*Special Feature

A "New" Quality Tool for Leveraging Human Resources on Large and Complex Problems

Greg A. Mann
Sandia National Laboratories
Albuquerque, NM

Problem

Many American companies, government agencies, and universities are finding they have to do things differently to survive in today's marketplace and economy. Quality improvement and meeting customer requirements are edicts coming from everyone's lips. But, the problem we face is going beyond the cheerleading rhetoric and putting these mandates into action. To meet the changes in today's environment requires the understanding and application of proven management and process improvement tools. From this viewpoint, the systems-level problem has two components: (1) how to most effectively combine the strengths of two proven quality tools, and (2) how to apply this "new" methodology to organization-level management problems.

This "new" quality tool is based on combining AT&T's Process Quality Management and Improvement (PQMI) methodologies with Quality Function Deployment (QFD) techniques for the analysis of a complex policy management issue. This case study illustrates how a large team (approximately 45 people) in the U.S. Department of Energy (DOE) used this methodology to improve a critical management communication process.

This methodology provided the analysis framework for determining the action required to design a new *directives system* within the DOE.[1] The *directive system* was not working; it was broken by all performance measures. At the very least, the *directives system* had lost all credibility as an effective communication management and policy-making tool. Senior management had lost confidence in using the system and were routinely using other means to bypass it. Individuals in the field questioned the feasibility of the published guidelines because the instructions were often of questionable relevance, extremely expensive to implement, or took control away from the individuals who best understood the intricacies of field operations.

When an organization's communication process breaks down, the efficiency of the organization is seriously jeopardized and can result in substantial misuse of scarce human resources. People are no longer doing the *right things right.* In this instance,

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* This is an invited paper by Greg A. Mann. Mann is a Senior Member of the Technical Staff at Sandia National Laboratories in Albuquerque, NM. He is also a consultant and instructor with the Productivity and Decision Analysis Group. Mann specializes in organizing and facilitating large teams and adapting various process improvement techniques necessary to resolving complex problems.

Parts of this paper were presented to the Strategic Management classes at Sam Houston State University during the Spring, 1993, semester.

1 *Directives* may be known by other names, for example, *corporate procedures, company regulations, operating instructions*, or *policy standards* to name a few common labels.

and typical to similar cases when communication fails, there was considerable waste, scrap, and rework of human effort because of the inefficiencies in the current *directives* process. The communication process was perceived by most everyone as a one-way process, top-to-bottom. Because of the complex and varied operations across the department, the requirements passed down by this process often failed to fit the situation. In other words, field operations personnel did not understand the senior management's requirements, and at the top levels, senior management did not understand how best to ensure proper execution of the field operations.

Written instructions are routinely used by large organizations for communicating management's polices into the day-to-day operational guidelines and practices in the organization. The DOE has approximately 300 directives which are costly to develop and to implement across 180,000 employees and operations that are geographically dispersed throughout the U.S. These directives or management guidelines cover a wide spectrum of activities from the mundane administrative issues to those that are essential to the management and safe operation of critical activities. For example, there are instructions ranging from parking lot procedures and smoking policies to assessing environmental risks and operating limits of nuclear power plants.

Background

The methodology presented in this paper is based on the quality principles taught by Dr. W. Edwards Deming, the founder of the new economic and industrial era, and Dr. Yoji Akao, Japan's leading Quality Function Deployment (QFD) expert and teacher. Deming's 14 principles of quality management provide the overarching framework for total quality management programs. QFD is most frequently used to define customer requirements, identify and resolve conflicts between requirements, develop performance measures and prioritize areas for improvement opportunity. To understand the development of the "new " methodology and to appreciate its strength requires a general understanding of the two underlying methodologies: PQMI and QFD.

• PQMI. Process Quality Management and Improvement (PQMI) is based on Dr. Deming's work at Florida Power and Light in the early 1980's. FPL successfully applied Deming's principles and was the first and only non-Japanese company to win the Deming Prize for Quality. AT&T studied FPL's quality program and developed their own version of the quality improvement process - PQMI.

