Kennedy Space Center's NASA/Contractor Team-Centered Total Quality Management Seminar: Results, Methods, and Lessons Learned

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Introduction

It is apparent to everyone associated with the Nation's aeronautics and space programs that the challenge of continuous improvement can be reasonably addressed only by NASA and its contractors acting together in a fully integrated and cooperative manner that transcends the traditional boundaries of proprietary interest. It is, however, one thing to assent to the need for such integration and cooperation; but it is quite another thing to undertake the hard tasks of turning such a need into action.

Whatever else total quality management is, it is fundamentally a team-centered and team-driven process of continuous improvement. The introduction of total quality management at the Kennedy Space Center, therefore, has given the Center a special opportunity to translate the need for closer integration and cooperation among all its organizations into specific initiatives.

One such initiative that NASA and its contractors have undertaken at the Kennedy Space Center over the past six years is a NASA/Contractor team-centered Total Quality Management Seminar. It is this seminar which is the subject of this paper.

The specific purposes of this paper are to describe the:

- Background, development, and evolution of Kennedy Space Center's Total Quality Management Seminar;
- Special characteristics of the seminar;
- Content of the seminar;
- Meaning and utility of a team-centered design for TQM training;
- Results of the seminar;

- Use that one Kennedy Space Center contractor, EG&G Florida, Inc. has made of the seminar in its Total Quality Management initiative; and

- Lessons learned.

Background

During the period of NASA's Productivity Improvement and Quality Enhancement (PIQE) Program, Dennis Kinlaw designed a seminar for delivery to the Agency's civil servants called the Productivity Improvement and Quality Enhancement Seminar. In 1986 KSC asked Kinlaw to modify the seminar for delivery to NASA and NASA contractors.

Since 1986, The seminar has undergone a series of revisions. A major revision occurred in 1988 when the seminar was modified to focus on teams and team development. Since 1988 all participating organizations have been expected to send only teams to the seminar.

To date over 5,000 people and over 150 teams have attended the seminar. Participating organizations have included all NASA KSC organizational elements, Boeing Aerospace Operations; EG&G Florida; Grumman Technical Services, Inc.; Lockheed Space Operations Company; McDonnell Space Systems Company; PRC; Rockwell International Corporation, Space Systems Division; Rockwell International Corporation, Rocketdyne Division; TRW; Thiokol Corporation; and USBI. This year members of the U.S. Fish and Wildlife Commission on KSC's Merritt Island National Wildlife Refuge requested to attend the seminar and we have had two teams to date.

The various kinds of teams attending the seminar have included:

Intact Work Teams - groups of people from the same company or organization who daily work together and who, most often, have a supervisor or lead.

Management Teams - a manager and his/her staff and direct reportees including secretaries, deputies, technical assistants, etc.

Integrated Teams - members from various internal and/or external organizations that must work together across various organizational interfaces.

Project Teams - people put together to produce some specific product within a designated period of time.

Special Improvement Teams - quality action teams, quality circles, process improvement teams, TQM teams, etc.

Network Teams - people who work together, share information, participate in related tasks, but who may rarely see each other, e.g. the network of secretaries that link

together all sorts of processes and actions in organizations.

Committees and Councils - permanent and temporary groups like EEO councils, source evaluation boards, awards committees, child care committees, promotion boards, etc.

Special Characteristics of the Seminar

The seminar has a number of special characteristics. It:

1. is team-centered, i.e., designed for team-learning, team management, and team implementation.
2. employs trained facilitators with each team;
3. uses senior executives as presenters;
4. provides the opportunity to share information across multiple organizations;
5. requires pre-seminar preparation;
6. uses a process of team assessment and feedback;
7. uses input from teams having previously attended the seminar;
8. encourages post-seminar team action.

Team-Centered

The most important characteristic of the seminar is that it is team-centered. The meaning of team-centered is covered in a later section of this paper.

Trained Facilitators

Each team attending the seminar is expected to bring a facilitator who has been trained in the dynamics and content of the seminar. These facilitators have responsibilities before, during, and after the seminar.

Uses Senior Executives as Presenters

Each seminar starts with a presentation from a senior executive from NASA or a KSC contractor. The presentations typically serve the following purposes:

Demonstrates the commitment of the executive and his/her organization to TQM;

- Demonstrates the commitment of the executive and his/her organization to KSC's TQM Seminar;

- Provides participants with information about the implementation of TQM in the executive's organization; and

- Provides participants with an opportunity to ask questions and clarify their own understand of TQM.

