Re-energizing a Stalled Reliability Effort at Phillips Borger

Abstract:
The Phillips Chemical plant in Borger, Texas has significantly improved its reliability and bottom line performance by engaging its workforce in a defect elimination effort. The improvements at Phillips are especially interesting because they came after a TPM implementation that stalled out and did not deliver the desired results. We are re-energizing our effort by employing front-line leadership, an innovative workshop, creating a singular focus on defect elimination and consistently following through on follow through on actions started.

Introduction

The Specialty Chemicals division within Phillips has set aggressive growth objectives over the next 10 years. Our objective is to grow sales from $28mm to $100mm. To achieve our objective we must get everything possible out of our existing assets and deliver better product more reliably than the growing competition. The Borger, Texas facility, called Philtex/Ryton, has begun to make this improvement by engaging our front-line workers in eliminating the defects that limit production, add waste, increase cost and decrease sales. Our success so far has been driven by a strong management commitment coupled with outstanding leadership from the front-line and the union. Our success has come after some implementation and organizational struggles that give us as just as important lessons as does our success.

The market for our products has become much more competitive and is driving our push for reliability. There have been and will continue to be pressure on prices. We believe that high reliability will enable us to have lower unit costs. Unlike manufacturers of highly commoditized products, we are closely connected with our customers. Reliability directly translates into improved customer service. If we are to continue our growth we will need continued investment. Phillips will only do this if they see a good return on that investment. Reliability will help to ensure that we get that return.

Background

The Philtex/Ryton facility was founded during World War II as a research facility for synthetic rubber. It has the capability to run over 500 different products including Methyl Mercaptans (over 100 million pounds per year), Ryton® an engineered plastic with high temperature capabilities, and specialty chemicals for various industries. The facility employs around 500 people and the hourly workforce is represented by the International Union of Operating Engineers, Local 351.

One of the most interesting aspects of the improvement story at the Borger Complex is the history of implementation here. In 1993, Phillips started a Total Productive Maintenance (TPM) initiative at its Sweeny and Borger, Texas sites. The two sites jointly developed a TPM Master Plan for introducing and implementing this reliability approach at their sites. Implementation got rolling in 1994 and 1995. What is interesting is that the Sweeny Complex was able to stay the course and has reaped huge rewards from their program.

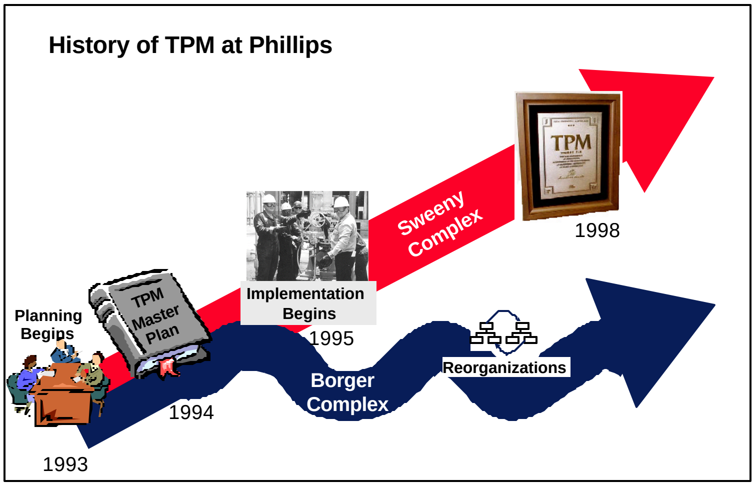

Figure 1

Some of their successes were documented and presented at NPRA in 1998 by Mike Woolbert in an article entitled, “Operator Driven Maintenance, TPM in the Refinery.” Sweeny reduced its maintenance costs while setting production records and reducing slop production. Meanwhile, with the same implementation plan, the Borger complex was seeing small successes but not the change in overall results and culture that we had hoped for. Even worse, we managed to alienate and disillusion many of our key front-line personnel in the process. By 1998 the Sweeny plant had won the coveted Japanese Institute Plant Maintenance Award while the TPM effort in Borger had almost completely stalled out. Based on this history, it would be hard to argue that our struggles at Borger came from a poor plan. The problems that we had came from execution and the lessons that we learned helped us with our current efforts.