PQMI is based on the premise that all work is part of a process. Deming's influence is strongly seen in the emphasis that the worker is motivated to do good work. Therefore, when poor quality products or services are produced, we should not blame the worker, but management should be held accountable. For management to be successful in a total quality environment, it must yield the authority and accountability for quality to the workers who are most knowledgeable about the process. This is the essence of PQMI. Let those individuals who best understand the process decide how best to improve the process.

The PQMI methodology is broken down into seven steps for investigating a process and deciding where process improvements should be made. The steps are:

1. Establish process management responsibilities. This step identifies both the process and someone who is most knowledgeable about the process. This

process owner is also the individual that is accountable for the performance or process outputs, and is capable of making changes to the process.

2. Define the process. This includes identifying suppliers and process inputs, and identifying customers and process outputs. There are frequently several stakeholders with numerous interfaces involved in the process. A flowchart is often a useful means of understanding stakeholders responsibilities and graphically illustrating the relationships between activities.
3. Define and establish performance measures. This step requires a good understanding of how the process is satisfying customer requirements and internal business objectives. These measures are best developed through direct interview with the customer where possible.
4. Assess conformance to customer requirements. This is a gap analysis that compares process outputs (step 2) to customer requirements (step 3) and identifies potential problems in meeting customer requirements..
5. Investigate process to identify improvement opportunities. Once data is collected, the analysis turns to understanding how process problems have adversely affected customer satisfaction and turning these problems into opportunities for improvement.
6. Rank improvement opportunities and set objectives. After identifying improvement opportunities, the team needs to establish a priority for each improvement opportunity based on the impact to customer expectations.
7. Improve process quality. This is the implementation step which provides a structure for carrying out the corrective actions necessary to achieve process improvements.

• Quality Function Deployment (QFD). Quality Function Deployment is a systematic approach for planning and decision making that can be used throughout the product or service realization process. It is driven by customer needs and is characterized by the use of crossfunctional teams and the application of graphical tools to aid and document decisions. The QFD team translates customer needs and requirements into appropriate company or technical requirements at each stage of the project. The methodology stresses understanding customer needs, focusing effort and resources on the most important customer needs, and communicating or deploying customer needs to all organizations involved in providing the product or service. The structure QFD approach consists of five essential steps:

1. Identify customer needs. Customer inputs are needed if the product or service is to be based on customer needs. Ideally, the "voice of the customer" is direct. If customer inputs are not directly available, the team will need to validate "assumed needs" for QFD to be truly effective. In QFD jargon, customer needs are sometimes referred to as the "Whats."
2. Rank the priority of customer needs. The customer focus is further emphasized by gathering and validating customer perceived priorities. It is important to recognize that if there are various customer groups, the team should maintain a connection between the need statements and priorities and the particular customer.
3. Identify performance characteristics or "customer satisfaction measures." This step focuses on the things or actions that the company or organi-

zation can do to satisfy the customer needs. These performance characteristics can, in general, be described as things that the organization can control, characteristics that are quantifiable or measurable, and characteristics that do not dictate solutions to the problem. In QFD jargon, performance characteristics are sometimes referred to as the "Hows."

4. Map the performance characteristics (i.e., customer satisfaction measures) to the customer needs. The team determines the relationships between the performance characteristics identified in Step 3 and the customer needs. A mapping matrix organizes large groups of information in order to graphically display the logical relationships or correlations between the "Whats" and "Hows" (i.e., House of Quality). As the team examines each cell of the matrix they also must decide on the importance or correlation strength of each relationship strength relative to every other - strong, medium, weak, or none.
5. Identify the most important performance characteristics. The team determines the value or importance of each of the performance characteristics in addressing or satisfying customer needs. This importance is determined by combining the customer priority for a need with the relationship between the customer need and the performance characteristic. The performance characteristics that are strongly related with high priority needs are the most "important."