Provides the Opportunity to Share Information Across Multiple Organizations

Another characteristic of the seminar is that it is designed to help participants learn about the progress of TQM in other organizations at KSC--beyond their own. The participation of senior executives from the various organization is one way that information is shared. In addition, on the second day of the seminar, presentations are made by a TQM representative from an organization (other than the one represented by the senior executive who presents on the first day).

Pre-Seminar Preparation

Participants are expected to complete several tasks before attending the seminar. They are assisted in completing these tasks by the facilitator assigned to their team. These tasks include:

1. Completing a set of questions related to TQM and continuous improvement;

2. Completing the *Superior Team Development Inventory* (Part 3);

3. Familiarizing themselves with the content of the seminar as described in the *Participant Notebooks*.

Team Assessment and Feedback

As indicated above, prior to attending the seminar, the members of each team complete the *Superior Team Development Inventory* (Part 3). The particular instrument that has been used has varied over the years, but from the beginning of the seminar assessment and feedback have always been a key element in its design.

Uses Input from Teams Having Previously Attended the Seminar

As the seminar progressed and developed its own history, we began to invite teams (that had attended the seminar earlier) to give a brief report of their progress since attending the seminar. These teams are asked to emphasize two key points: what specific improvement projects have been undertaken and what lessons have been learned.

Post-Seminar Team Action

During the seminar each team completes an *Action Plan*. The specific targets included in this plan are derived from the various exercises and activities that each team goes through during the seminar. These reports permit the progress of teams to be followed and periodic evaluations to be made of the effectiveness of the seminar.

Present Content of the Seminar

The core sessions of the seminar are:

I. TEAM-CENTERED TOTAL QUALITY MANAGEMENT

In Session I the need and payoffs from TQM are discussed. The Team-Centered TQM Model is introduced. Participants develop a common understanding of TQM.

II. KEYS TO SUPERIOR TEAM DEVELOPMENT AND PERFORMANCE

The Superior Team Development and Performance Model is introduced. Participants assess their work team's levels of team development and performance using the *Superior Team Development Inventory (STDI)*. They translate the results of their assessment into an improvement *action plan*.

III. SPECIAL TQM METHODS AND TECHNIQUES

This session introduces participants to several methods and techniques for strengthening team development and improving TQM performance. The specific methods and techniques covered will vary depending on current need. Example include, work simplification, statistical process control, rational problem solving, nominal group technique, assessment and measurement, and customer needs analysis.

IV. CONTINUOUS IMPROVEMENT AND MEASUREMENTS

In this session a Model for Continuous Improvement and Measurement is introduced. Teams participate in several exercises in which they identify opportunities for continuous improvement and develop measure for tracking these improvements.

V. PLANNING TQM INITIATIVES

Throughout the seminar, participants identify improvement opportunities. During the last session of the seminar, participants make specific plans to undertake these improvements opportunities on the job.

The Meaning and Utility of a Team-Centered Design for TQM Training

The typical function of training in TQM programs is to build the competencies in people that they require for undertaking their responsibilities for the continuous improvement of quality. Even when such training focuses on team leadership and team membership, participants are largely expected to make their own individual application of their learning. In a team-centered design (like the one used in KSC's TQM Seminar) the function of training is vastly different and enlarged. The general characteristics of team-centered training are:

- Learning focuses on the primary unit of performance, i.e., groups of people vice individuals;
- Participants learn with the people with whom they will apply their learning;
- Participants become mutually responsible for the learning of each other;
- Team application of learning is planned by the team during the seminar;
- Each team engages in real time team development during the two days of the seminar; and
- The total organization's capacity for team development and continuous improvement is strengthened.

By bringing teams into the training program to learn as teams, we can also equip them to apply their learning as teams. But more important, by targeting the training for people who work together, we obviate the need to translate learning into the work environment. **The work environment is already present with the teams in the training environment.**

Results of the Seminar

The seminar has focused on producing concrete and measurable improvement projects. Although a number of general results like improved networking, improved awareness of TQM method, etc. have been achieved, only examples of specific improvement projects will be reported here.

Team improvement projects tend to fall into the following categories:

- Customer (internal or external) satisfaction;
- Quality of product or service;

- Work process/procedure;

- Supplier (internal or external) performance; and/or

- Team Development.

