Proactive Manufacturing
accelerating step change breakthroughs in performance

provided by

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Introduction

BP (British Petroleum) is one of the world's largest petroleum and petrochemicals companies. Our main activities are: (1) exploration and production of crude oil and natural gas, (2) refining and marketing, supply and transportation, and (3) manufacturing and marketing of petrochemicals. We have major operations in Europe, the USA, Australasia and parts of Africa, and are expanding our presence in other areas, most notably China, South East Asia, South America, and Eastern Europe.

This paper discusses recent improvements at BP's Lima Ohio Refinery. This refinery improved performance by $0.77/bbl from 1994 to 1997--largely without capital investment--by using knowledge and people processes to generate this "self help." Lima Refinery evolved its capacity to function as a learning organization and increased its capacity to generate step change breakthrough results. Examples of improvements we will discuss have been in the areas of pump reliability, planned work, hydrocarbon loss, and safety.

The approach to we took to change was not traditional; performance improvements beyond what is typical in a change effort resulted. We did this by (1) liberating unused capacity in the people of the refinery (engaging everyone to help), (2) creating new paradigms for how we integrate operations and maintenance work with the commercial realities of the business (via three simple rules--see figure 18), and (3) reflecting systematically about our successes and failures, to learn how to improve going forward.

These results truly came from the skills and experience of our people, not from technology or even process. We think this story is an example of new behaviors within BP that create "our unique software" --our people and the innovative way we work--as the company's most distinctive asset.

A new leadership style emerged. Refinery leaders behaved more like farmers than the captain of the ship, and worked to ensure a healthy leadership ecology throughout the organization. Real leadership emerged from all levels, based on knowledge.

Front line workers evolved their skills, abilities, and awareness to become breakthrough change leaders. Internal networkers moved around BP assets worldwide to learn and share learning.

We started to see both knowledge and leadership as a "phenomena" that emerges within a system that is alive (which is more like an organism than a machine, that you cannot *control*). The financial benefits generated by these phenomena are the

fruit, the consequences of applying practical knowledge about high leverage points in a very complex and interdependent system.

To give an example of using knowledge in a high leverage way, we recognized that the shift teams (operations) had to perform well for the business to succeed, but that much of our focus had been on cost reduction and maintenance efficiency improvement in the past--not always resulting in effective operations capacity to deliver for our customers. We reoriented our focus to creating value for our customers by enhancing operational discipline, and saw the value of this as being higher than the cost it might take to achieve this value. And to deliver on the promise, we needed to increase cooperation between operations and maintenance, and reduce functional entrenchment which limited our ability to get at more fundamental systemic issues.

Evolving this awareness and capacity for effective action was a process, not a one time "aha." Each action team success shed more light on what was required, and the leadership team improvised their next steps based on this evolving understanding of what would be effective. Building collective awareness, meaning, and then agreement for next actions was a key aspect that enabled team learning. Framing the data in the context of the whole system, with some ability for "systems thinking" also seems to have been important.

The financial results are the consequence of becoming a learning community.

We altered and adapted learning tools such as the Manufacturing Game™ and systems thinking so they became ours, and used these to move ahead.

Lastly we are inquiring deeply into what we did via a "learning history" process, so we can understand, capture, and then replicate these sorts of rapid improvement results elsewhere in BP where differing business contexts may require adaptation of approach.

This combination of research, flexible application of "learning organization tools," and rapid financial improvements seems to us to move beyond "best practices" for organizational change.

We accomplished a major transformation of the organization and performance results within three years. Creating the capacity for large scale continuous change and increasing the ability of everyone in the organization to think and behave like a business owner via "self organizing" principles is something new.

Much has been written about "the learning organization" yet there still is a lot of confusion about what a learning organization really is, or how to create one. It is our hope that by telling our story as a particular case study, it will become more clear about what is involved in creating and sustaining a learning community.

How this paper is organized

The flow of the paper is to first review the results, then talk about what we did to create these results, and then examine the organizational theory base that underlies the success of this approach--why and how it works.

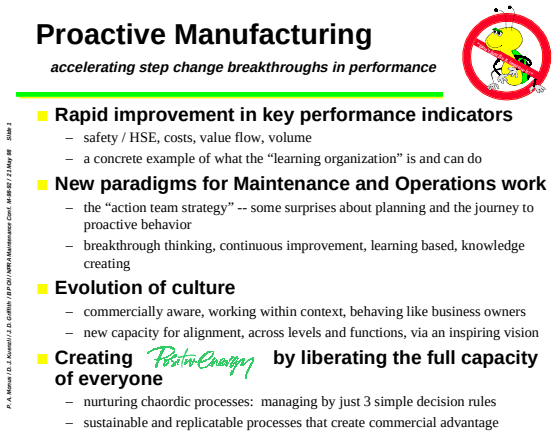


figure 1

Performance results since our last paper

At the 1997 National Petroleum Refinery Association (NPRA) maintenance conference, we presented a paper (**Proactive Manufacturing at Lima Refinery**). Our 1997 presentation to NPRA chronicled rapid improvements in Lima Refinery key performance indicators, but noted that a strategic decision had been made in the company to cease crude processing at the end of 1998. Thus it would be reasonable to have had many of the impressive results from prior years trend in the other direction following this decision.

This is not what happened. Instead, the improvements continued:

--pump MTBF increased
--hydrocarbon loss decreased
--safety improved
--$0.77/bbl net margin improvement

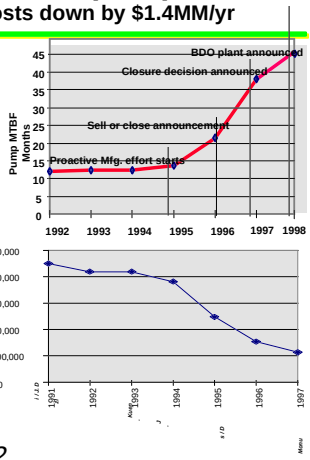
We began our efforts to create a proactive manufacturing culture in 1995 with rotating equipment reliability. Notice that even after the decision was made to cease crude processing at the Refinery pump mean time before failure (MTBF) increased during 1997 (figure 2).

Our first objective was improving rotating equipment reliability

Lima Refinery: Pump Repairs

MTBF quadrupled; costs down by $1.4MM/yr

Year	# Repairs	Repair Cost
1991	643	$2,250,500
1992	599	$2,096,500
1993	599	$2,096,500
1994	545	$1,907,500
1995	355	$1,242,500
1996	221	$773,500
1997	163	$570,500



in spite of the closure decision, improvements in pump MTBF continued; why?

because this is the right way to do maintenance: cheapest, safest, best on people

figure 2

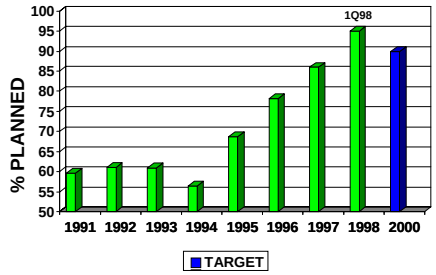
Notice in figure 2 the steepness of the pump MTBF curve. We began the work to improve pump reliability out of aspiration, not desperation. We had noticed that in the past Lima Refinery had been able to do a lot better with preventive maintenance, predictive tools, and a culture of operational discipline in how to run the equipment that had been eroded over time. We aspired to return to this legacy of the past where we had done better. One reason for the decline was that the specialist teams who had been involved in promoting preventive maintenance improvement efforts had been disbanded in a cost cut in the late 1980's and reliability had slipped.

Using the "action team strategy" which will be described in more detail later in the paper, we made the rapid improvements in reliability and reductions in cost noted in figure 2. Over 1.4 million dollars per year were saved and the number of work orders dropped from about 600 per year to less than 200. This had benefits beyond cost savings, in many ways. One major benefit was to encourage us that this effort could work, and that we were on the right track, esp. related to Operations.

Another major area where improvements were needed was in how maintenance work was done. We sought to increase the percent planned work to a breakthrough level of 90% or better, similar to some best examples from the benchmarking studies.

We knew planning was a route to efficiency, but didn't focus on it; yet it resulted

Lima Refinery Planned Work



this improvement was achieved NOT by better planning, but by eliminating work via action team strategy. the outcome was higher % planned work

figure 3

Figure 3 shows how planned work improved. Planned work is defined in this chart as the number of job orders that were not marked either rush or emergency, which must be completed within 48 hours. A corollary to this measure would be number of "surprise jobs" that required pulling off work to pursue a higher priority job. The chart shows a rapid improvement, and also fits with the subjective feeling that the many surprises and changes that had been going on no longer occurred.

Focus on action, not planning

It is interesting that even though we believe in the value of planning as a means to more efficient maintenance work, we did NOT focus on planning. These results were merely a consequence of having fewer jobs in total to do, which could be planned better using the existing planning and scheduling approach that was in place during the time when the measure was in the 50% to 60% range.

The reasoning for this is that pursuing defect elimination via the action team approach eliminates much of the repeat work. This happens because defect INFLOW is reduced, avoiding putting defects into the system, esp. from Operations. The traditional approach focuses more on taking defects OUT OF the system once they are in, rather than stopping the inflow by engaging everyone in the system. By eliminating work we had a side effect of being able to do the work that remained with more efficiency, and have a higher percentage planned.

We did not focus on data, RCM type studies, or a CMMS driven strategy. Instead we focused on taking action, by everyone, to prevent defects from getting into the system, and to being committed to personally get rid of defects. It was more unstructured and challenging for management vs. the traditional approach to maintenance improvement, but also much faster.

The traditional approach goes through a "worse before better" time while building up capacity to do predictive, planned, scheduled, and preventive work. In most cases this has to be done without extra resources, which then strains the capacity of the organization to handle reactive work.