The Original TPM Effort

A detailed description of TPM is beyond the scope of this article but our original approach as described in the TPM Master Plan was a very traditional approach. TPM like many of the quality initiatives, originated in the US but was first widely adopted and made popular in Japan. Japanese manufacturers had used this front-line approach to reliability improvement as a cornerstone of their drive to lean manufacturing. The basic tenet of TPM is to eliminate manufacturing losses by engaging all of the employees in finding and eliminating the defects that cause these losses. There are six main types of losses that the TPM process attempts to eliminate or at least minimize: breakdowns and setups that reduce availability; minor stoppages, reduced rate and idling that reduce performance and product defects, rework, scrap and yield loss that reduce quality. Unlike other maintenance and reliability initiatives, TPM always requires cross-functional participation and cooperation. Our plan was built around the 5 pillars of TPM as shown in Figure 2.

The first phase focused on Operator Autonomous Maintenance, “clean-to-inspect” and some basic focused improvement projects with the idea of stabilizing the failures and eliminating repetitive work. The Operator Autonomous Maintenance piece involved moving some of the old maintenance jobs like lubrication to the operators so hat they would develop more

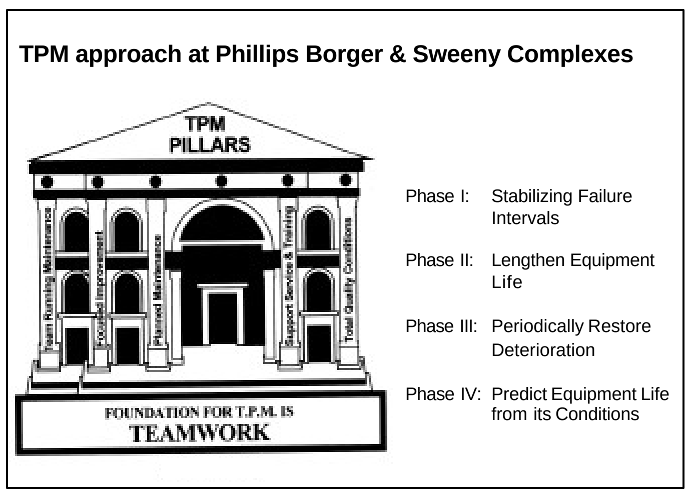

Figure 2

ownership for the equipment and defects in their area. In this phase we attempted to get the equipment back in "like new" condition. We also included some of the preliminary steps to planned maintenance in this first phase. The second phase concentrated on focused improvement projects to design out failures due to poor or inadequate design. The third phase put together our planned maintenance approach and included some replacement of inadequate or inappropriate equipment. The final phase was to implement condition monitoring through advanced autonomous maintenance. The plan was comprehensive and well thought out but it was still just a plan.

TPM stalls out at Borger

While the Sweeny Plant was able to stay focused over several years our execution at Borger suffered through several starts and restarts due to several reorganizations. We had three reorganizations during our attempts to implement TPM. This disruption took management's focus off of TPM at a critical time. Front-line workers did not yet know what this new approach was and their natural inclination was to be a bit skeptical of what they considered a "program of the month". When management did not consistently drive the process, the front-line assumed that it was not important. However, it would be incorrect to assume that the reorganizations were the only reason for our limited success.

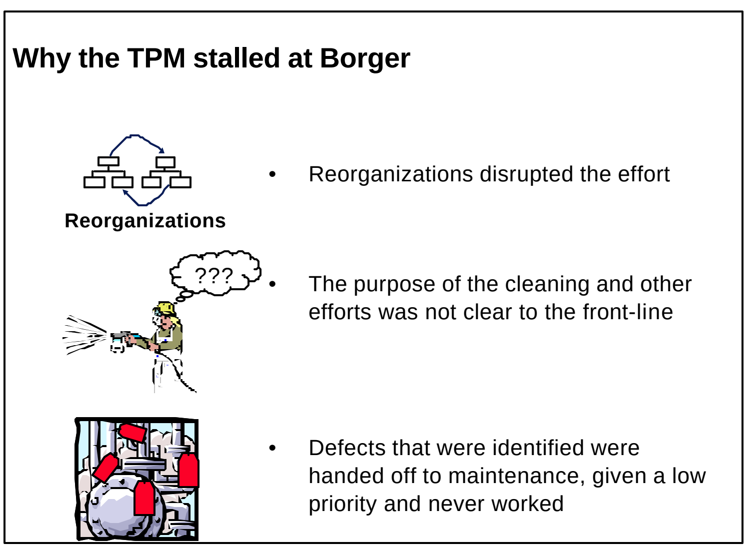

Figure 3

We managed to start our TPM implementation without ever effectively communicating to the front-line why we were doing things such as cleanings. We were very task oriented, with a "tick the box mentality" about many of the implementation steps. As a result we got compliance with the program but limited buy-in and little enthusiasm. If Phase I was set to be completed in three months, then at three months we moved on to Phase II regardless of the success in Phase I.

