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# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

## **1990 Ship Production Symposium**

### **Paper No. 2B-1: TQM for Survival**

U.S. DEPARTMENT OF THE NAVY  
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## Report Documentation Page

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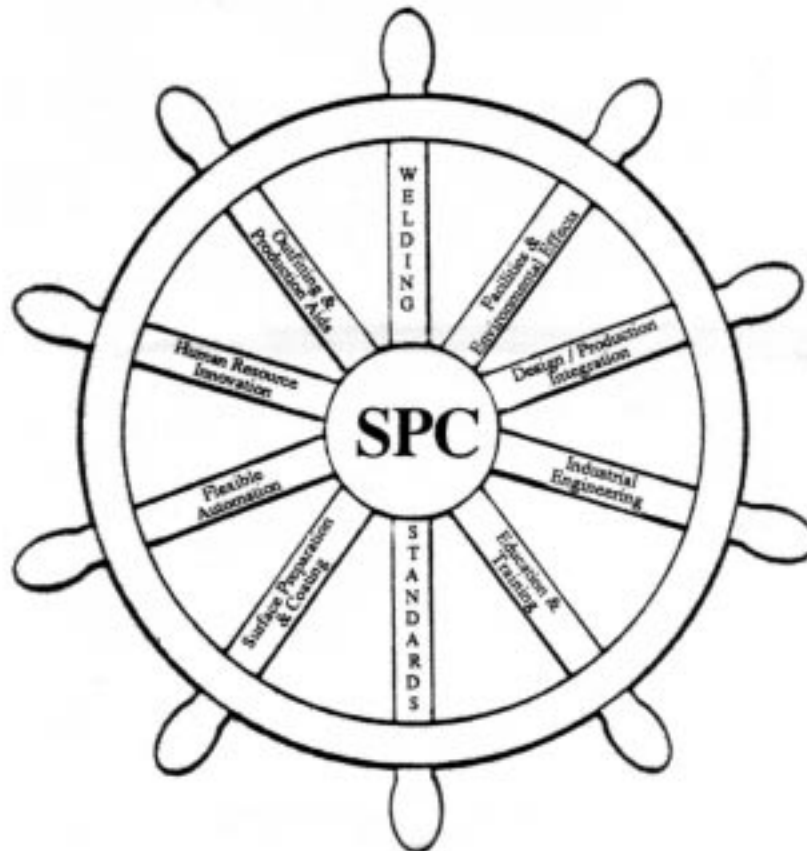
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## 1990 SHIP PRODUCTION SYMPOSIUM

Preparing for the 21st Century:  
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August 22-24, 1990  
Pfister Hotel  
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## TQM For Survival

2B-1

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### ABSTRACT

Naval shipyards face a declining workload in the nineties and beyond. Survival is a key issue. Total quality management (TQM) is one of the keys to survival. Being the best performer by focusing on customers' ever-demanding needs is the bottom line.

Portsmouth Naval Shipyard has developed a TQM effort that will allow us to improve performance, communicate more clearly, and focus on customer demands. Our TQM model requires committed leaders, involves training for everyone, and calls for the building of teams to break down the functional barriers. It includes teams making incremental improvements in all of their work processes and dramatic improvements in the vital few work processes. It also listens to the voice of the customer.

TQM is a long-term system of improvement; however, some results are already evident from working in this new way:

- Pipe weld radiography technique rejects have been cut in half.
- Shipboard power distribution testing has been improved by 600%.

Material inventory in one area has been reduced by \$5 million with no effect on customer service.

- Savings of \$1.4 million per year resulted from eliminating unnecessary technical instructions.
- Savings of \$61,500 resulted from applying the lessons learned from ship to ship on a new systems installation.
- Savings of \$1.3 million per ship resulted from improving the work processes on applying a special hull treatment system.

### TQM FOR SURVIVAL

Why TQM? Portsmouth Naval Shipyard is one of eight naval shipyards. All are involved in surface ship or submarine repair and overhaul. Our work involves only nuclear submarines. Portsmouth currently has about 8300 employees. We are the primary employer in our area; hence, many communities in Southern Maine and New Hampshire depend on our jobs. The yard has an economic impact in this seacoast region of three quarters of a billion dollars. The outlook for the next ten years can be seen from Figure 1.