By not handling the reactive work as effectively during the time when "planned domain" work is being pursued as a priority, a backlog of breakdowns builds up, and eventually the Operations group makes enough waves that some of the "dedicated resources" for planning have to be pulled back and put on breakdowns. This then stifles the planning effort and a backslide into the reactive mode occurs.

It is only if the organization can stay the course for long enough that the benefits of the planned domain come true.

In our work at Lima Refinery we felt that we didn't have the needed time or resources to build up the planned domain work; instead we needed a way to get rapid improvements without the "worse before better" dip in performance.

The action team strategy provided a new, but risky, approach to this. In this strategy the focus is first on breakdowns--you must repair all broken equipment as soon as possible. But by focusing on precision work and defect elimination (the strategy), while engaging the entire workforce, the idea is to put equipment back into the plant "better than new" by removing as many defects as possible (don't just fix it, improve it).

The cost consequences of this strategy are not that severe: the main cost is to remove the equipment from the plant and reinstall it after repair--doing three or four repairs or improvements instead of the one thing the

equipment came into the shop for does not cost that much more incrementally. But if MTBF can be extended by doing this, the payback can be large, as is seen in the pump data (figure 2).

Figures 2 and 3 should be looked at together. They are related and show that the strategy can work.

By not focusing on planning, we achieved improved planning as a byproduct. This is not an intuitive result. More on this later.

This change in focus towards defect elimination, and seeking to include operations and design --not just maintenance) suggested a reason to us why past efforts at improvement had produced some initial wins but lost steam over time and had disappeared over the years only to be resurrected over and over.

Another example of where creating a learning culture produced financial benefits is hydrocarbon loss. This is a key metric for the refinery that tracks the difference between incoming crude oil and outflow of salable products to customers.

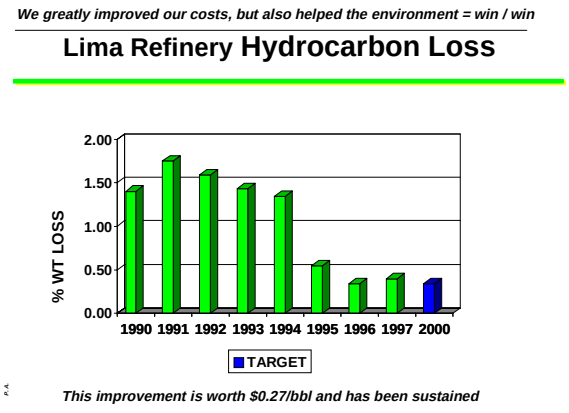


figure 4

Reducing hydrocarbon loss means we retain valuable products eventually are sold rather than flaring them to the atmosphere--a win/win for the company and for society. Figure 4 shows the data. How did we achieve this? Again it was a combination of specialist knowledge combined with the action team approach where everyone became engaged in the effort to reduce losses.

The ability and willingness to work across functional boundaries was important to achieving these results; we think that this is an example of where "systems thinking" contributed.

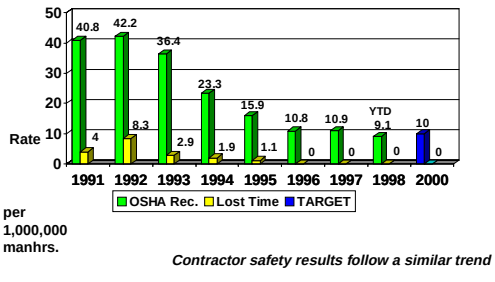
Flow meters were installed in various key locations in the flare headers. Losses were measured and communicated. Action teams went after small but important defects, some of which produced surprisingly impressive results (esp. the butane action team--see pages 10-11 for the story on this team).

Reducing hydrocarbon loss, like raising pump MTBF demonstrated the credibility of the action team approach and the possibility of large financial benefits as "low hanging fruit" --meaning activities that produce quick financial wins for minimal effort. Improvement of hydrocarbon loss by itself is worth $0.27/bbl as compared to baseline data prior to the improvement program in 1995.

Another key area is plant safety and HSE results. These metrics also dramatically improved over three years. See figure 5 for the data on employee safety. Few refineries have done better.

The explanation for these results may involve culture and participation--if we can create a proactive culture of defect elimination the equipment runs better, but it also adds to workplace safety.

Employee Safety Performance



Contractor safety results follow a similar trend

figure 5

Many other actions contributed to improving safety performance not discussed in this paper, but we wanted to note that working for proactivity is very aligned with a strong focus on HSE and safety as well.

Bottom Line Improvement = $0.77/bbl

Figure 6 shows the impact of these efforts were worth 77 cents per barrel with very little capital investment, largely by using the capacity of our people.

Each of the line items in figure 6 has a story connected to it, not expanded on here. One item not shown in detail (under "process optimization") is process online analyzer reliability, which improved from 75% and not trusted to 97% and trusted.

Evidence is emerging that the analyzer benefit on added value to BP refinery operations is in the region of 10 to 12 cents per barrel—this is due to the benefits of process control and optimization from using accurate real time data to tightly control to commercial specifications vs. “giveaway” of higher value products into lower value streams.

In addition to the work on analyzer reliability, three engineering advanced controls projects were completed (Cat Cracker, Crude Unit, and Blender).

Refinery management set and achieved stretch breakthrough targets

Cash Margin Enhancement 1997 vs. 1994

	$/BBL Crude 95 Basis
Higher Reliability	0.08
Hydrocarbon Loss	0.27
Process Optimization	0.22
Crude Delivery & Quality Costs	0.05
Energy Efficiency	0.06
Cost Savings Initiatives	0.07
TOTAL CASH MARGIN ENHANCEMENTS	0.77

figure 6

Figure 6 represents the hard metrics that management set for action teams to influence. These are significant in that management did not merely hope that the action team strategy would work, but rather took the step of setting performance goals in very tangible "hard metrics" form and then worked the soft issues to capture the value.

Merging both soft and hard metrics at the same time, as an integrated force, and having the skill to inspire the average person in the refinery to want to join the efforts is required to succeed with the action team strategy.

We had been pondering the question, “Why have past efforts of dedicated individuals in maintenance programs at Lima Refinery failed to produce a complete transformation to the proactive mode?” Reflection on these results indicates that a balance is needed between purposeful and orderly improvement efforts (like capital budget projects, RCM teams, etc) and more chaotic aspects related to people's passion, actions, and desire to create.

This also suggests that the Lima Refinery story cannot be *easily* transferred to other places. We now think that these results were a consequence of our being able to form a true learning community, with a strong cohesion, and a commitment to

defect elimination and the culture of "don't just fix it, improve it."

Breaking long standing mental models and adopting new decision rules in practice is very difficult and the subject of much in the learning organization literature. It involves building new capacity for thinking and action, not just in the leaders, but in everyone. This is the "unique software" aspect mentioned earlier.

To replicate these sorts of results in a new place requires reinventing the needed actions in a customized way applicable to the business context, plant culture, and capacities of leadership, salaried, and hourly people. It requires improvising from general principles; no sheet music is available, or is likely to become available.

So, the dilemma is that while we would want to replicate the rapid financial performance results achieved at Lima Refinery elsewhere, to do so requires the new location's management finding a very site specific approach that blends tools and methods with culture, needs, and capabilities present in the new location.

To succeed requires building capacity in the "people" element of Figure 7, especially in asset management.

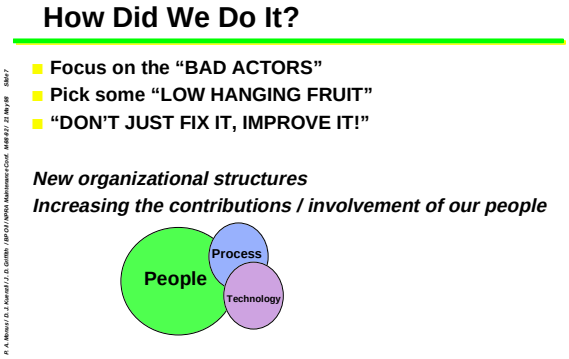


figure 7

Figure 7 shows some key aspects of how we improvised in this way. The approach was to continue the "orderly" side of what we were doing via processes such as planning and scheduling, preventive maintenance, and minor capital projects, but add to these a "people process" that would adopt the "don't just fix it, improve it" slogan as a means to approaching all work.

We focused on low hanging fruit, where without additional capital money we could either (1) stop doing something dumb, or (2) start doing something we knew we should be doing, or (3) use the knowledge and skills of people in the system about root causes and how to avoid defects getting in.

Much of this was "operational discipline" and did not directly involve the maintenance group. Some of it did involve maintenance and procurement / storehouse, and this cross functional interaction was a place where the learning culture we sought to build had to succeed.

As we started working to eliminate defects, we at first focused on improving maintenance. We then realized that we couldn't improve maintenance by itself, but had to do this improvement within the context of the whole of manufacturing. And to do this required having a means of surfacing, challenging, and then changing some of our most deeply held ideas and behaviors in the plant.

Operations giving maintenance time to do their work to the best they knew how, building awareness and skill in plant operators to use the "best approach" of the most skilled operator, learning what causes equipment to fail and having honest and productive conversations about what really happened were areas we learned.

It boils down to getting the best performance from everyone, and everyone being willing and able to contribute.

Action teams were a "practice field" for this development, as were the Manufacturing Game ^{TM} workshops (discussed later in this

paper). Some new organizational structures came into being as well, which are attributed as being both the driver and sustainer of some of these changes.

The first of these structures was building shared awareness of current reality (we are reactive) and a clear vision of where we wanted to go (the proactive domain) via Manufacturing Game™ workshops.