After completing the above steps, the team must ask themselves: "Does this make sense?" This is a common sense or intuition based sanity check of the process that is extremely critical before going further. It also checks team member "buy in" before transitioning from the "problem analysis" phase to the "problem fixing" phase of a study.

• The "New" Quality Tool. From comparing the two quality tools, it is obvious that there are overlaps and similarities between the PQMI and QFD. Additionally, from experience in applying the tools, it becomes clear that each tool has shortcomings and as well as strengths. These shortcomings are especially apparent when challenged with improving large complex systems level problems. Since neither tool alone provides a complete solution and both have contributing strengths, the answer becomes obvious: *combine the two to develop a "new" robust quality tool that eliminates the overlap, minimizes the deficiencies and maximizes the strengths of each approach.*

Approach - How to Apply the "New" Quality Tool

The "new" tool requires a name. Therefore, from its heritage, it takes the "*process analysis* " techniques from PQMI. It takes the voice of the customer and "*improvement deployment*" techniques for comprehending complex issues from QFD. Thus, with some liberty, the "new" tool is referred to as the Process Analysis and Improvement Deployment (ProAID) methodology.[2]

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[2] Note the word "quality" is not in the title of the ProAID methodology. Why? It is the author's contention that, rightfully or wrongfully, the word is overused, hackneyed, and people are "jaded" by the use of the word "quality." This is particularly the case at the lower levels of

The ProAID methodology is based on a four step process: (1) System definition, (2) Requirements analysis, (3) Developing systems-level critical requirements and system redesign, and (4) Implementing Improvements. The fours steps of this new "tool" is supported by several subtasks.[3] Each step of the ProAID process is discussed in context of its application to the *directives system project* case study.

1. System Definition
   - identification of the system owner (PQMI)
   - description of the current system using a process flowchart (PQMI)
   - identification of the system users or customers (PQMI and QFD).

The system owner is the single individual that coordinates the multiple functions and activities of interrelated processes and is ultimately accountable for the effectiveness of the system if implemented as defined. The system (or process) owner must have the authority to change the system across organizational or functional boundaries with agreement from these organizations. In the *directives* project the system owner was a mid-level manager who was given control and accountability for the redesign of the *directives system.* In the *directives* project, three subsystem teams (development, coordination, implementation) were formed to define the existing *directives system* activities on a flowchart for each subprocess. The three subsystem flowcharts were integrated into one flowchart that described the entire *directives system* as it existed before any changes were made.

2. Requirements Analysis
   - identification of customers requirements (PQMI and QFD)
   - prioritization of customers requirements (QFD)
   - definition of performance or satisfaction measures for prioritized customer requirements (PQMI and QFD)
   - determination of relationships between all customer requirements and all performance measures (QFD)
   - assessment of current system's ability to meet customers requirements (PQMI and QFD)
   - identification of the most critical performance measures (QFD)
   - translation of most critical performance measures into the most critical system requirements.

A basic premise of the DOE *Directives System* Improvement Project was that the new system must meet the major requirements of the key users (customers) of the system to ensure acceptance of the system. There were five distinct customer groups of the *directive system.* They ranged from the Secretary of Energy and his senior staff to the field level staff and technicians. Each customer brought their parochial positions to the study. This caused real, as well as emotional conflicts with expectations of the new *directives system.* It was necessary that team members represent their organizations and therefore consensus building among the team members was an ongoing activity throughout the project. Consensus building required the involvement and

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an organization where action speaks louder than words. The workers in an organization are motivated to do "quality" work and the use of the term in reference to their work processes may be perceived as blaming.

3 The parentheses identifies each step of the analysis task as originating as either a step from PQMI or a step from QFD.

active participation by all affected organizations with points of contact identified for each. It also required an aggressive communications plan to inform and enlist support from all levels of the user/customer organizations.