We have collected data on over 300 projects undertaken by teams. The following section of this paper will show the results that EG&G Florida, Inc. has achieved through the seminar. Examples of the projects of teams from the other organizations include such achievements as:

- Establishment of new procedures for centralizing data, documents, etc. for all groups involved with hazardous gas.

- Changes to eliminate incidents of damage to test fixtures and equipment of Launch Equipment Test Facility.

- Development and delivery of training in test tools that contributed to reduction in LPS down-time. Since 1989, down-time has been reduced from 4% of support time to less than 0.1% of support time.

- Development of "User Services Comment Card" to inform end-user comments on services. Initiated the development of software to track all computer all computer related trouble tickets, customer service requests and PC/Network configurations. The system now saves approximately 100 work-hours per week.

- Development of procedure with goal of zero defects in printed circuit boards. Results in 1991 were great reduction in production time and error rate.

- Improvement of problem report flow during solid rocket motor/external tank processing.

- Development of discrepancy documentation logbook system to reduce process time and work hours used by quality, engineering, and configuration management in determining validity and/or prior acceptability of an observed discrepancy.

- Designed new travel request process and significantly reduced time, people, and paper involved.

How EG&G Florida Has Made Use of KSC's TQM Seminar

EG&G Florida has found that the key to building motivated teams is to give them quality training to function as teams. Teams are motivated when they feel they are

functioning efficiently and experiencing success as a team. We have a variety of TQM training programs for teams and KSC's TQM Seminar has been an integral part of this training. The seminar has been effective in both equipping our own EG&G teams as well as integrated teams composed of EG&G members and members from NASA and other KSC contractors.

Examples of Integrated Teams

Selected examples of KSC integrated teams and their results are described below.

Heating, Ventilation, and Air Conditioning (HVAC) Teams - The design, development, procurement, installation and maintenance of HVAC controls is a very complex operation that involves NASA, the Base Operations Contract, the Shuttle Processing Contract, and the Payload Ground Operations Contract. The issues involved in the HVAC controls function present many opportunities for improvement that can only be addressed cooperatively by key personnel from all the organizations involved.

A special seminar was held on April 7-8, 1992 to address the problems surrounding HVAC controls. Represented at the seminar were NASA directorates: Design Engineering, Center Support Operations, Shuttle Management and Operations, and Payload Management and Operations, and the three major contractors at KSC: EG&G Florida, Lockheed, and McDonnell Douglas. As a result of this seminar, the following teams were formed to pursue the improvement in the process of HVAC controls.

- **HVAC Design Team** is improving design documentation, assuring operational requirements are met, assuring life cycle costs rather than one time costs are utilized in project analyses, and developing HVAC controls strategy which utilizes the recommendations developed by the O&M team.

- **HVAC Operations and Maintenance Team** is improving the operability and maintainability of HVAC controls, assessing current methods of specifying O&M requirements, and measuring improvement initiatives.

- **HVAC Integrated Team** is integrating HVAC training requirements for O&M technicians and engineers, design engineers, procurement, and construction management personnel.

Propellant and Life Support Teams - Many issues surrounding KSC's propellant and life support requirements provided similar opportunities for improvement. As a result, a special seminar was recently conducted for NASA and contractor personnel involved in propellant and life support processes. The following teams were formed to pursue continuous improvement in propellants and life support processes.

- **Facilities and Systems Design Team** is improving the process of designing, constructing and activating propellants and life support projects, especially those involving two or more engineering disciplines, operations, contracts, and

those involving two or more engineering disciplines, operations, contracts, and construction management.

- **Environmental Regulation Team** is improving the process of compliance with environmental issues, e.g. industrial waste water, hazardous waste handling, etc., to ensure unified action planning, timely distribution of information concerning changes in environmental compliance, and improved evaluations of the impacts on affected organization.

- **Fleet Sizing Team** is streamlining the planning and documentation process for "right sizing" KSC's propellant and life support mobile equipment and facility systems.

- **Resource Scheduling Team** is eliminating duplication of effort and improving the process of allocating and scheduling propellant and life support to achieve more benefit from scarce and valuable human resources.

- **Shared NASA/Air Force Resources Team** is examining propellant and life support requirements in support of NASA and Air Force customers and resolving the funding issues that will provide for the sharing of manpower, equipment and facilities.

Energy Conservation Team - During the last two years, the NASA and EG&G Energy Conservation Team have made significant strides in reducing energy consumption at KSC which has resulted in well over a million dollars per year in annual energy savings. The team developed programs for installing new meters to measure energy consumption, installing timers to reduce energy consumption at facilities during unoccupied periods, investigating and targeting projects to improve energy efficiency in selected facilities, and lobbying for improved energy conservation methods through the design review process.