The Manufacturing Game™ -- a practice field for learning

--virtual reality to engage everyone in taking action for improvement

Operations, Maint., Commercial fcns.

Team of six start in a reactive way of working, and must figure out how to evolve and break-through to a pro-active way of work

Engage head, heart, body

Simple rules in use emerge

--the game creates passion, energy, and is real to life
--people can visualize and reflect on their "theory in use"
--meaningful work, risk taking, skills
--a safe "container;" OK to make mistakes
--then apply the learning back into the real world

figure 8

New capacities for systems thinking, reflective inquiry and dialogue, and a process of taking time to meet monthly to evaluate progress on the journey in a group we came to call the Continuous Improvement (CI) Forum all contributed.

To get the most out of our resources we knew we needed a means of engaging everyone in eliminating defects and the sources of defects that limit us.

We realized that in order to make any process improvement effective and sustained, we needed a means of working on our thinking and behavior--for everyone in the bigger system--from top to bottom.

The key driver which enabled much of this was the Manufacturing Game ™.

The Manufacturing Game ™ Organizational Learning for Everyone

The Manufacturing Game ™ was created at DuPont as a product of over three years of benchmarking work to understand the nature of world-class maintenance and reliability. The creators at DuPont started with this mountain of benchmarking data and a question that was eerily similar to the one we had at Lima, "Why do we fail to sustain improvements in maintenance and reliability and perform well below world-class standards in spite of the fact that all of the components of world-class performance are well known to us?"

The result of this study was a detailed systems model of how reliability works and why organizationally it is so hard to improve. From this detailed model DuPont built a board game representing operations, maintenance, and business services. The game uses poker chips to represent the products, supplies, and resources involved in manufacturing. The game is part of a two day workshop that focuses on creating the shared vision of what can be accomplished and what needs to be done to make these improvements happen.

The creators of The Manufacturing Game™ had succeeded in building a virtual world of plant operations that was a structurally accurate representation of how a process manufacturing facility and organization work. They had proven within DuPont that this tool could express the complex concepts that they had uncovered, in a way that was meaningful for people at all levels in the organization. "Learning by doing" in the Manufacturing Game™ workshop provides actionable knowledge, even if people cannot articulate any theory about what they have experienced, or the disciplines of a Learning Organization.

From the early sessions with The Manufacturing Game™ we had five new insights that were significant "aha" experiences for us. These are more fully discussed in our paper from last year; we

only include the highlights of these now, but these remain as key insights for us.

Five key insights and "aha" experiences about operations and maintenance

Insight 1: Reliability and maintenance are all about how you deal with defects in the total manufacturing system

Insight 2: We must be very careful in what we consider to be goals.

Insight 3: There are several stable operating regions[1] of manufacturing (Figure 9) that can exist and each of these domains has the characteristic that it is mutually reinforcing.

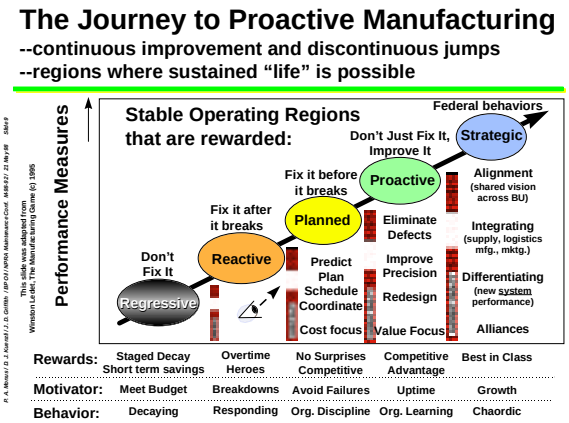


figure 9

Insight #4: Tapping into intrinsic motivation is required to succeed on the journey to higher stable domains.

Insight #5: Focus on low hanging fruit and what you have passion for. This approach will create time to go after the big dollar items later.

The approach we adopted

We developed a plan based on these insights to engage the entire organization in moving to what we started calling Proactive Manufacturing. As a philosophy we adopted "Don't Just Fix It, Improve It". We decided to run two Manufacturing Game™ workshops each month for the next nine months (in 1995) to offer every person in the refinery an opportunity to attend with the goal of building shared vision of where we were headed. The workshops created the enthusiasm and launched the action that we knew we needed.

We also decided to use the concept of action teams (small cross-functional teams that are put together with the idea of solving a specific problem or going after a specific opportunity) to go after specific short term projects (60-90 days). These teams would disband once the project was complete or in 90 days if nothing was happening. Unlike quality teams we had tried in the past, we encouraged teams to meet as infrequently and for as little time as they felt necessary and to focus on the project and not the process.

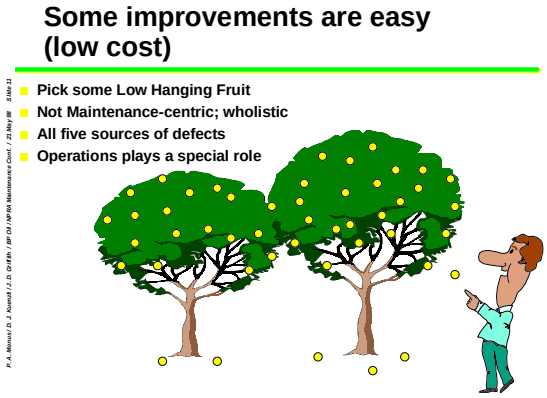


figure 10

We quickly found that after playing The Manufacturing Game™ teams typically had a list of defects that they knew about and had passion to tackle. So we evolved from assigning projects to encouraging teams pick projects that were meaningful to them and to the refinery.

[1] The concept of stable domains originated out of work by Nobel prize winning professor Ilya Prigogene and was later adapted to human systems.

Action teams coming out of The Manufacturing Game™ workshops were also a perfect vehicle for giving people a chance to practice new proactive behaviors.

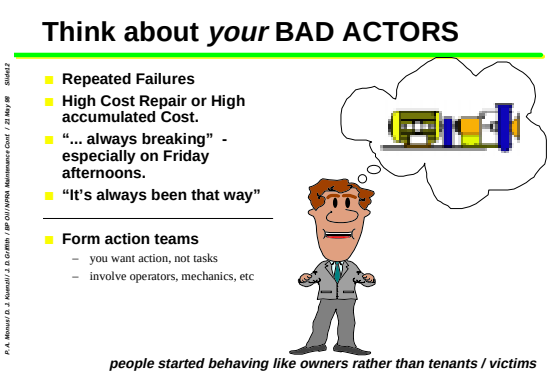


figure 11

Teams seemed to have little trouble identifying a number of defects they could immediately work on, mostly from "bad actors" (equipment that fails frequently) that were personally meaningful to their area.

The key in forming a successful action team was to focus on "what can we do" without delegating work to others, and to behave as true owners rather than feeling like victims. We stressed that we wanted a commitment to really take action, not a task that no one was really ready to take on themselves.

Management supported the process by designing and promoting efforts on key issues that they wanted to work anyway, so the action teams were not a "side activity" that people perceived as optional. Instead the most successful action teams were on topics near and dear to the heart of manageme as well as the workers.

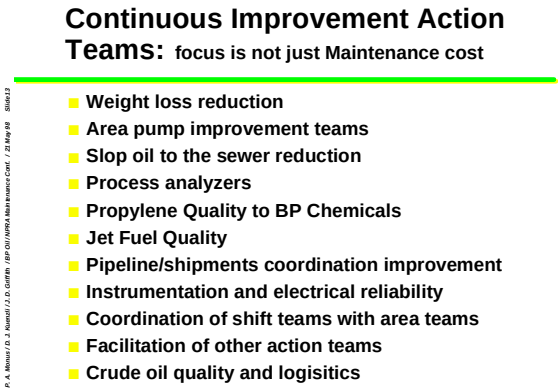


figure 12

Figure 12 gives a flavor of some of these action teams. Notice that there are a range of issues we addressed, outside of traditional maintenance department pursuits.

A good example of how the action teams worked is the Butane Action Team Story.

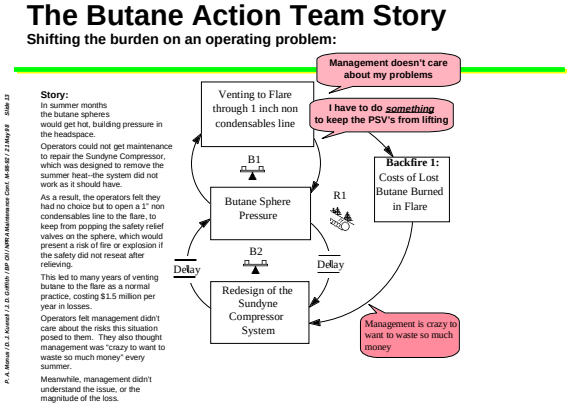


figure 13

The Butane Action Team

For many years the butane storage operated in a quick fix mode during hot summer months. Butane (a blending component in gasoline) has a high vapor pressure and expands when heated, increasing pressure in the storage vessel. The cooling and vapor compression system designed to maintain overhead pressure below the safety valve settings on the vessel was insufficient.

Plant operators would watch the overhead pressure, and when they became concerned that they were too close to the limit, they would open a 1 inch diameter non-condensables line going to the flare header, to vent butane from the spheroid to the flare to reduce the pressure.

During the dialogue at a "Proactive Manufacturing" workshop in March 1995, the operators and management committed to do something about this problem. The team had played the Manufacturing Game™ and had gotten excited about the idea of capturing low hanging fruit and using existing knowledge. Management proposed a theme for the plant operators and mechanics to work on, but they rejected this idea in favor of working on the "butane problem" which the management team had no awareness of.