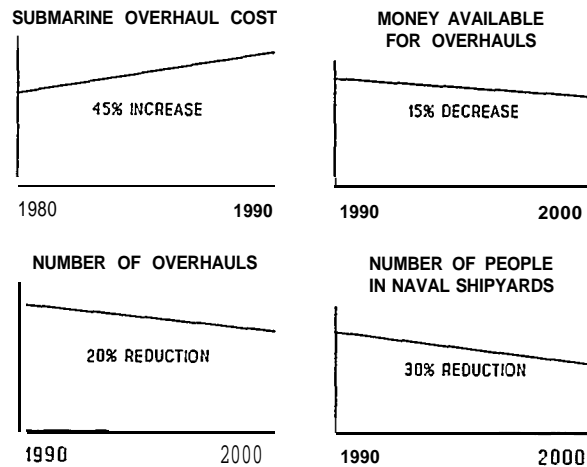


Figure 1

This makes the question "Why TQM?" an important one for this shipyard.

The answer is obvious: long-term survival. Survival in a changing world is not unique to shipyards. The automotive and consumer electronics industries are certainly good examples of survival and a changing world, and what can go wrong.

#### What's ahead?

John F. Welch, Jr., CEO of General Electric, sums it up very nicely: "Simply doing more of what worked in the

eighties . . . will be too incremental. More than that, it will be too slow. The winners of the nineties will be those who can develop a culture that allows them to move faster, communicate more clearly, and involve everyone in a focused effort to serve ever more demanding customers. To move toward that winning culture we've got to create a 'boundaryless' company. We no longer have the time to climb over barriers between functions like engineering and marketing, or between people-hourly,, salaried, management, and the like."

How does this fit with long-term survival and TQM? TQM is a major part of the cultural change we are trying to make to better serve our customers. Our TQM effort is customer focused. It involves teams to allow us to move faster, communicate more clearly, and break down the barriers between functions and people. TQM is not something in addition to what we already do. It is not another program for management to administer. It is the new way we will we operate-a never-ending journey of process improvement involving everyone.

Lessons Learned

When we went through the quality circle and improvement team cycles in the past, we learned some valuable lessons for quality improvement:

Top leader commitment is absolutely critical;

You must have a clear focus on process improvement in the organization:

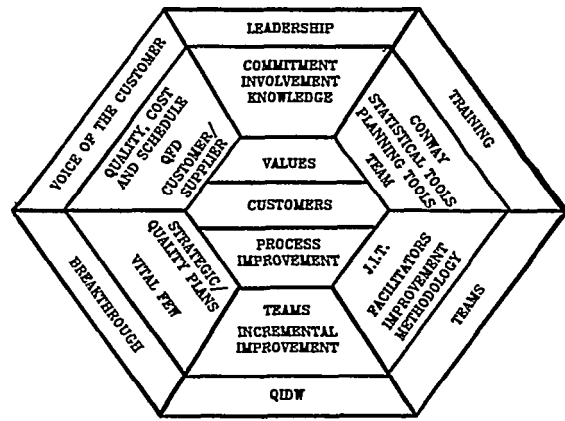
everyone must be involved, starting at the top.

Accordingly, we sought to employ these lessons learned in building our present improvement effort.

TQM MODEL

In the last two and a half years we have developed a TQM model (figure 2) that will help us see the huge and rapid changes that lie ahead as opportunities rather than as threats. Our model centers on customers, values, and process improvement. The model represents how we have developed and will continue to develop our TQM effort.

The model starts with leadership at the top. our first effort was to build a core of top leaders who were committed to lead the TQM effort. They had to get involved to show what had to be done. (People watch your feet, not your lips.)



PORTS MOUTH TQM MODEL

Figure 2

The knowledge required came through training, the next part of the model, which started with William E. Conway's course, The Right Way to Man-. Much of our TQM effort is based on his concepts. Training also includes the statistical charting tools, the planning tools, and how to function in teams.

Teams, the third part of the model, are the basic way we will operate in the future. They are the technique that best allows:

clearer communication;

- more rapid response;
- breaking down the functional and people barriers;

tapping the vast potential of our people.

our experiences show that teams must be supported by facilitators and just-in-time training in group dynamics and statistical charting tools and techniques. An improvement methodology serves two important purposes: (1) to keep teams focused on process improvement, not just problem solving; (2) to create a common language to more clearly communicate improvement.

The next part of the model, quality in daily work (QIDW), involves the teams in action, working on maintaining or incrementally improving the work processes. Day-to-day work is managed by facts. Statistical tools are used to reduce the variation in the work processes.