Each customer group developed their respective set of requirements. This resulted in a combined set of 182 customer driven requirements, needs, or expectations of the organizations's *directives system.* Representatives from each of the five identified customer groups met independently to analyze and consolidate this larger set of requirements. Each of the five customer groups were tasked to limit their requirements to ten and to rank them in priority order. Thus, the 182 base requirements were reduced to 50 prioritized customer requirements. The 50 requirements were analyzed and the subsystem teams developed performance measures that allowed the system owner to know when the customer requirement is satisfied. This resulted in 33 specific performance measures of customer satisfaction.

Each of the performance characteristics and the associated performance measures were compared to all the prioritized customer requirements. This resulted in a 50 x 33 relationship matrix (ie., House of Quality). Relationships between requirements and performance characteristics were assessed as either strong, moderate, weak, or none. A numerical value was associated with the relationship strengths and resulted in an overall relative importance rating for each performance characteristic.

The performance characteristics with the highest importance ratings were candidates for becoming the most critical performance characteristics for a new *directive system.* These semi-quantitative results were subjected to the common sense test and scrutinized on the basis of "Do they make sense?" This resulted in the project team's consensus on the twenty most critical performance characteristics which were translated into the twenty most critical system requirements for the new *directive system.* The identification of systems-level requirements now provided a solid basis for changing and improving the *directives system.* Thus a new system, with these improvements implemented, provides the greatest opportunity of satisfying the greatest number of system customers.

3. Critical System Requirements and System Redesign
   - focus cross-functional Quality Action Teams (3-5 people) on the most critical system requirements (PQMI)
   - identify improvement opportunities and action plans (PQMI&QFD)
   - define the components of the new or improved system (PQMI)
   - design flow chart for the new system that connects critical system requirements (PQMI)
   - develop the new system based on solutions to critical system requirements (PQMI).

Twenty quality action teams were formed to develop candidate improvement solutions (or fixes) to each of the 20 most critical system requirements. Since the teams worked independently and in parallel to develop options, they used the larger combined project team meetings to validate their proposed fixes and to resolve trade-offs and interfaces with other action teams. Each quality action team was tasked to develop a component level flowchart for their activity. The 20 component flowcharts were integrated into a single systems-level flowchart. The new system identified the sequence of events, decision points, and key process steps, along with the system requirements they satisfied. This flowchart provided a graphical illustration that assured a consis-

tent end-to-end process for developing and coordinating, and implementing new *directive* requirements. Narrative descriptions and procedures were required to describe the specific process details for the operation of the new *directives* system.

At this point, it is critical that the results of the analytical, consensus-based, and customer-focused ProAID methodology are communicated to all system users. This is the highest risk element of the project: gaining consensus and acceptance outside of the project team from the larger organizational interest. This is when system users at all levels are afforded the opportunity to identify and accept the most critical system needs, the proposed solutions, and the new system requirements.

On the *directives* project, emphasis was placed on satisfying users and not just on concentrating on process requirements. It was accepted that it was not possible to develop and implement a directives system that met all the requirements of all the system customers. As a result, several system issues were too contentious and too difficult for easy agreement on a solution. They were deferred and will be addressed later as part of continuous improvement initiative. Considerable time was required to coordinate and resolve problems with the design for the new system, however, this effort was successful and the *Directives Requirements Document* was signed by the Secretary of Energy.

4. Implementing Improvements
   - establish schedules for near and long-term actions (PQMI)
   - prototyping and testing solutions (PQMI)
   - reviewing all existing directives in agreement to the new system.

The last step of the ProAID methodology is implementing the approved system. The implementation process must now consider other organizational issues such as culture, resource availability, and management support. Implementing large systems changes and dealing with these three organizational issues can be extraordinarily difficult. These constraints will greatly affect developing realistic schedules and action plans. Most of these issues should have surfaced during the coordination process with the organization and should not be a surprise. However, it is now time for decision and management must be involved. These organizational issues are best dealt with by identifying the decision criteria and ensuring that senior management participates, along with the system owner, in the analysis and development of a feasible plan for implementing major systems-level changes. Communication of this plan throughout the organization is extremely important to let everyone know what is happening and their role in the implementation process.