The story that unfolded suggested that knowledge existed within the company for many years, the operators suggested at least eight years, but probably longer, about the problem. They suggested that "management is crazy to want to waste all this money" by venting butane to the flare (their "quick fix) instead of doing something (the fundamental solution) to resolve the root cause of the problem. In the past they stated that their supervisors weren't interested in this issue, mainly because they had found a way "to get by" via the venting to the flare fix.

The Butane Action Team Story (continued)

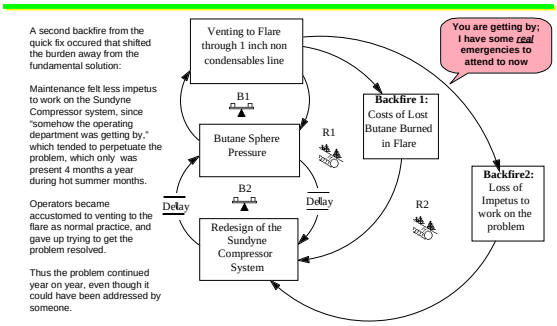


figure 14

A second side effect (see figure 14) of the quick fix was a "backfire" in the sense that the maintenance department no longer felt pressure to resolve the fundamental problem with the compressor; they took the attitude that "you're getting by" and "I've got real crises to attend to" so operators got used to just venting butane to the flare when summer weather arrived.

Something happened in this workshop; honest dialogue took place, some new knowledge was tapped into (the DuPont defect elimination paradigm, and going for low hanging fruit) liberating new willingness and ability to take effective action.

The operators knew that the compressor which wasn't working was too hot--you couldn't touch it. They thought that a first step was to cool it down. The existing cooler was the size of a shoe box; the team wanted to find a big cooler to replace it.

The Butane Story: the intervention
$5,000 cost, completed in only two weeks time, saving $1.5 MM / yr

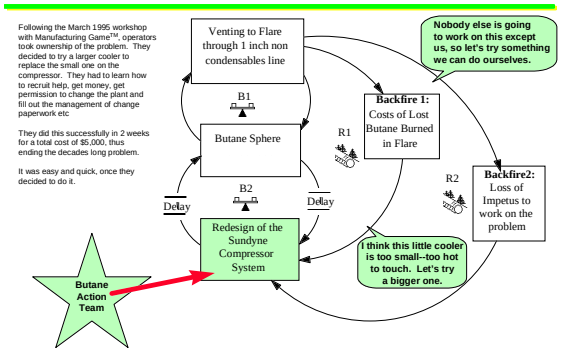


figure 15

The team went driving around the plant looking for a bigger cooler they could use. They found one and had it checked out via the management of change process (involving some supervisors and an engineer). When it was found to be suitable, they had it installed. The new bigger cooler worked; the compressor

started working as it was supposed to work, and the overhead pressure in the butane spheroids dropped. The operators were able to eliminate all venting to the flare. For $5,000 and about 2 weeks of effort by a few people, we now have an improvement in place that saves $1.5 million per year.

What was amazing was how easy this was, how fast it could be done, how little capital investment it took, and how long this known problem had been in the organization without a cure. We had become addicted to and blinded by the quick fix of venting to the flare, rather than going deeper to find the root cause.

The next question we asked was, if this was so easy, why hadn't we done it before? If people could suddenly take ownership, rather than delegating the problem to management or engineers, what was it that made them do this?

We inquired into this via a "learning history" project. We found five key themes in the learning history, and fact checked these with the original butane action team members. (Our Butane Learning History is available to anyone who is interested in these themes).

These themes and the learning history document were then disseminated to the Lima Refinery "CI Forum" (figure 16) as the next step.

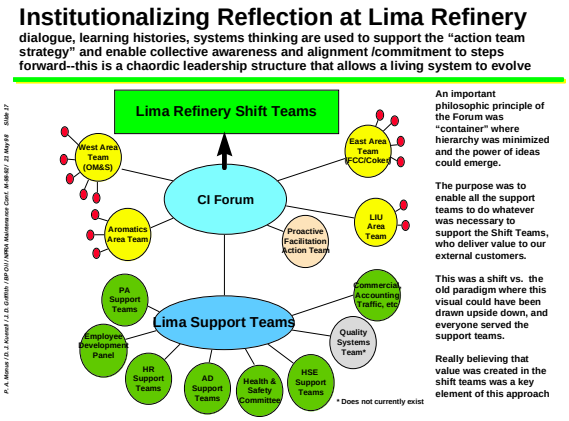


figure 16

The CI Forum is a group of managers, engineers, team leaders, and workers who meet regularly to create a space for dialogue about the journey to proactive manufacturing, to reinforce what is going right, and to learn.

About 28 people from the Refinery spent 3 hours discussing what had happened in the Butane Action Team, using the learning history as input data to aid our thinking, and some new insight emerged (some people from the original butane team were in this forum meeting).

After learning and thinking about how to replicate this successful action team, it was decided that the whole refinery should hear the story. The next action was to disseminate the butane learning history to EVERYONE in the refinery in a series of 13 day long workshops, as part of a communication package on progress to date vs. our CI goals. This day included systems thinking breakouts, a drama entitled "Why the gondoliers are always singing in Venice", reports on how value creation was evolving from various action teams, reports on key performance indicators, and the learning history on the butane action team.

After this learning history was disseminated to everyone, we saw an increase in the ability to create successful action teams, to remove defects from our equipment and work processes. More ownership generally occurred, and the rapid improvement in safety, loss data, maintenance cost, and operating effectiveness (reliability etc) continued.

This butane action team breakthrough became a "mythic story" that encouraged people to believe in the possibilities and to work for the goals of proactive manufacturing.

Management celebrated the success of the butane team in stopping the $1.5 Million per year loss rather than looking for someone to blame for why it hadn't been stopped all the prior years (the policy of "reinforce what is going right"), and made it safe for other "dumb things we are doing" to surface, so they could be corrected.
The butane story is a great example of the power of learning, and the long range impact it can have.

The Bug Picture

A key insight from the Butane Action team and other successful action teams was the importance of keeping the message of defect elimination simple: don't just fix it, improve it. Becoming personally accountable for this and really doing it is the change. People had to have many conversations about what "it" was, in the context of the whole. Systems thinking always encourages looking outside our little box to the next layer outside our own.

Owners have the ability to think contextually and to weigh tradeoffs, in commercial terms. In the past plant operators and mechanics were not asked or expected to do this. Beyond just the experiences in action teams and the workshops, we needed a visual symbol that carried the essence of our message and theme to everyone. The Bug Picture (created by Ron Rowland, a refinery employee and computer wizard) was a key help in getting this across (see figure 17).

figure 17

This picture appears in many places in the refinery--on posters, placemats to eat on at home, stickers for hardhats, etc The bug is green and yellow (BP's colors) and looks friendly enough. We had big debates over whether he should look angry and threatening or friendly and benign. We chose friendly because bugs often get in without causing failures--it takes time and more accumulation to lead to failures. We put the "no bugs" slash with our "don't just fix it, improve it" slogan to indicate that we didn't want him in our plant.

The bug is our poster child for proactive manufacturing. We think it is important to have visual cues in the workplace to remind people of the principles of proactivity.

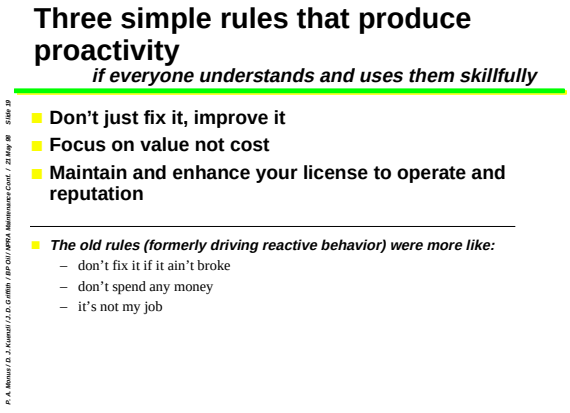


figure 18

Along with "don't just fix it, improve it" we eventually articulated two other key "decision rules" that we were following in our pursuit of defect elimination via the action team strategy (see figure 18).

Many examples can be cited where a debate emerged over "can we afford to fix it right?" vs. "don't just fix it, improve it." How to decide? The second rule of "focus more on long term value, not just short term cost" gives guidance in these cases.

But again, as with the first rule, people had to discuss what "value" meant, and "long term vs. short term" issues. An owner can make these tradeoffs and take the attendant risks for the value. No value is to be had without risk, so the third rule often also played a role of "maintain and enhance our license to operate and reputation." Part of this license to operate included how our shareholders view us.

In the workshops, game players often go deeply into debt, but eventually come out of debt and succeed. These strategies often arise from the traditional focus on planned domain and involve a "worse before better" period. In real life this is often not an option, as shareholders would intervene and demand restoration of profitability.

The action team approach is a means of avoiding this problem, as it is possible to generate enough short term successes to sustain financial reputation and license to operate with the shareholder while pursuing defect elimination on the journey to proactivity.

But to succeed involves breaking some old bad habits, and adopting new mental models and skills for action.

Questions for us to ponder

- **What are the *simple rules* you and your colleagues follow?**
  - "weak link theory" -- everyone must practice the same rules to succeed
  - the simple rules are the "theories in use" and mental models that lead to action and results; are we willing to experiment with these?
- **Do you have the skill to *lead* people without control and yet have order emerge?**
  - action teams create some feeling of loss of management control which must be tolerated
  - a safe place, a "container" for risk and learning collectively
  - practice fields build awareness; then simple rules and new culture emerges
- **How often and how effectively do you "convene the whole system" to *reflect, learn, and think collectively*?**
  - Reflection, CI forum, practice of dialogue, use of learning histories

figure 19

As we pondered how we might best approach getting everyone to think and behave according to the new paradigm, which simply meant following the three simple rules of figure 18, we asked ourselves in each situation what simple rules we were following. As we built up a number of decisions and stories from these that illustrated how we now were acting, people got the idea and were able to abstract these simple rules into new situations.