"Today's Leaders Look to Tomorrow," Fortune, 26 March 1990, p. 30.

<sup>2</sup>Produced by Conway Quality, Inc., Nashua NH.

Breakthrough is a key part of the model, since it involves meshing our strategic business plan with our Quality planning to determine which "vital few" objectives will get a large focus of resources and efforts to make dramatic improvements in the key work processes related to those objectives.

The final part of our TQM model, the voice of the customer, is mostly in the conceptual stage. Again, we will use teams-most likely cross-functional-to optimize the management of Quality, cost, and schedule at the shipyard level. In this part of our TQM model we want to build a system where every person knows their customer's expectations and is working to meet those expectations and create new ones.

#### PROGRESS IN IMPLEMENTING THE TQM MODEL

We began implementing each part of the TQM model as it was being developed. Our progress can be seen in the following overview of each part:

##### Leadership

- All the top and mid-level leaders in the shipyard have been trained in the basic concepts of TQM.
- Each of the top 30 leaders has finished leading at least one team through at least one improvement project.
- Approximately 30% of the leaders are committed to TQM.

##### Training

- Approximately 60% of the shipyard population has had TQM awareness training in the Conway concepts.
- Statistical tools training and team training are working well.

##### Teams

The just-in-time training of teams is very effective because training is delivered when the need to learn is highest.

More facilitators are being developed to meet the expanding needs of a growing number of teams.

- Our improvement methodology keeps teams focused on process improvement. It also helps build a common language for process improvement.

##### Quality in Daily Work

Over 300 teams have been formed to work on improving daily work processes.

##### Breakthrough

- The 30 top leaders have been trained in quality planning tools. They have developed a strategic business/quality plan that includes a mission, a vision, and objectives that focus our TQM efforts on the vital few issues.

Deployment of the strategic business/quality plan is under way.

Several top leader teams are working on major shipyard systems that will enable us to meet our vital few objectives.

##### Voice of the Customer

- Customer-supplier training has been developed and shown to be effective in a few areas.
- Key top leaders are being trained in quality function deployment to better understand how this tool can be used to support this part of the model.

#### CHALLENGES AND OPPORTUNITIES

There are at least five key challenges and opportunities in implementing our TQM effort.

1. We must continue to build the core of top leaders who are fully committed to TQM. We believe there are four possible barriers to top leader commitment.
  - a. Leaders feel that being committed to TQM is not clearly in their best interest. (Promotions, awards, and recognition are still being given to leaders who are not involved in TQM.)
  - b. They are not empowered with authority and resources.
  - c. They don't understand how to implement TQM.
  - d. They choose not to be committed to TQM.

These four opportunities for improving commitment will be pursued through continuing TQM education and through collecting data to identify which barriers apply to whom and then acting on the data.

2. Deploying our mission and vision (the strategic business/quality plan) throughout the shipyard and accomplishing the one- to two-year objectives that support our mission and vision are clearly an opportunity to work on the breakthrough part of our TQM model. These tasks also provide an additional opportunity to get top leader commitment and involvement.
3. A challenge for both management and the unions is to be full partners in the TQM process. In the future struggle for survival there will be little room for the waste that results from barriers between management and the unions. Both must move toward the middle to become partners in the TQM process if we want to use all of our efforts to survive in the competitive and changing world.
4. Another serious challenge is changing our basic systems and methods to allow everyone to think, work, and act according to our values. These values-excellence, treatment of people, teamwork, satisfying the customer, and continuous improvement-must be woven into every decision, every act, and every thought-by everyone. This is the culture that John Welch talked about in the Fortune article. These basic systems and methods, if not aligned with TQM, are as Welch says, "the barriers to clear communication, improvement, and teamwork."
5. The final opportunity is to develop the voice of the customer to complete our TQM model.

## RESULTS

The results of our TQM effort that can be measured at this time come mainly from the QIDW teams working on process improvement. Major improvements in processes will occur as we make breakthroughs. These breakthroughs and the improvements resulting from changes in our basic systems and methods (those affecting our values) will bring the

greatest dollar savings. We are almost at this point in our TQM effort.

Listed below are six examples of process improvements involving QIDW teams from quality assurance, engineering, supply, and production. These examples also represent a cross-section of leaders from first-line supervisor to department head.

### Radiographic Technique Rejects

The team that worked on improving the radiography process included the department head, all levels of supervisors, and workers.

