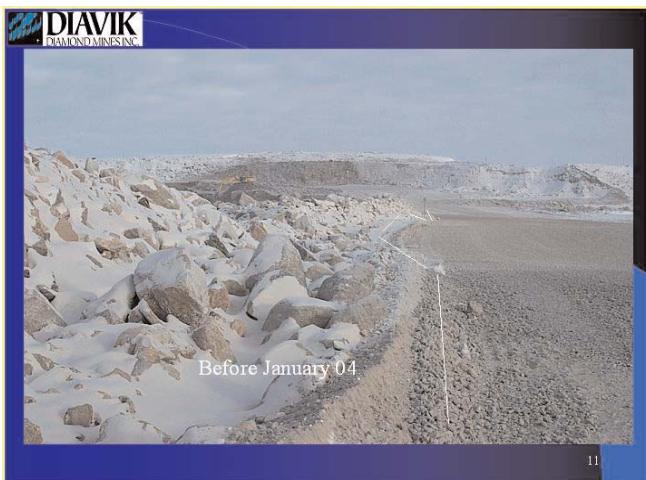


Road Maintenance

### Tire Cuts Average



Not only did this Action Team drastically reduce cut tires, but they also improved safety performance, as the risk of an accident due to blown tires was reduced. Also, the environmental impact has been greatly reduced as they now have fewer tires to remove during reclamation. The Action Team created to reduce tire failures, launched as part of the Manufacturing Game® workshop, resulted in a 55% reduction in cut tires. This will translate to hundreds of thousands of dollars in savings during the life of a 20-year mine. The current life expectancy of tires at Diavik has increased and is now averaging 10,000 hours and they believe they may see some with as many as 12,000 hours.



Before and after results



They recognize that this process will have to be continually reinforced with operators and supervisors; it is not an issue that is resolved and then goes away. They plan to continue with road maintenance and the new operator-training programs to not only sustain the improvement, but also to improve even more.

