Improving Reliability and Maintainability Through Process Management

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SUMMARY AND CONCLUSIONS

A recent study by the Scientific Advisory Board found that the Air Force spends approximately $2 billion a year on simple structural aircraft parts. Responsibility and management of these parts (fasteners, actuators, connectors, tools and subsystems, or FACTS) is spread across the Air Force major commands and weapon systems. In order to improve the reliability and maintainability (R & M) of these parts, and decrease the amount of time needed to acquire and provide the parts to the aircraft maintainers, the Acquisition Logistics Division FACTS Office (ALD/FA) was founded.

The FACTS Office acts as an advocate for maintainers by helping with the procurement of better parts. The office also attempts to change the systems by which the parts are acquired. By making permanent effective changes to the systems, the FACTS Office goal is to work itself out of a job. Several of the methods used to assist in this endeavor are summarized.

The FACTS Office has established an internal process using project teams, a sophisticated computer hardware and software system, and management support to improve the R & M of simple aircraft parts. This management system, though still in its infancy, was developed around the Total Quality Management (TQM) concept of process improvement. The successful implementation of this approach should provide a significant improvement in the way the Air Force acquires and supports these items. Already several projects have been completed successfully with both tangible and intangible savings identified.

1. BACKGROUND

The mission of the FACTS Office is to drive down costs due to FACTS related deficiencies, improve the quality of life of maintenance personnel, and improve FACTS R & M. The FACTS Office will accomplish its mission by improving existing processes to facilitate acquisition and technology transition of FACTS. Once the processes have been improved and the FACTS part problems can be easily corrected by the maintainer, the mission of the FACTS Office will have been successfully accomplished and the office will be eliminated. This milestone is currently planned for June 1998.

The existing processes and infrastructure that the Air Force uses today to acquire, maintain, and modify aircraft weapon systems generally work well in accomplishing their objectives. Yet, as AF weapon systems have become more complex, so too have the processes by which they are acquired and maintained. While technology of aircraft weapons systems has advanced significantly over the past 10 years, research and development of simple structural parts has not kept pace. In fact, "the rivets, bolts, nuts, electrical connectors, relays, hydraulic fittings, hand tools, and all the hardware that constitutes the mechanical infrastructure that holds aircraft together are almost the same as those that held together the B-17s and P-47s of World War II" (Ref. 1). A Scientific Advisory Board (SAB) study, published in September 1990, found that the Air Force spends approximately $2 billion per year in operations and maintenance (O & M), for fasteners, actuators, connectors, tools and subsystems, which equals to about 20% of the annual O & M budget (Ref. 1). Problems which drive this large expenditure include defective and counterfeit parts received in the field, excessive procurement lead times, proliferation of like items, and a slow, complex supply support system.

FACTS items have not received the management attention they deserve for several reasons. First, there is no single point of contact for these items in the Air Force. Second, the per unit procurement cost of these items is usually very low. Third, maintenance man-hours are not tracked in Air Force systems down to the individual part level. Hence, there was little visibility of the magnitude of the problems with FACTS parts.

2. THE TOTAL QUALITY APPROACH

Cultural Change

The SAB recognized the need to use the TQM model to make permanent changes in the way the Air Force acquires and supports FACTS. For such an approach to be effective, however, the cultural climate must change to provide an environment in which the role of management shifts from providing strong specific direction to an environment where employees feel empowered and are trusted to try new innovative ideas. Examples of the cultural changes required are outlined in Figure 1 (Ref 2.). Though all of the attributes listed are necessary to
establish a true TQM mind set, this paper will focus on the role of process management to improve the R & M of FACTS items.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>PREVIOUS STATE</th>
<th>NEW CULTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Style</td>
<td>Management style with uncertain objectives that instill fear of failure.</td>
<td>Open style with clear and consistent objectives, which encourage group-derived continuous improvement.</td>
</tr>
<tr>
<td>Jobs and People</td>
<td>Functional, narrow scope control-directed.</td>
<td>Management and employee involvement; work teams; integrated functions.</td>
</tr>
<tr>
<td>Customer Requirements</td>
<td>Incomplete or ambiguous understanding of customer requirements.</td>
<td>Use of systematically approach to seek out, understand, and satisfy both internal and external customer requirements.</td>
</tr>
<tr>
<td>Improvement</td>
<td>Acceptance of process variability and subsequent corrective action as the norm.</td>
<td>Understanding and continually improving the process.</td>
</tr>
<tr>
<td>Problem-Solving</td>
<td>Unstructured, individualistic problem-solving and decision-making.</td>
<td>Predominantly participative and interdisciplinary problem-solving and decision-making based on substantive data.</td>
</tr>
</tbody>
</table>

Figure 1. Examples of Cultural Changes

Managing the Processes

The charter of the FACTS Office is to improve/simplify the extensive acquisition, stock, store and issue processes so that the maintainers receive the right parts at the right time. In order to do this, there must be an effective and permanent change to the systems (Ref. 3) that control the provisioning of those parts.