Radiographic technique rejects increase costs and cause delays. The Pareto chart in figure 3 identifies sensitivity as the major cause of such rejects. It shows that the number of

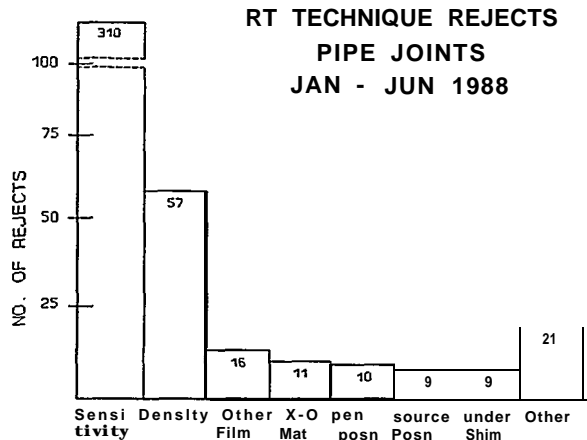


Figure 3

sensitivity defects was five times as high as the second main cause of rejects. All of the following processes that could affect sensitivity defects were studied by flow charts and cause-and-effect analysis:

- setting up and taking the shot;
- selecting the type of film;
- processing the film;
- interpreting the results.

Variation in these processes was reduced by making the radiographers aware of the variation and its effect on sensitivity. One change in the process was implemented after cause-and-effect analysis showed it could be a major contributor. The results are shown on the control chart in figure 4.

The plot on the left shows the process before the study was undertaken. The process had wide variation and a 21% average reject rate. The plot on

the middle shows that the variation was reduced and the average reject level was down to 14%. This resulted from studying the work processes and making the radiographers aware of the variation in the processes they used. The plot on the right shows the process after making a process change. The average reject rate is down to 10%. However, the variation needs work. One month was out of control due to a special cause-several pipe joints with configurations that were difficult to radiograph.

### Radiographic SENSITIVITY REJECTS

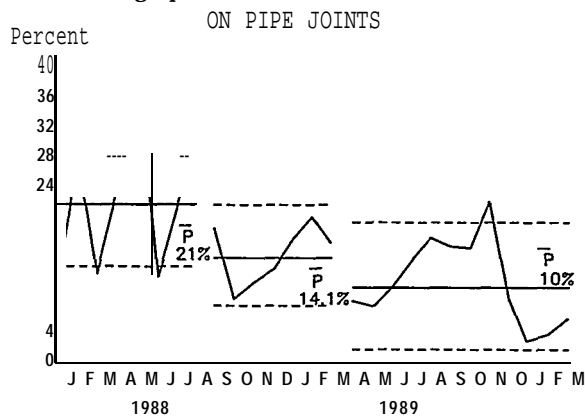


Figure 4

### Shipboard Power Distribution Testing

The production people who worked on shipboard power distribution testing felt there were many forms of waste in the testing process, so they formed a team with the engineering people to eliminate the waste. The team identified a number of sources of waste by brainstorming and then fixed the identified problems. Brainstorming showed the process contained:

- redundant and unnecessary steps:
- inefficient sequencing of operations;
- excessive changes in test procedures;
- delays in processing test procedure changes:
  - too many verification points.

The savings in time and elimination of problems can be seen in figure 5. As the number of instruction changes was reduced to one, the delays in processing changes were eliminated.

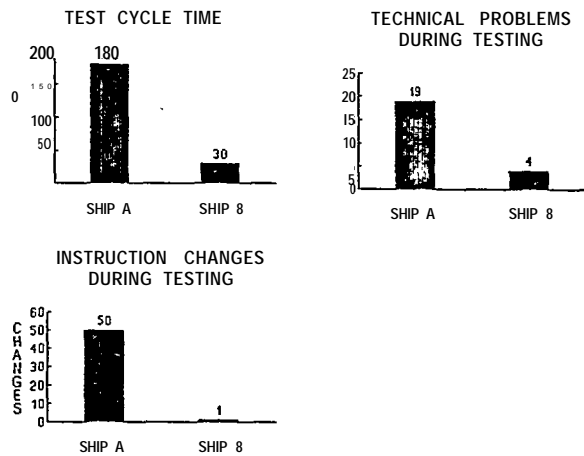


Figure 5

### Excess Material in Inventory

A team consisting of the department head and several levels of supervision identified excess material in our shop stores as a source of waste. Shop stores materials are consumables that are low cost, fast moving, and issued near the work sites.