Other Considerations for Systems-level Studies

Some suggestions on the organization and logistics are discussed to help minimize problems when using ProAID methodology on large systems-level improvement studies. Some of the more significant issues are the formation of the project team, developing the project plan, using consultants/facilitators, meeting coordination and support.

• Project Team. The *directives* project team was chaired by a mid-level manager from the Office of Human Resource Management. This person should be a well respected risk-taker, willing to release considerable control to the project team, and willing to adopt recommendations out of the team. The permanent membership of the project team included representatives from several departmental elements and as well from all

levels of the organization. This wide spectrum of participation provides a wide range of viewpoints and is very important when working large organizational problems. The project team was supported by three 15-person subsystem teams with each responsible for one of three phases of the *directives* process: development, coordination, and implementation. Since a large team is often necessary to address all aspects of a large organizational issue, it is important to break the team up, if possible, into subteams (less than 15 members per subteam) to make the group size more manageable and more productive.

• Project Plan. A project plan should outline the study, and include the charter for the project, project leadership, team membership, expectations from senior management, scope of activities (i.e., what is within and outside of the team's authority), and identify deliverables. Large studies, because of the human resource requirements, are costly and require management's commitment to investing the effort. The plan should provide for periodic corporate management review and opportunities for study redirection, an organization communications plan, and a schedule for the approval of proposed actions by senior management. Periodic management review and communication feedback on progress to stakeholder organizations is critical to preventing surprises and obstacles in coordinating the final redesigned or new system.

The *directives* project plan divided the project into three phases: analysis of requirements, developing system corrective actions, and implementation. Eight monthly, 2-day team working sessions, were scheduled to complete the first two phases, analysis, and developing corrective actions for the *directive* system. The third phase, implementation, was scheduled for completion within 12 months after sign off on the design by the Secretary for a total of 20 months devoted to the project.

• Project Consultants/Facilitators. Because of the magnitude of the *directives* study, three consultants were required to support the various phases of the study and analysis. The consultants worked on behalf of the project leader and the three subsystem team leaders. The facilitators and leaders met prior to each exercise to review the process agenda, determine the objectives for the working sessions, and recommendations for resolving any teamwork related problems. The facilitators' role was to get the evaluation and redesign completed in the most efficient manner. They were responsible for the process and where constantly collaborating on the team dynamics and the ProAID methodology.

The importance of using outside consultants/ facilitators for large-complex issues cannot be overemphasized. As outsiders, they are responsible for moving the team through the ProAID methodology, and yet they are neutral on the content with no particular bias to the outcome of the new design for the system. They should be systems-level thinkers and capable of pulling the many disconnected pieces together into a complete system. For example, the consultants' major concern on the *directives* project was the reconfiguration of the numerous component activities and subprocesses into a new and coherent systems design for the new *directives* system.

• Meeting Coordination and Support. Meeting logistics were complicated by the large team size, coordinating the availability of team members, making travel arrangements, and consolidating the volumous data coming out of the meetings. The initial team was large because of many organizations with vested interests. The team size continued to grow as the momentum for the project was boosted by early successes and broad senior management support. The large team was both a problem and a

benefit. Progress was often slow because of varied viewpoints and extended discussions, however, the large team also provided the necessary resources required to address the numerous quality action teams. Availability of team members for meetings was fully never resolved because of individual schedule conflicts. However, by scheduling project team meetings three to four months in advance, the project maximized attendance and continuity in membership.

The most cumbersome support task was collecting "rough draft" data outputs from the meetings and transforming the material into useful charts, matrices, glossaries, minutes, and project deliverables. This is an essential task that can be greatly assisted by dividing the work among all participants with a single project "assignment" coordinator responsible for pulling the information together. On large projects, this "assignment" coordinator function can be a full-time function for the duration of the study.