Process management entails a change in the focus from end of the line inspection to analysis and management of the systems which produce the output. That is, rather than sending defective items back for rework (a band-aid solution), it involves tracking down the specific points (or subprocesses) where the defects originated, and changing the system. By gaining control of trouble spots of processes, variability of the end items is reduced and end of the line inspection can be eliminated.

In addition to analyzing processes in order to identify trouble spots, process management also identifies opportunities for process simplification. By analyzing the small functional units within processes, process analysts can determine which units add value and which ones can be eliminated or combined with others. The potential benefits of these process improvements are numerous. They can save time and money, and free up manpower for other critical requirements.

3. FACTS OFFICE

Establishment

The current state of FACTS parts is largely a result of the proliferation of items throughout the inventory, in concert with the lack of a responsible focal point for the systemic improvement of these parts. Solutions to these problems often fall below funding lines because of the low priority of these items. The impact is felt most in the field and at the depot where additional maintenance manhours are expended due to the inadequate R & M of these piece parts. The FACTS office is able to look across weapon systems and across major commands for trends and common items which require improvements (Ref. 4).

The FACTS Office was formed as an outgrowth of a process action team (PAT) established to find an improved blind fastener for the F-15 aircraft. People were brought into Wright-Patterson AFB from several locations to participate on the team, and were trained to use several quality tools and techniques. This effort provided the proof of the concept recommended by the SAB; an organization could be chartered to use TQM as the modus operandi to drive down the costs of FACTS parts and to improve their R & M. The results of this PAT were briefed to senior Air Force leaders who approved the resources necessary to form the office.

Structure

In order to maximize the potential of people with diversified expertise, and because one person rarely has the knowledge and background to tackle a complex problem alone, the organizational structure of the FACTS Office is based on teams. These teams are led by a project manager, who is the team leader, and have members who are maintenance technicians, engineers, and logisticians. Each team also has a facilitator assigned to evaluate the dynamics of the team and assist the leader in using TQM tools and techniques to identify, analyze and improve processes. The team is responsible for the complete conduct of the project whose recommendations are reviewed by management and implemented. This informal organizational structure, shown in Figure 2, utilizes teams to act as agents of change.

There are several other advantages to building a team framework into the organizational structure. Team members can act as a source of support for one another, something that can be crucial for long projects when things become difficult and enthusiasm can wane (Ref. 5). The use of teams also helps to break down barriers between staff areas. These barriers are caused by attempts to do horizontal work flow in a vertical organization, and can lead to voids and overlaps (Ref. 3). Teams which include people from different functional areas can more easily identify where the overlaps and voids exist, and identify opportunities for improving the processes.

The team concept is utilized not only within FACTS, but is expanded outward to our customers and suppliers. Process
improvement projects can often involve people from a multitude of functional areas. Some of the areas often included on a project are the flightline maintainers, base supply personnel, depot item managers, and even those outside of the Air Force, such as General Services Administration (GSA), Defense Logistics Agency (DLA), and commercial manufacturers. The FACTS Office will act as a facilitator to open up lines of communication among these diversified groups of people to assist in identifying areas for process improvement.

LOTUS NOTES® was selected as the groupware product and installed in the FACTS Office in March 1991. It combines database management, text search and retrieval, electronic mail, forms management, and allows for customized applications. Novell NetWare® was chosen as the software product to connect the office 80386 personal computers (PCs) because it is extremely robust. The PCs have Microsoft Windows Version 3.0 as the interface software which provides an extremely user-friendly graphic interface.

Figure 2. Organizational Structure

Tools

In order to implement quality improvement, the FACTS Office recognized very early the need for an effective communication system. Quality Decision Management (QDM), Inc., of North Andover, MA, was consulted to assist in the development of the requirements for such a system. Interviews were conducted with the potential users and a system specification was written. The system architecture selected is shown in Figure 3.

This system is designed around the new communications technology of groupware. Groupware is communications and networking software that enables people who are physically remote from one another to collaborate more effectively.

Groupware provides a structured system for cooperation, sharing of information, and continuous improvement (Ref. 6).