This sounds simple enough, but in reality was hugely complex. Management at all levels had to unlearn some things, and develop new capacities, for listening, collectively reflecting and learning, for building aligned approach and execution, and to do all of this without command and control.

Dee Hock (founder of VISA) describes this process as "chaordic" and says "out of control and into order." We found it to be exactly so. As mysterious as this sounds, it really isn't. But a new habit of convening the whole system, as a whole, and having a deep and meaningful conversation was a new capacity for us.

The CI Forum (see figure 16 above and figure 20) was a key new organizational structure that enabled this change. Systems thinking suggests that "structure

causes behavior" and evokes all the patterns we see. Thus it is high leverage to notice system structure.

One of the new insights from a systems thinking perspective in figure 16 was the little arrow going up to the shift teams. This indicated a philosophy that all other teams and departments in the refinery were there to support the success of the shift teams. The shift teams are the ones who deliver value to the external customer, and thus the emphasis.

In the past it was more like figure 16 being upside down, with the shift teams supporting the support teams. Back to simple rule #2: focus on value-- if we really want to follow this rule, we have to focus on the shift teams, since they can create or destroy value most powerfully.

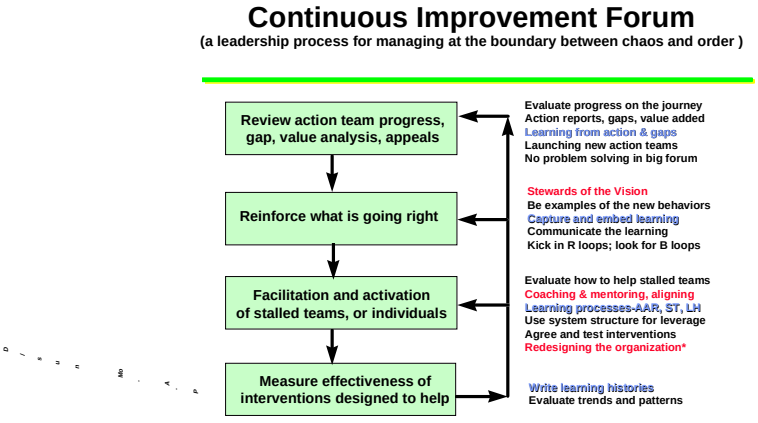


figure 20

What did the CI Forum do?

Figure 20 describes the processes of the CI Forum. The CI Forum was "system structure" for *collective* leadership instead of individual leadership, and provided the means for creating shared awareness of current reality, time and space to collectively reflect on events and their meaning, and became the "container" (a safe place) for us learn collectively.

The main topic in CI Forum meetings was "progress on the journey" to higher stable domains. We reflected on how our action teams were doing, what was being accomplished (value), and what could be learned and applied in other places. We took the attitude of reinforcing what was going right, rather than stopping what was going wrong, and used Winston Ledet's "value, passion, ideas, sensitivity" model to understand why action teams stalled or how to facilitate teams still working. We reviewed metrics and data, and served as coaches and mentors to action team leaders.

The CI Forum was a place for everyone to increase their capacity for leadership.

We chose the word "Forum" carefully. Originally this body was a group of managers for the refinery and we called it the "steering team." We saw that this was a theme of control and that this might kill the spirit and participation of those not in charge of doing the "steering." Instead we sought to make the Forum a place for dialogue, and to minimize hierarchy.

We hope to commission a learning history project in the near future that will include inquiry into the leadership aspects, particularly the "emergence of order without control" by inspiring people to follow the three simple rules.

Another aspect the CI Forum provided leadership on was vision. We created a "roadmap" (not described in this paper) -- to get from a commonly agreed starting point, our current reality, to where we wanted to go--our vision. At a celebration of three years of success in Feb. 1998, we reviewed progress on 7 key mindset and behavior competencies (figure 21) for the whole refinery and noted much progress towards our goals, even under the difficult circumstances of crude cessation at the end of 1998.

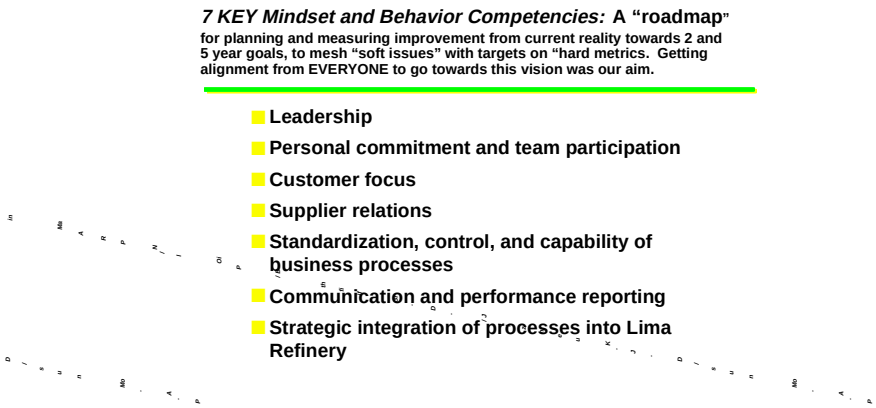


figure 21

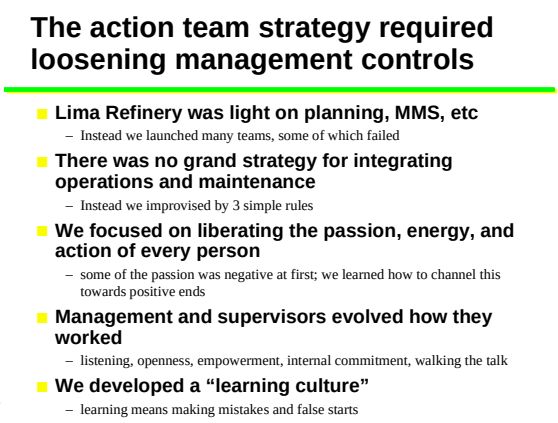


figure 22

At first we wondered how we might handle meetings with a large group (typically 30 people would attend CI Forum meetings). Another surprise is that we had no trouble with this at all. In fact the large size of the CI Forum contributed much to the diversity of our thinking, reflection, and taking it back to those not present at the meetings.

The power of reflection was another key surprise. We are action oriented, and typically had not spent much time in collective thinking, building shared meaning. Taking 8 hours a month to stop doing and get together to think as a big team (30+ people) was something new.

We believe that what was going on was "going slower to go faster" where the team would later find themselves doing things in a much more coordinated and aligned way, for no apparent reason. In a sense this is what some have called "chaordic leadership."

Much more could be said about the CI Forum, but we can't take more space for this in the paper; suffice it to say that it was highly significant to our success.

Lima Refinery was able to delegate much more responsibility to lower levels in the organization for vital business decisions than typical in our plants—some of this is credited to the leadership of the senior team in the refinery, but some of this is also due to the development of a shared mind on the issues, so everyone could take action with the same mental models and goals.
The refinery developed a "learning culture." This includes a willingness to try new things, to change, and to make mistakes and false starts. The key is to learn from these and avoid repeats.

Instead of having "sheet music" for everyone to follow, we were more like a jazz combo, which improvised within a simple structure. The three simple rules (figure 18) were a replacement for a "grand strategy" for integrating operations and maintenance. We were light on planning, continuing what had been in place already, but not focusing on this as DuPont and some sister plants within BP were doing. Instead we launched many action teams and hoped they would create benefits themselves.

Many of these action teams failed, but we learned from these failures. Out of this emerged a more powerful capacity than we would have created had we followed the traditional approach for improvement.

It was risky, in the sense that it depended on the passion, energy, and action of people who in the past had not contributed as much as we needed now. Some of the passion emerged as negative energy at first; management had to learn to channel this towards positive ends by stressing we had common end results in mind, and testing new approaches. Managers and supervisors had to evolve how they worked in many ways.

We are not sure what really had the most impact on our ability to manage in this "chaordic" manner. Was it the crisis evoked by the threat of closure? How important were the natural talents of the people who were in positions of leadership? What things helped move us to embody the new paradigms for collective leadership? Why and how were we able to make the switch from the old "simple rules" to new mental models embodied in the simple rules for proactivity in figure 18? Probably all of these questions are important; we will be studying these factors in a new learning history we are just now starting, to reflect on the past three year's work in more depth.

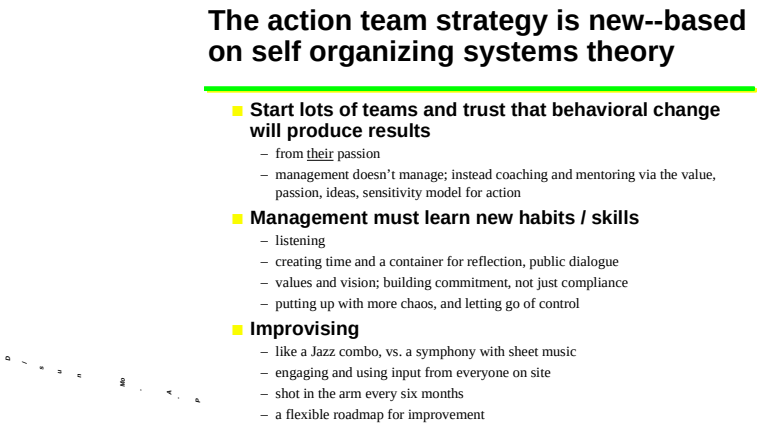


figure 23

Figure 23 summarizes the main features of the action team strategy. A key is to recognize that some loss in yield may be required (action teams that don't succeed) against the "control and manage the teams" approach to assure they do something. But the tradeoff is well worth it in the sense that teams that do increase their capacity to produce results important to themselves will have an ongoing ability to continue doing this, whereas a managed team will tend to do only what they are directed to do (a "shifting the burden" structure).