Leveraging Human Resources

ProAID is a disciplined approach for investigating complex systems level processes and placing priority on the "Voice of the Customer." It is based on the formation of crossfunctional teams where team members each bring a different point of view to a problem. As such, it is a robust approach for developing teamwork, gathering and synthesizing enormous amounts of data, and identifying critical system deficiencies and greatest opportunities for improvements. Because all decisions are based on consensus and a fair amount of discussion takes place, people feel that all their interests are addressed, not always to their satisfaction, but at least their opinions are heard. This communication at the functional interface between two or more functions or organizations is critical. As people see the larger picture, individual concerns may not be as critical and some rationalization takes place.

The greatest advantages of the ProAID methodology is leveraging of human resources. For example:

- Communications tool. The four step methodology provides an analysis roadmap to team members. It breaks down large system-level problems into manageable phases and then logically addresses each phase of the analysis in detail by the sequence of subtasks. The communication process is further supported by the use of graphical tools that capture the various activities, relationships, requirements, and priorities necessary to develop a set of systems level requirements. This approach helps reduce the ambiguity and increases the understanding of interrelationships when dealing with many complex and interacting variables of a large problem. The graphical presentations not only leverage internal team-communication process between team members, but is also beneficial when communicating to decisionmakers and individuals outside the team.
- Handling large amounts of data. Teams can generate enormous amounts of data and without an effective means of capturing and handling this data, much effort will go to waste or become a major retrieval problem. The methodology provides a systematic means of handling and using this data to identify critical needs and performance characteristics. The data capture and storage process is supported by commercially available software. The software files can be manipulated, if necessary, and allows sensitivity analyses to be conducted by modifying either inputs, priorities, or relationship weights. These large data files are important in assisting the continuity in transitioning

from meeting to meeting, particularly when the meeting participants are not always the same.

• Increased Teamwork. The methodology helps large systems-level teams cooperate and communicate effectively. Since teams are made up of cross-organizational members who bring different perspectives to the problem, they will typically go through the "storming"phase. However, this methodology may help leverage the team's ability to move more quickly out of "storming" into performing and making positive gains on system improvements. The methodology provides a logical sequence of efforts and provides the team a systematic focus on the application of the team's resources.

• Emphasis on the customer. In general customer requirements are vague, incomplete, and often conflicting. The methodology is beneficial in developing explicit and measurable definitions of customer requirements. By clarifying and validating requirements and priorities with the customers, a team also demonstrates to the customer that they are concerned for customer satisfaction. In so doing, the team leverages its credibility with the customer.

• Resolving conflicts between requirements. Large systems studies often have multiple customers and customer requirements which may be in conflict with one another. The methodology accommodates each customer's prioritized set of requirements without bias. When all requirements are integrated through the relationships analysis, all customer requirements are given the priority assigned by the customer and the team does not have to directly decide which customer is most important. The methodology's relationship analysis and method of developing of the most important performance characteristics in a semi-quantitative manner avoids the subjective arguments over importance.

Summary

In summary, this case study presents the results of the application of a newly developed methodology for handling systems-level process improvement challenges presented by large and complex management problems. This quality tool breaks down barriers and leverages the talent of human resource in their quest for quality. The methodology is based on combining the best features of two quality tools: PQMI and QFD. The result is called Process Analysis and Improvement Deployment (ProAID). ProAID is a logical, customer focused, disciplined methodology that can be applied in a flexible, adaptive manner for the identification of critical system requirements. Once critical system requirements are identified, they are used as the basis for redesigning or developing a new systems-level solution to the complex problem. The methodology requires that the study team take chances with the four step process and in the application of the subtask under each step of the methodology. Systems-level problems typically present an overwhelming challenge when first assessed. However, the complexity of issues that are pervasive and run across all operations of a large organization can be dealt with effectively when broken down. This methodology provides a systematic approach to identifying sub-processes and looking at each in the context of satisfying customer performance on a limited number of critical system requirements.

References

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