The LOTUS NOTES® groupware, which was modified by QDM to meet the needs of the FACTS Office, greatly enhances the effect of teamwork. Within NOTES is a series of databases which help the team members, management and other individuals to communicate quickly and succinctly. Other sections of the databases help to provide structure for strategic planning and to keep the office on track in terms of TQM goals. The FACTS Strategic Planning Forum, currently in development, will provide the vehicle to communicate the vision, goals and objectives to everyone. It will also establish a method to continually evaluate the achievement of objectives as a strategy for continuous improvement. Within the Strategic Planning Forum, objectives can be separately viewed by division, quality criteria, and year, and each will have quantitative criteria established to measure progress. Figure 4 is a sample view of the Strategic Planning Forum.

The FACTS Office also maintains a planning database referred to as the QUIPET (Quality Improvement Process Evaluation Technique) based on the eight quality criteria for the President's
Awards. Like the other databases this one is available to everyone and provides a way to propose changes to the status quo. The objectives in the strategic planning database are cross-referenced to the eight President's Award criteria to ensure systems alignment and constancy of purpose.

![Image of Strategic Planning Forum](image)

**Figure 4.** Strategic Planning Forum

All of the FACTS projects are maintained in the Projects database. This allows team members to have concurrent access to files and to receive the most up-to-date information without having to track down a paper file. Figure 5 is a sample of a Project File menu. Plans for the future include getting our customers on line with the project files which will eliminate the need for status reports and provide an immediate mechanism for them to give feedback on future plans of actions.

**Measurement**

In order to determine if the new way of doing business is in fact better than the old way, a method of measurement must be established. Metrics will be established to measure the project management process and will be automatically computed in the project data base. The main metrics are based on the milestone dates for various task functions in the life cycle of each project. These include dates of project receipt, project approval, task assignment, and the four project phases: investigation, determination, verification and implementation. Other metrics which measure the performance of the organization include the average number and age of projects in work. Control charts can be used to find variability in the processes and eliminate any unwanted special causes. Plans for future metrics include use of Time-Line® (a computerized method of project management) and "eye think" (a dynamic modeling tool) to determine the time savings when converting from a current process to an improved simplified one.

**Hurdles**

The FACTS Office is attempting to create and then function within a culture in which new ideas are welcomed, where the old style of business is challenged, and rank or position is not easily apparent. Attempting to establish a more open culture within a military framework is difficult and sometimes frustrating. Military operational units have a very definitive chain-of-command and well understood rules of engagement. In staff and support organizations, such as the FACTS Office, this is much less the case.

The FACTS Office has also gone through some growing pains. The number of people assigned has practically doubled in size within the last year, necessitating a great deal of training. Most of the new arrivals have had little, if any, TQM training. Most of the TQM training that is available is conceptual and needs little, if any, TQM training. Use of the computer network has also caused the need for extensive training.

Despite these hurdles, the process established to improve these simple parts is beginning to show results as the FACTS Office implements process improvement. The use of the computer network is accelerating rapidly. The teams are learning to function as a cohesive whole rather than as a group of individuals. Training is being received and modified to meet office requirements.

Approximately 95 projects have been opened to date with over 25% reaching successful conclusions. Though summary statistics for all of the projects are not available at this time, both operational and financial impacts have been seen. For instance an improved masking tape for painting aircraft was identified with a savings of $1.6 million in reduced maintenance manhours. Another example is the C-130 aircraft spring which is used to hold cargo pallets in place. Without this spring aircraft could not meet their full airlift capacity; something that was especially crucial during Desert Storm. The FACTS Office was asked to
intercede with the procurement of the spring and reduced the procurement lead time from a matter of months to weeks.

Still, the ultimate success of the FACTS Office will hinge on several factors. How well can the office satisfy their customers? Can the organization field new, improved parts and change the acquisition and support processes? Will management continue to commit to maintaining a quality culture? These and other questions remain to be answered as the FACTS Office continues its quest to improve R & M through continuous process improvement.

REFERENCES


4. FACTS Office Program Management Directive (draft)


BIOGRAPHIES

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Tim Sharp is a logistics manager with the United States Air Force. He has extensive experience in the acquisition and support of propulsion systems and training systems. He worked at Defense Electronic Supply Center and Oklahoma City Air Logistics Center prior to his assignment to Wright-Patterson Air Force Base in 1975. Since then he has held numerous positions in Air Force Logistics Command and Aeronautical Systems Division. Tim was also the Assistant to the Commander for Quality for the Acquisition Logistics Division. He is a graduate of The Ohio State University, the Air Force Institute of Technology and the Air War College. He is a Certified Professional Logistician.

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Cay Ervin is a logistician at Wright-Patterson Air Force Base. Her experience there has included the development of Total Quality Management within the Acquisition Logistics Division; assisting management with methods of implementation, and facilitating work teams. Prior to her current position she was a Research Associate with Anthropology Research Project, Inc., of Yellow Springs, Ohio. She has also been a practicing mental health therapist. Cay is a graduate of Wright State University with a M.S. in Human Resource Management.