Accelerating the Traditional Approach

Traditional approaches to reliability have focused on predicting, planning, scheduling, coordinating--all the aspects of getting firmly into the planned domain. These activities all take a large amount of organizational energy and expense. And as discussed earlier the traditional approach is primarily focused on dealing with the known defects more efficiently, more than preventing new and unknown defects from getting in.

Another concern with the traditional approach is that it tends to be maintenance centric—people often forget that the largest source of defects is from a lack of operational discipline, and that redesign may be a key issue. The action team focus (which is fundamentally cross functional) reinforces the notion that one must work on improving all parts of the system at the same time to succeed.

And instead of doing maintenance work better, the focus was not to do maintenance work at all.

We also found that action teams and defect elimination took a great deal of cost out of the organization. These savings could then be applied to the investment required for more traditional maintenance improvement approaches, creating a virtuous, self reinforcing process.

Having the right process to design action teams prior to the workshops, organize the management, and to improvise when necessary became a key requirement to make sure all of the positive energy and enthusiasm created by The Manufacturing

Game™ did not dissipate. The process for facilitating design and follow-up of action teams is not discussed in this paper, but there was a team formed to manage this for the CI Forum.

The importance of reaching front line supervisors

We focused on development and recognition for first line supervisors, and involving them in using positive discipline, an approach we called “MEP” for “Managing Employee Performance.” We found that many of our past change programs had not adequately supported or developed our front line supervisors, who in many cases felt not a part of either management or the workers. A number of development opportunities helped, and an action team was created to “improve the lot in life of the front line supervisor.”

As the evolution to higher domains progressed, we saw that we needed our supervisors evolving from “chief operators” to “coaches, mentors, designers, and breakthrough leaders for capturing commercial value.” We hoped they could see their vital role in leading action teams as a key competency.

It doesn’t work to involve just some of the people--engage the entire workforce

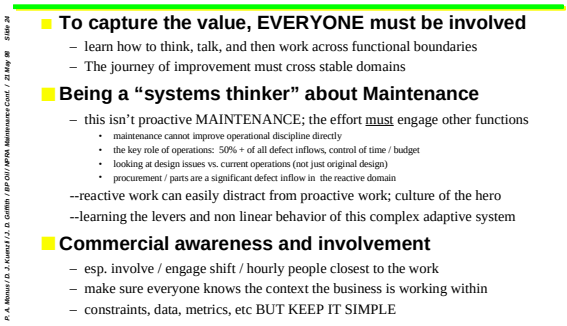


figure 24

Figure 24 notes the observation that Lima Refinery engaged EVERYONE in the processes and workshops, which upon reflection now is seen as a key success factor vs. some other sites pursuing a similar approach who did not do so.

We now speak of the "weak link theory" and the ease whereby we can backslide into a reactive mindset. To succeed required us to get everyone to learn to think, talk, and work across functional boundaries and know how to skillfully apply the three simple rules (figure 18).

We also think that getting EVERYONE to become more systemic in their orientation was important. The journey to proactivity is non-linear, and involves much more than just maintenance. We think that the Operations function plays a very key role in supporting and leading the work.

The benchmarking data and learning from the workshops indicates that the highest leverage in the system is in focusing on operational discipline and design, and then on quality materials in the storeroom and procurement areas. Building shared awareness and action based on these non intuitive systemic insights is key; the Manufacturing Game™ is a great way for people to learn these levers in a fun and "hands on" manner.

Beyond just learning where to focus, the workshops seemed to embed a commercial awareness and involvement in hourly people that had been lacking to some extent prior. Since these people are closest to the work and have major impact on results, raising the commercial awareness of these groups is important. Seeing the financial impact of my work and how what I do impacts the work and results of others can be a significant "aha" experience.

The key management input to this is CONTEXT for the business, with constraints, key challenges, metrics, etc given, but in a way that is clear and simple. Given the understanding and data, and allowed to be a full partner in the improvement journey results in much more

possibility for ALIGNMENT in implementation.

Another area of continued study is how these processes are contributing to increased levels of commercial awareness and involvement in hourly people.

We think that Winston Ledet's model for how Paradigm Shifts happen is involved (see figure 25).

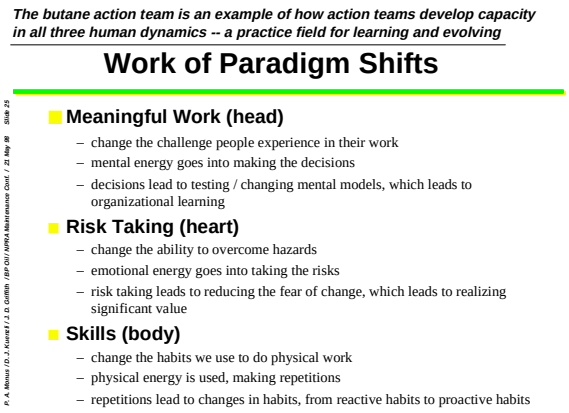


figure 25

Ledet notes that a paradigm shift requires having no objections in our head or heart, and then having the skills in our body to live in the reality we now see. This involves new habits to do the physical work, based on new insights and thinking (decisions based on the three simple rules), and willingness to risk for value (the emotional principle).

Once people experience the paradigm shift to new thinking and new behaviors in the environment of the Manufacturing Game™ learning workshop, the leadership challenge is make sure this positive energy does not dissipate.

To make the journey in the refinery requires learning how to "walk in two worlds" where the new paradigm is in mind while yet dealing with the consequences of the old paradigm in our interactions and work process. Think and be proactive even though I am forced by circumstances at times to be reactive. To do this individually, one must learn and change. To do this collectively is an essence of a "living company."

Arie De Geus (formerly head of planning for Shell Oil Company) describes what he calls "Living Companies" in his most recent book. In thinking about the Lima Refinery story, much of what Arie describes is present (see figure 26).

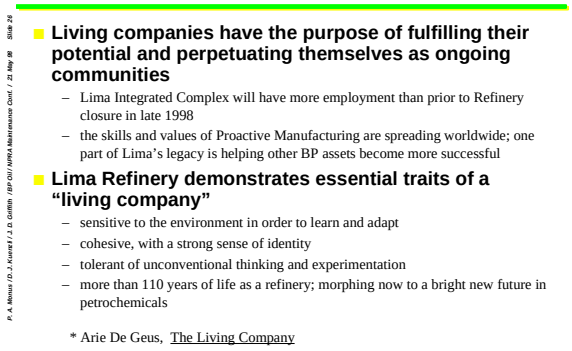


figure 26

With the announcement of closure of Lima Refinery in 1996, there was a lot of discouragement and frustration. But the organization did not just give up; instead new possibilities for the site emerged that have now given what was Lima Refinery a new lease on life as a chemicals complex. After crude cessation at the end of 1998, BP will invest over $100 million dollars in a new Butanediol (BDO) unit as the first step in a growth strategy that will use the skills and learning capacity of former Lima refinery employees.

It is projected that the new "Lima Integrated Complex" will employ more people as a Chemical Plant than would have been employed had the refinery not ceased crude processing. In addition, the skills and values of Proactive Manufacturing are spreading worldwide within BP, and the Lima legacy is one of helping other assets improve performance.

A community of learners has a purpose bigger than just making money. As Arie De Geus notes, *long range and sustained* financial success is the consequence of being a living company, rather than the goal.

This is a paradox in some ways. Is the purpose of commerce to make money, or something bigger than this?

We think that there is something bigger, and that it is based on creating value for society. Sustainable value, created in a responsible way, provides something that people can really buy into and help with.

This is part of all three simple rules: rule 1 (don't just fix it, improve it), rule 2 (focus on value, not cost), and rule 3 (maintain and enhance your license to operate). If society doesn't find that we are creating value for them in a responsible way, we lose our ability to continue running our business.

Susan E. Mehrtens and Margot Cairnes suggest in their 1993 book The Fourth Wave that society is on the verge of a major upheaval and that oil plays a major role in the evolution that will occur.

In times of discontinuous change, the only safety is in the ability to learn and adapt.

The "notable result" in the Lima story is creating a learning organization

P. A. Monus / D. J. Kuenzli / J. D. Griffith / BP Oil / NPRA Maintenance Conf. / 21 May 98 Slide 27

- **Lima Refinery found a way to "facilitate the emergence of order"**
  - re-engineering in 1994 created chaos and "unfreezing"
  - we succeeded in getting much greater engagement of the total workforce, but it was messy and we zig zagged up and down (progress, backslide, etc)
  - leadership evolved to enable and drive this change process, at all levels
  - systems thinking, dialogue, team learning, building shared vision facilitating new order to emerge, but via "a simpler way" -- "the 3 rules" , not via planning and control
- **The financial results were the consequence of becoming a learning organization**
  - learning is defined as "increasing our capacity to produce the results we truly desire"
  - the financial results were not the GOAL; the goals were results people truly desired, like continuing to live as a business, reliable equipment, responsible to the environment, and safety

figure 27

Viewed in this light, the "notable result" in the Lima Refinery story is creating a learning community, or "learning organization" which found its way in the midst of many troubles and rapid change. The financial results noted above ($0.77 per barrel improvement), the improvements in how work is done, and the ability to evolve all indicate this. The interesting part is that we did it with an "emergence" approach, based on simple rules, rather than an "order approach" based on control and planning.