The second issue that really hurt the process and made the implementation lose credibility was our failure to prioritize equipment inspections and the work orders to correct defects that were found. We empowered operators to find defects and notify maintenance of them. We even trained them to clean and inspect everything, instead of focusing on critical bad actors. We got a fair amount of cooperation from operations which meant that maintenance was faced with a mountain of these new defect elimination work orders. They, of course, still had their normal load of planned and reactive work orders so the biggest portion of the new work orders fell to the bottom of the priority list and were never done. All defects that had been identified were tagged in the field, which was a continual reminder to the operators that nothing was happening and, to them, proved once and for all to the operators that no one was serious about this effort and left many of them very disillusioned.

Re-energizing our efforts – PRIDE initiative

While TPM was floundering, we were having tremendous success with another initiative in a very similar area – Safety. We called our behavioral safety initiative POWER. Not only did POWER change our safety performance, it changed our views on how to implement a large culture change process at our site. It helped us realize the mistakes that we had made with TPM. The Union realized that it had a role to play in these change efforts and that ultimately these initiatives affected all the things that we had traditionally cared about – job growth, job security, pay, safety, etc. Management realized they needed more than compliance. They needed enthusiastic and passionate support from the front-line. We also learned that you don't change behaviors and cultures by handing it off to another group or another function. You have to take responsibility yourself.

Tapping into Intrinsic Motivation

One of the keys to making a change in culture is tapping into intrinsic motivation. The original TPM program at Borger, like so many change efforts, relied on outside or extrinsic motivation, like fear, rewards and incentives. As long as management was standing close by with their preferred carrot or stick the organization made some progress. As soon as management's attention was taken away, the program lost all momentum.

What the POWER program showed was that when you tap into intrinsic motivation, you get far more than compliance. In Japan, intrinsic motivation for TPM and other quality initiatives has been largely attributed to their culture of "wanting to please the group." There is a strong desire within their culture to fit in and go along with the group. At many North American sites no such culture exists and in Borger, in the middle of the Texas Panhandle, you could argue that the exact opposite culture exists – everyone wants to be the Lone Ranger. In the POWER program and now with their revitalized TPM effort the Borger team has tapped into the power of invention and ownership. When you invent an idea, there is a natural desire to push to get it implemented. But how do you get over 300 people to invent roughly the same idea?

An innovative workshop that created intrinsic motivation

We needed a tool that could create excitement and commitment around finding and eliminating defects in the system. We found an innovative workshop called The Manufacturing Game® to fit the bill. The Manufacturing Game® is a two day workshop that has a simulation game as its centerpiece. The Manufacturing Game® originated in DuPont as part of their benchmarking of best practices in maintenance and reliability The simulation is a practice field where our employees could practice the transition from reactive to proactive manufacturing. We found that it created the excitement and commitment needed to implement this new approach that was missing in our earlier attempt. The game shows how all of the functions, maintenance, operations, and stores fit together and how they must work together to improve reliability. The second half of the workshop is focused on taking the motivation and lessons from the game and applying them to the real world through small cross-functional teams.

There are three roles in the simulation, Operations, Maintenance, and Business Services. Operations produces product, decides on what equipment it can take down and invests in eliminating operational defects. Maintenance decides where to allocate its resources: reactive work, proactive/planned work or defect elimination. Business Services is the logistics area; shipping product to customers and collecting revenues. They also run the store room and are responsible for supplying the spare parts needed for repairs By having people switch roles the game helps people understand why different functions behave the way they do. The game helps everyone understand what the impact of making such a change would be from both a personal perspective and a business perspective.

The workshop and the simulation have many subtle lessons but the over-riding core lesson is that all of the employees at the site, especially the front-line operators and mechanics, need to focus on eliminating defects from the system if the plant hopes to achieve world-class performance.. The front-line employees know where the defects are and often can eliminate them by changing procedures and habits. The workshop introduces participants to the 5 major sources of defects:

1. Quality of Materials - Quality from the vendor, how you store, how you transport.
2. Workmanship - The quality of the work you do.
3. Failure - While defects can cause failures, failures can also cause new defects. When something is run to failure new stresses are added to the system.
4. Operations - Some defects come from normal wear and tear but defects can also come from how you operate something. Cavitating a pump for instance can cause excess wear and defects to enter the system.
5. Design - To whatever degree that a piece of equipment does not meet the current business needs it has defects from design.