The team's project involved flow charting the processes to see how they could be improved. The team was particularly interested in determining if there was a clear line of responsibility for controlling excess inventory. They also used Pareto charts to identify the best shop stores issue stations and then used those as models for improving the others. The results of their efforts are shown in the two run charts, figures 6 and 7. Material inventory was reduced by almost \$5 million without impacting customer service. Unsatisfied customer demands remained around 3% while the volume of business remained steady.

### Shop Store Material Inventory

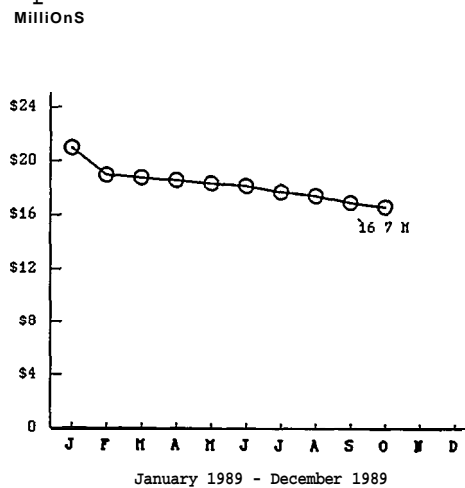


Figure 6

## Shop Store Material Issues January 1989 - January 1990

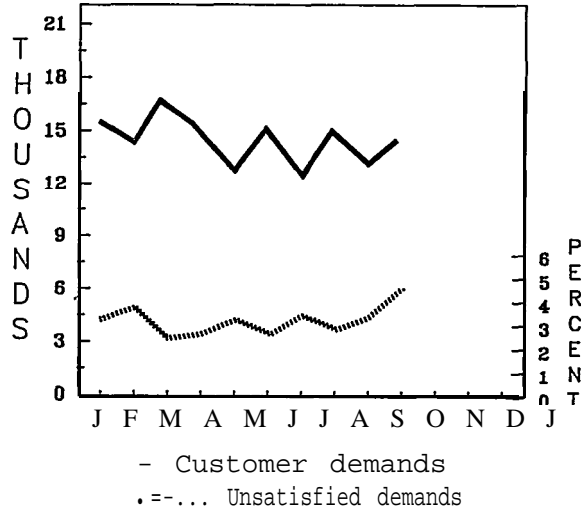


Figure 7

### Unnecessary Technical Instructions

People in the engineering division believed they were writing many unnecessary technical instructions. They formed a team with supervisors from one of the production shops to identify and eliminate the waste in the system used to resolve technical problems encountered at the work sites.

There are two ways for the workers or foremen to resolve these problems: either orally or by written request. Oral resolution is used when the problem is simple and requires no record of change. Written requests are used for all other cases. The cost of a written request ranges from \$500-\$900.

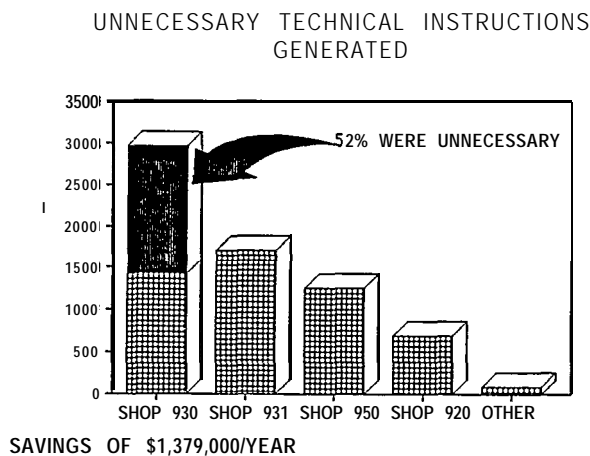


Figure 8

When the team collected the data from the shop with the most requests, they saw that many requests that could have been resolved by phone calls were written. They also found that material problems were being resolved by written request. Most material problems can be resolved on the phone.

The team used flow charts and training bulletins to educate the workers and leaders in that shop. Figure 8 shows the savings per year that will be realized when the system is fully implemented in this shop. The team is working with a second shop to identify unnecessary instructions and to ultimately eliminate them in that shop.

### Lessons Learned But Not Applied

A team of engineers, their supervisors, and production supervisors felt there was waste in repeatedly fixing the same problems from ship to ship. Typically, lessons learned on one ship are not always effectively implemented on the next, especially where new systems are involved.