It was messy at times, and it felt chaotic to be zig zagging up and down (in terms of perceived progress on the journey). Much of this was due to the uncertain nature of how people respond emotionally to threat and change. It took leadership to enable and drive the change process, but we also started with a great bunch of people who had a long history of excellence and were proud of it. Thus once we got started and were able to demonstrate that we were serious and that Proactive Manufacturing was not a "flavor of the month" the rank and file helped us.

What is a "learning organization?"

P. A. Monus / D. J. Kuenzli / J. D. Griffith / BP Oil / NPRA Maintenance Conf. / 21 May 98 Slide 28

- **A great team, with real synergy and personal care for one another, that creates a fulfilling place to invest your life's work**
- **A group of individuals who are pursuing the five discliplines which are the "art and practice" of a learning organization:**
  - systems thinking
  - personal mastery
  - mental models
  - building shared vision
  - team learning
- **A group of people who are continually enhancing their capacity to create the results they truly desire**

figure 28

Figure 28 gives our view of a "learning organization." We stress the importance of becoming a great team, and personal care for each other, which then creates a fulfilling place to invest your life's work. This work can become meaningful; this meaning comes from the value we create, both in terms of our products for customers, the

way we operate in society and the world (as leaders) and in our interactions in the plant.

During CI forum meetings in 1998, members have expressed feelings about how important these efforts over the past three years were to them personally and how much they learned from each other. Visitors and outsiders to the refinery have noted a shift towards a "knowledge based" organization (see figure 29).

The shift toward the "KNOWLEDGE--BASED" organization

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from Peter Senge / Fred Kofman

Task	Resource-Based Organization	Knowledge-Based Organization
Direction setting	Vision from on top	Shared vision
Thinking & executing	Top thinks; local acts	Thinking & acting merged at all levels
Nature of thinking	Atomistic Thinking	Systemic Thinking
Conflict resolution	Political Mediation	Dialogue & building shared mental models
Role of leadership	Make key decisions	Design learning processes

figure 29

Instead of seeing people as resources (like a machine) we sought to capture the full capacity possible by first designing learning processes to engage them with business context and better practices, the nature of our non linear system, and our various differing mental models about these. This then highlighted our need for dialogue about our differences to build shared mental models and eventually shared vision, so that when faced with daily small decisions we could apply the three rules skillfully--merging our thinking and acting in a way that a business owner would, rather than needing a boss to direct us.

Getting this down to the lowest levels was part of the breakthrough, as this liberated a lot of pent up energy and capacity that resulted in breakthroughs, and encouraged real commitment from everyone rather than just compliance.

It isn't easy to create or sustain a learning organization

We resisted the hunger for prediction, control, and quick fixes

P. A. Monus / D. J. Kuenzli / J. D. Griffith / BP Oil / NPRA Maintenance Conf. / 21 May 98 Slide 30

- **In the past many of our plans tended towards seeing our system as a machine rather than a living organism**
  - the danger is when people become treated like cogs in the wheel, like machines
  - we lose creativity, passion, and capacity to create breakthoughs
  - we lose the meaning in our work
  - striving for control and prediction can create overly detailed plans and many words which then get lost in the nature of reactive work
- **If an organization is a *living system* we cannot control it**
  - this isn't a happy recognition, just true; all we can do is perturb it and notice what happens, then adjust
  - we must focus on aspects of life and how fragile the ecosystem is; the organization is fundamentally made up of people, and is NOT a machine
  - Self organizing systems give birth to themselves; this is what being alive means, to regenerate and sustain our own life
  - giving birth is both an orderly and a chaotic process; the initiation of life comes from our passion, our desire to live on and produce what we truly desire

figure 30

It wasn't easy, and it was fragile for a long time. Management of the refinery resisted the temptation (which at times grew strong) to impose solutions and approaches, to establish more control, and to opt for quick fixes rather than long term value creation.

We think our ability to resist these temptations to backslide to old thought patterns and behaviors was supported by the belief that the organization is a living organism, rather than a machine.

Going deeper into theory about why this approach was effective

What follows in the paper from this point on is an examination of "why" what we did was effective. Some readers may not find this useful, as the concepts and tools used to articulate our thinking may be unfamiliar. But we decided to include what follows in the paper because we think it helps increase comprehension of the approach, and for those who are familiar with systems thinking and the learning organization literature it may be useful to compare our experiences with the theory.

So if you want to jump to the end of the paper, you could turn to page 24 for conclusions.

There are two key theory aspects we want to consider: Systems thinking about complex non linear dynamics in a living

system, and emergence of order without control.

Using systems thinking causal loop diagrams we articulated some of the key factors and forces that are involved in our "living system" that have to be operated interdependently to get the payback from the action team strategy (see figure 31).

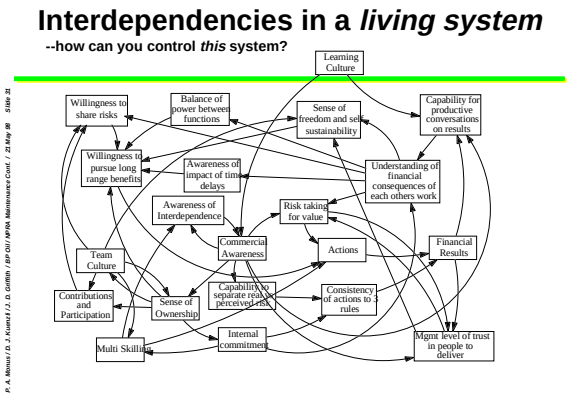


figure 31

Without even knowing what each factor is, or what other influences there are for each factor, one can quickly intuit that this is a system that is impossible to predict and control. Soft variables such as "willingness to share risks", "multi-skilling", "sense of freedom and responsibility" and "capability for productive conversations on results" all are fuzzy and hard to measure. Yet these are deemed important; some appreciation of these needs to be built, so leadership decisions can ensue that are helpful to the betterment of the system.

Since each decision is a test of decision rules and new situations require change, capacity to improvise and learn within the boundaries is more art than science.

Complexity theory suggests that one cannot control a living entity; instead all one can do is perturb it and then notice what the living entity does in response to the input. This isn't a happy recognition, as sometimes the system responds in undesired ways.

This gets back at the importance of the simple rules, and in getting everyone to follow them consistently. The organizational ecosystem is fragile and can easily become damaged; if we depend on the passion and willingness of people as a key driver in the change process, then we must manage and lead in a way that does not impair ongoing and sustained contributions from anyone.

Thinking about passion and how strange an idea this is in an "engineer culture" dominated society like a refinery which seeks and loves order, backup systems, precision, and certainty--one can see why the action team strategy is a perceived risk.

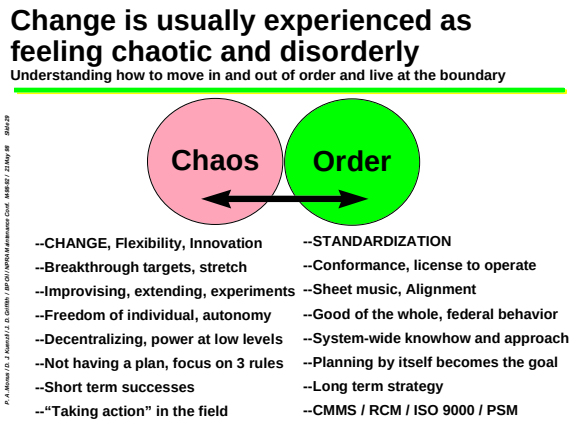


figure 32

No one likes change. So if change is needed, and esp. if one has to tolerate a loss of control, prediction and order to "unfreeze" our mental models for a while and then refreeze with new improved ideas for the new context, this is experienced by us as feeling chaotic and unpleasant.

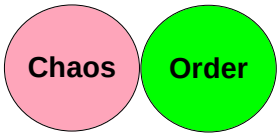
We (especially we who are engineers) like order, standardization, conformance, planning, prediction, and control. We argue that this is to maintain our license to operate (management of change processes limit change), and for the good of the whole. It is like sheet music, so everyone can share the same notes and maintain alignment.

All of this is good.

But to change is to venture into the unknown, be flexible, experiment, risk, and stretch beyond what we know we can do. Improvising, esp. when under pressure or threat, is not comfortable for most people.

The three simple rules form a conceptual framework whereby people seemed to be able to evolve a way to take action in the field without the sheet music, and stay pretty much aligned.

Conflicts in approach to change arise from being stuck *only* in order or chaos



"Don't Innovate, Obliterate" (Re-engineering)

"Let's commit to STEP CHANGE breakthroughs" (JMW)

"Let's pick the low hanging fruit, by finding high leverage actions" (Senge: systems thinking)

"Don't Innovate, Imitate" (Learn before doing)

"Let's use benchmarking data and continuous improvement to gain INCREMENTAL CHANGE of what we do" (TQM / ISO 9000)

"Let's invest to have top performing assets" (Pacesetter--Investment paradigm)

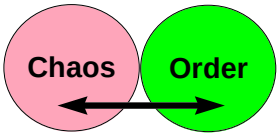
figure 33

Thinking about the need to unfreeze our thinking and then refreeze with innovative approaches suitable to new context explains some of the conflicts we experience with change (figure 33). It also explains the dilemma some feel between whether to pursue incremental change within an existing process or seek to create a step change breakthrough as the focus.

The answer to the dilemma is that it isn't either a step change breakthrough or incremental change for continuous improvement of what already is in existence--it is "both, and."

Dee Hock describes this ability to effectively and safely migrate from order into "chaos" and then refreeze with order again as a "chaordic" process--having the characteristics of both order and chaos at the same time, like living at the boundary.

It isn't "either, or" -- it is "both, and"
This what is involved in nurturing chaordic behaviors



We need to learn how to live at the interface, the boundary between chaos and order, and move freely in and out of chaos and order.