Participants experience the vicious cycle of reactive maintenance shown in Figure 3 at the beginning of the simulation. A large amount of reactive maintenance leads to reactive repair work which inherently uses a large amount of lower quality workmanship which adds new defects and causes new problems. The breakdowns also cause collateral damage that adds even more

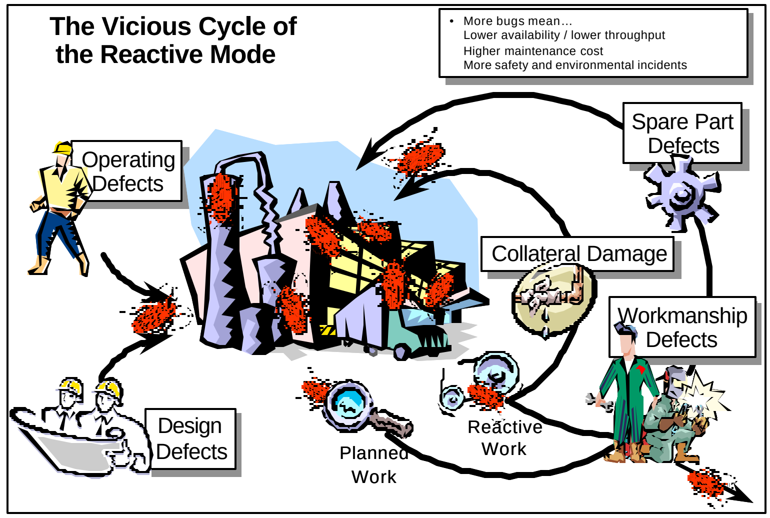

Figure 4

defects into the equipment In the store house managers are forced to "stack'em high and sell'em cheap" to keep up with the seemingly random demands of the reactive operations. Consequently there is slow turn-over and high defect rates. Operations and engineering don't see reliability as their jobs; "that's a maintenance function" and they are so busy fight the fire of the day they have little time to look for or defects or design them out.

Participants learn that achieving world class performance requires tackling the defects from each source. Using more resources for reactive or planned maintenance to remove defects faster will only get you so far. Participants see that taking a purely maintenance functional approach, like most planned maintenance initiatives, means that only a few sources of defects will be addressed. By having participants self-discover the approach to getting out of reactive mode, the game creates intrinsic motivation. The power of invention is incredible. When people invent the ideas to pursue themselves they will run through walls to get it done.

All of this energy, enthusiasm and learning is focused on the second day of the workshop into action teams or as we called them Philtex Ryton Integrated Defect Elimination (PRIDE) teams. Each workshop that was run at Borger launched 4-6 PRIDE teams that are equivalent in concept to Equipment Improvement Teams in TPM. These teams focused on a specific defect that they believed they could eliminate within 90 days with little or no capital outlay. The team is cross-functional to ensure that learning and cooperation occurs across functions.

Union Leadership in the PRIDE initiative. The union involvement and leadership was another huge difference in the PRIDE initiative versus the original TPM effort. Through the POWER program both management and the union leaders realized that the union could be a chief ally in the improvements. All of the PRIDE facilitators were chosen from the hourly ranks and they largely took the lead on pulling together, launching, encouraging and tracking the PRIDE teams. While management was heavily involved in the process, the union members could challenge and cajole their peers much more effectively. They could often tell the difference between a legitimate issue that needed attention and an old gripe that should be challenged. Some of the typical tough organizational issues like "is this training and team process mandatory?" simply disappeared with hourly, union members in leadership positions.

Structure of the Effort

We started the process of re-energizing our reliability effort by organizing cross functional PRIDE teams. These teams were typically made up of operators and mechanics from an area of the plant and included engineers, staff members and even administrative support. These teams participated in a Manufacturing Game® workshop that focused them on eliminating a specific defect in their area and instilled the intrinsic motivation described above. Teams often used the skills learned in the earlier TPM effort like clean-to-expect activities to eliminate their chosen defect. Within a nine month period every employee at the chemical complex had participated in a workshop and had the opportunity to work on a PRIDE team.

Once the teams were launched the four PRIDE facilitators, who are all hourly workers, followed up to help encourage the teams and remove perceived roadblocks. We held PRIDE days each month where the facilitators would meet with each active team to review progress, coach and guide the team, and give our employees the tools they need to make reliability improvements. PRIDE days also encourage areas to detect any and all defects during the "clean-to-inspect" routine. The team would also conduct process training on PRIDE days through on-point-lessons or other methods. When defects are identified during PRIDE days, our mission is to fix them on the spot if at all possible or work through the continuous improvement process to identify root causes and corrective action plans.
. In our early PRIDE days we found over 57 cases where we repaired equipment immediately and avoided writing work orders. PRIDE Teams track the results of their activities through SAP "activity" reports, notifications written, and work team activity sheets. All equipment repair histories are recorded in the SAP equipment reliability database.