The team focused on problems encountered in installing a new ship-board electronics system. They started by flow charting the process from planning to installation and testing, looking for waste and redundancy. Next, they categorized the problems that required technical resolution on the previous ship. Figure 9 shows the results.

### PROBLEMS REQUIRING TECHNICAL RESOLUTION

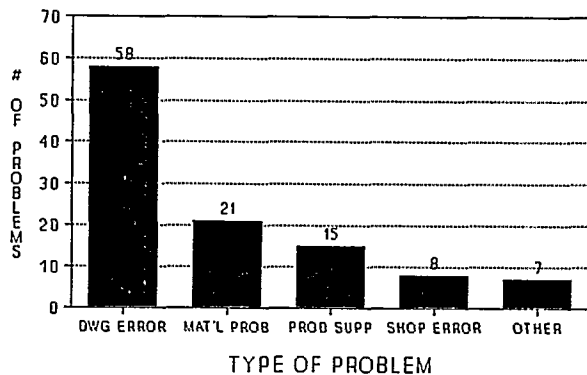


Figure 9

The root causes of those problems were eliminated. The teams then measured how well they were doing by counting the number of technical instructions generated at various phases of the work and comparing the number with those on the previous ship. A cost comparison was then developed, based on the average cost to generate a techni-

cal instruction (figure 10). Rework cost savings were not included, so cost savings are very conservative.

COST COMPARISON APPLYING LESSONS LEARNED FROM SHIP TO SHIP

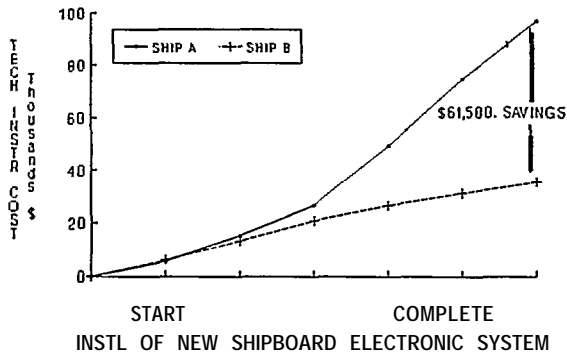


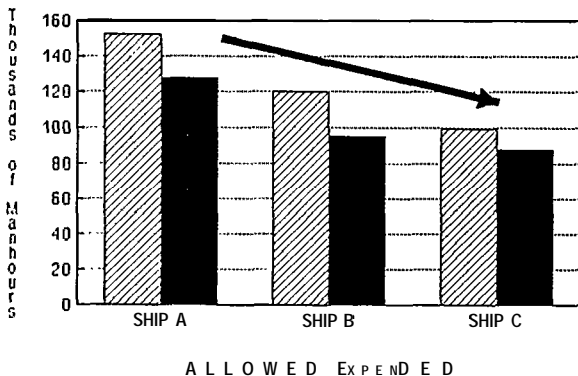
Figure 10

Special Hull Treatment Process

Special hull treatment is applied to most submarines during overhaul. The engineering and production people who design, plan, and install it decided there were many forms of waste in the whole process, so they formed a team to improve it. The team flow charted all of the work processes and collected data on what worked well on previous ships. From the flow charts and data analysis they:

- developed a more efficient installation technique;
  - changed the work sequence in a major operation;
- improved the blasting and painting process;

**SPECIAL HULL TREATMENT**



ALLOWED EXPENDED

SAVINGS OF \$1,306,600,

Figure 11

used a different configuration of work enclosures;

- developed a plan to more effectively use experienced people.

These actions resulted in the savings shown in figure 11 over three ships.

SUMMARY

Implementation of TQM is under way at this shipyard. We have a model that brings all of the elements together to focus on values, customers, and process improvement.

Values are the foundation for the way we will run our business. They are the goals of the cultural change we must make to foster TQM throughout our organization.

Customers--'internal and external--are the reasons why we provide products and services. No customers, no jobs! Obviously customers must be the center focus.

Process improvement is the way we use TQM to become more competitive. Improvements are normally made through teams of workers and supervisors. Teams break down functional and people barriers, promote clear communication, and allow people to reach their full potential. Teams must be empowered to be effective.

Savings are already evident. The greatest savings are on the horizon as we move into our breakthrough efforts, focusing on big improvements in the vital few areas.

TQM is the opportunity for survival. It's not an easy effort because it represents a huge change. Change is usually a struggle. Using change as an opportunity, we expect to ride on the TQM wave into the future.

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