How to do this?
--NOT by a control and planning paradigm
--more by improvising in the moment, by owners of the change

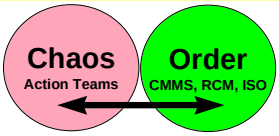
figure 34

This capacity to live at the boundary and nurture chaordic behaviors is a deep subject that still is pretty mysterious. What is clear is that one does not succeed by a control and planning paradigm. More likely, one succeeds by improvising, within some boundaries given by very simple rules (like in figure 18), by people who behave as true owners of the system and the change.

This helps us think about why the action team strategy has been shown to succeed at Lima Refinery and a few other places but as of yet is not widely known.

The strong desire for order and maintaining control explains our willingness to see the benefits of RCM, CMMS, and ISO 9000 or other organizational discipline processes, and have trouble believing that the action team strategy can work.

The action team strategy vs. the planned strategy



--In reactive domain, I don't have the time to do planned domain work first

--The focus is on eliminating work, stopping the inflow of defects (action focus)

--Use what I *already* know (root cause) rather than a lot of paperwork / study

--I have to give up control

--Trust people to do what is right

--Take the time to prepare for the future when the data will be needed

--Data (lots of it) is required; include all the data, not sure which will be important (data focus)

--Study failure modes of critical equipment / RCM discipline

--Maintain control: Design process and systems to "force" the troops to do the right things; cannot trust the troops

figure 35

The lesson from our experience is that to really be proactive means starting the journey to proactive behaviors and results ourselves before others have to impose change on us. Often the "solutions" imposed by others don't work, and are merely quick fixes that don't address fundamental issues.

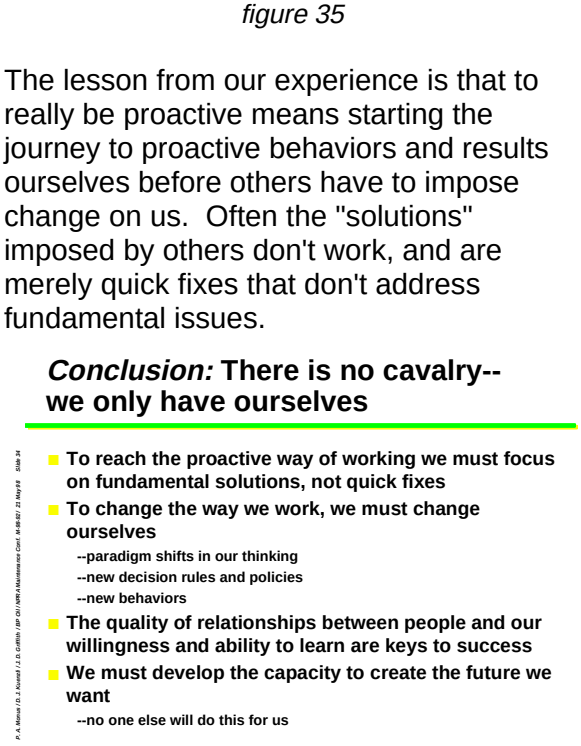


figure 37

Building up the unique learning culture that became our "organizational software" is something we should do out of aspiration, not desperation. We must focus on fundamental solutions, not quick fixes. To do this means we have to learn new ways of thinking and behaving, and adapt to change in a very fast and flexible way. No one else can do this for us, we have to do it for ourselves. And since we are a living system, we must focus on the quality of relationships and how we treat each other as key success factors. Learning how to nurture chaordic behaviors is a key leadership competency required to enhance our capacity to create the future we want.

We need to learn more of a sense of urgency for improvement; don't wait for the sheriff's posse to chase you. Start down the journey yourself. If not now, when?

The journey evokes meaningful work, higher morale for everyone, better decisions and actions. Everyone starts thinking and acting like an owner. But management must open themselves to the ongoing participation and shared leadership emerging from every level in the organization.

This can happen rapidly, but it is a series of small steps, going round and round the loops shown in the causal loop diagram in figure 38.

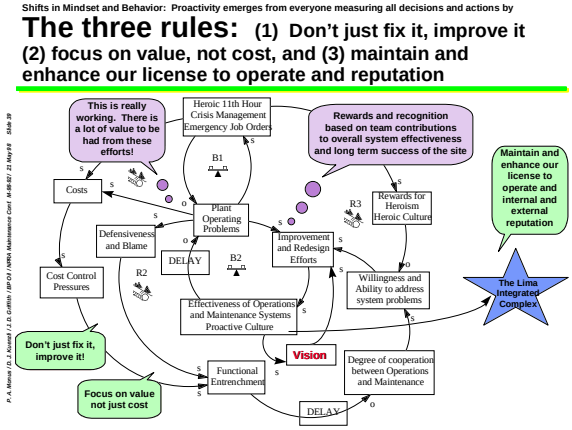


figure 38

Those without experience with systems thinking will not likely find this meaningful, but to us it explains a lot about what happened at Lima Refinery.

These ideas are spreading within BP. To date over 2000 people have participated in a proactive manufacturing workshop involving the Manufacturing Game™. Many assets have trained their own internal facilitators to run the workshops and facilitate the action team process within the business.

Spread of the *Manufacturing Game™* and Proactive Manufacturing within BP

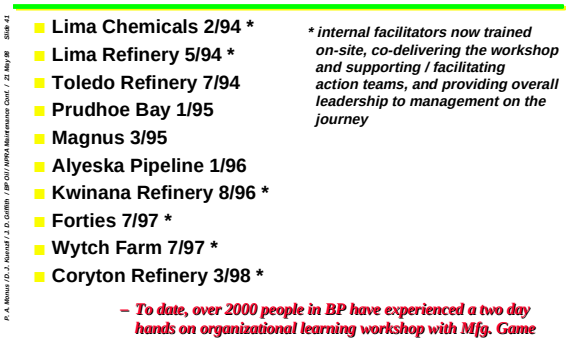


figure 39

Conclusions

Practice fields for learning are powerful enablers of large scale organizational change. Learning organizations are living systems, that function like any real community. So building learning organizations presents the same challenge as building real community.

Simple rules and the ability for everyone in the community to interpret the rules and skillfully apply them to new situations provide the essence of the "action team strategy" but to succeed requires leadership that can nurture chaordic behaviors. Supervisors and managers must evolve their ways, to be able to listen better, let go of control, to reflect and learn collectively.

In the turbulent times we are in now and likely to see in the future, taking action before we are forced by crisis to do so is wise. There are many reasons to begin.

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Summary of the paper: Proactive Manufacturing

The Proactive Manufacturing process at BP’s Lima Ohio Refinery has achieved very rapid improvement rates in plant reliability, cost reduction, production volume increase,

and quality improvement. Between 1994 and 1997 $0.77/bbl on crude were saved by these efforts, with minimal capital expense. This was achieved by engaging the whole organization in the work of defect elimination and proactivity.

These savings came by challenging mental models and developing new decision rules for action and integrating operations with maintenance. The “virtual world” of the Manufacturing Game™ is a “practice field for learning” that engages everyone from hourly craftsmen and plant operators on up to senior management, and has been a key driving force in creating the passion and system wide leverage necessary to achieve the rapid improvement rates achieved.

A new approach to improvement is emerging from this work, which sees the benefits as a consequence of becoming a learning culture, that functions according to very simple rules. Raising awareness and enabling "walking the talk" by new leadership skills and nurturing "chaordic behaviors" is key to the approach.

James D. Griffith (Jim)

Manufacturing Manager - BP Chemicals
Green Lake, Texas

Jim began his career with Standard Oil at Toledo Refinery in 1974 following his graduation from the University of Cincinnati with a BS Degree in Electrical Engineering. His earliest assignments were in refinery control systems, maintenance and operations. He served as Maintenance Superintendent and Superintendent for Oil Movement and Storage at Toledo before becoming Manager of Maintenance and Engineering at BP's refinery in Gothenburg, Sweden in 1988.

Upon his return to the states in 1991 he was the Manager of Commercial Operations for the Northeast Region of BP OUS. In 1994 Jim was named to the Ohio System Team as Manager of Plant Availability for the Lima site. He is now serving as Manufacturing Manager for the BP Chemicals Acrylonitrile facility at Green Lake, Texas. Jim is married to wife, Karen, and has three children ages 24, 20 and 8.

Donovan J. Kuenzli (Don)

Lima Refinery Manager--BP Oil
Lima, Ohio

Don began his career at BP Chemicals, Lima, in 1965 where he held various operational and technical positions, including Nitriles Plant Manager. In 1984 he became Plant Manager at BP's Green Lake, Texas facility. He joined BP Oil's Refining Department in 1987 as Operations Manager at the company's Alliance Refinery. In July 1990, Don began an international assignment as Business Technology Manager in the M&S Business Development Unit in London and later as Manager of the Technology Development Unit. Don earned a BS Degree in Chemical Engineering from Ohio University and completed the Tuck Executive Program at Dartmouth College. He returned to Lima in June 1993 as Site Manager and became Refinery Manager in November 1996.

Paul A. Monus

Senior Project Manager--BP Chemicals
Lima, Ohio

Paul Monus is on loan from BP Chemicals to BP Oil and is currently developing and implementing continuous improvement processes for BP Oil as part of the Pacesetter Refining Team.

He is involved with system dynamics, knowledge management, and learning organization pursuits within BP Group worldwide.

His prior experience includes operating and technical roles that cover a wide range of BP Chemical's US technologies including

-- Manufacturing Manager, Barex
-- Process Technology Manager, Barex
-- Area Superintendent Catalyst, HCN, Acetonitrile, Loading/Shipping
-- Area Superintendent Barex

Paul has a BS degree in Chemical Engineering from University of Minnesota.