Results

The PRIDE team and PRIDE day activities have resulted in over $2 million in improvements since the start of the effort. Maintenance cost was reduced by 27% from the first quarter to the fourth quarter of 1999 and has continued to fall as we have eliminate defects. On a relative basis maintenance cost is down as well. Philtex/Ryton had been close to the "best practice" benchmark of 2.3% maintenance expense as percent of replacement value.

Defect elimination efforts have driven the maintenance costs as a percentage of replacement value to 1.77% - well below best practices in our industry. However, cost is only one piece of the puzzle. Through April 2000 average production is up 20% over the plant records that were set in 1998.

Through the PRIDE effort we have also discovered and eliminated 36 potential safety and environmental issues. These team based efforts had two main benefits. First they provided bottom line improvement to the profitability of the plant but just as importantly they eliminated wasted time, effort and materials that could be refocused on more valuable pursuits. The second benefit was that as people participated on teams they had a chance to practice new behaviors and we started to see the culture change. The best way to illustrate the power of these PRIDE teams is to give a couple of examples.

The impact of PRIDE teams

The Elliot compressor team is a great example of what one of these teams can accomplish. The team identified repetitive failures on the bearings in these critical compressors as a defect to be eliminated. These compressors were part of the plant air system and if they went down the plant would lose air to critical instruments and tools. Within 30 minutes of a failure in the compressors, the entire plant could be shut down. Given the criticality of this equipment, management had rented a spare compressor as a "just-in-case" back up. The team made up of area operators, craftsmen and an engineer began by thoroughly cleaning one of the compressors. Once they saw the intake screen, they could see that the problem was due to deterioration of the insulation and soundproofing material. The material which had come from the vendor was breaking down due to the moisture and the corrosive effects of the product manufactured in the area. The team cleaned out the disintegrated soundproofing and installed a different type of insulation that was rubber based instead of foam based and was not prone to deteriorate under the same conditions.

This team eliminated the failures on the compressors (typically a work order every week) and reduced the cost to maintain by over $60,000 annually. A potential source of total plant shut down has been eliminated and the spare compressor that was being rented at over $100,000 per year has been sent back to the vendor.

When teams like this one eliminate defects, the vicious cycle of the reactive mode as described earlier is turned into a virtuous cycle. Fewer defects mean less reactive work. This leads to less collateral damage. For example each time one of the Elliot compressors went down there was potential to damage downstream instruments that relied on the compressors for air. Less reactive work also naturally cuts down on workmanship defects. The emergency jobs that used to be common on the Elliot compressors made it more likely that mistake would be made. Fewer work orders also means fewer spare parts and fewer defects from those parts. If every 10th bearing installed in one of these compressor was less that perfect, they were getting a bad bearing every couple of months. With the defect eliminated the same compressors get that 10th bearing after a few years.

The virtuous cycle also frees up maintenance time. The time spent on weekly work orders that used to be worked on the compressors can now be spent on planning or predicting efforts. The time spent by operators clearing equipment for maintenance and switching to spare capacity can be spent on equipment monitoring or operations training.

PRIDE teams impact revenues as well

Because our products are not strict commodities, reliability has a direct impact on our customer service. We decided to include people from our sales and marketing function in workshops and PRIDE teams to bring this perspective. By having these people together in a room with a common perspective on reliability we were able to address some long standing issues that we had never been able to address before. The best example of this was the shipping team.

This team made up of area operators, hard trades and marketing decided to tackle a reliability problem we were having in moving product from ISO containers to rail cars. There were several customers who wanted this alternative delivery capacity and one was ready to go to a competitor if we could not deliver. The team sat down and in an hour came up with a potential solution. They were able to identify an abandoned transfer line, return it to service and design a process for trans-loading. Now that the process is working we have been able to retain and increase sales by over $1.6 million in 1999 and by $2.2 million in 2000. Additionally, the change opened our eyes to another opportunity to reduce shipping costs by over $150,000.

While some might argue that this is not reliability or TPM, we believe that getting the customer what they want, when they want it and how they want it is the essence of reliability. This approach has lead us to not only deliver the business that we have cheaper and more reliably, it has also increased our sales.

Conclusions and Next Steps

Our efforts have already yielded significant results and the culture of our site has begun a dramatic change. We have engaged the workforce in a way that we never did in our initial implementation. The keys to our success have been: a focus on eliminating defects and creating motivation through the use of The Manufacturing Game®; leadership by our union members; and thorough follow up. Our challenge going forward is to make this approach a normal mode of operation and not just a program that is managed by a few people. We are looking for ways to continue to spread the commitment and responsibility for continued improvements.

Authors

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