Configuration Management Team - The primary goal of the NASA and EG&G Configuration Team was to improve the quality of the configuration management process to ensure that all necessary controls and procedures were in place for adequate configuration and control of KSC critical and configured systems and equipment. The team's initial project involved an end-to-end analysis of the processing of our system work authorization packages to understand how each process was accomplished. The project resulted in 49 specific improvement initiatives which has resulted in a systematic approach for identifying, controlling, and accounting for all configuration changes to KSC's critical and configured systems that are the responsibility of NASA Center Support Operations and the Base Operations Contract.

"Property Pushers" Team - After showing an upward trend in the number of lost or misplaced items of government property, our Property Management organization, along with NASA and other KSC contractors, recently participated in a center-wide

effort to educate space center employees of their responsibilities in the proper use, case and protection of government property. The integrated team used total quality management tools and concepts to determine why property is lost and identify solutions. Based on the team's request, Center Director Robert Crippen designated the week of July 5-11, 1992, as KSC Property Awareness Week which effectively heightened awareness of the individual responsibility of civil service and contractor employees to protect property from loss or damage.

KSC Wellness Network - The KSC Wellness Network involves NASA, EG&G, and other KSC contractors. The team is achieving significant progress in promoting well at KSC. Current projects of the team include planning for National Employee Fitness Day, planning for KSC Smoking Cessation Program, and expanding our Weight Watcher Programs.

Payload Customer Badging Team - The security requirements of customers involved in payload experiments presents many opportunities to improve the way we do business with this set of customers who are generally unfamiliar with KSC and our security requirements. The objective of the Payload Customer Badging Team is to provide education to payload customers pertaining to paperwork required for badging, improving communications with the Air Force and other organizations involved in the badging process, and providing policies and procedures that will ensure payload customers are badged in a timely manner.

Examples of EG&G Teams

The KSC TQM Seminar has been a major catalyst in motivating EG&G teams to improve the quality of the services they provide to their customers. During the term of the seminar, teams from seventy-eight different functional areas have attended the seminar. The following teams provide selected examples of improvement projects and results of the EG&G teams:

Master Planning Team improved the Centerwide drawing scanner system and developed a common data base to be shared by all users at KSC.

Water and Waste Team improved planning process that effectively reduced bench stock re-work and decreased real time logistics support to procure parts.

Resource Protection and Planning Team installed project boards to communicate current status of all projects, developed common format for regular and limited surveys, developed process to share design review information on all projects to everyone involved in the resource protection and planning process.

Metal Shop significantly reduced time to complete Work Authorization Package.

Logistics Analysis Team developed baselines for services provided, initiated customer surveys to determine the areas in which the team should strive to improve, and

developed a set of quality performance indicators to track the team's performance.

Propellants and Life Support Design Team developed "how-to" handbook for engineering assessments.

Launch Readiness Assessment Team generated a user's handbook of launch readiness assessment procedures and subsequently trained all users in these procedures.

Fix-It Crew reduced cost of purchasing new valve assemblies for rechargers, reduced turnaround time for maintenance of rechargers from three days to one day, and initiated a project to reduce maintenance time for compressors.

Financial and Administration Support Team developed and placed on line a user's guide for the NASA Stars Financial Application process.

Computer Operations Team implemented a monthly save process for all test and production databases which resulted in savings of 110 tape cartridges and eliminated the handling that was previously required to transport save tapes to a disaster recovery library.

Lessons Learned

Kennedy Space Center's Total Quality Management Seminar's impact on team development has been very significant. The teams that have been trained in the seminar have had to overcome various obstacles and have had to struggle at times even to survive. As we reflect on this activity, we can identify a number of mistakes we made, opportunities we missed, and a few things we would repeat if we had the opportunity to do it all over again. The following lessons learned were developed based on the perspective of the teams and others closely involved with KSC team activity. The lessons learned may help others who want to undertake similar integrated team-centered improvement initiatives.

1. **Senior Management Communications** - We could have done a better job keeping senior management and other key players more fully informed of the progress of the seminar and its results. The result of not accomplishing this task resulted in some organizations not taking full advantage of the seminar and a lack of clear understanding in some organizations of how the seminar could fit into their overall total quality management plan and initiatives.

2. **Facilitators** - Using trained facilitators in this seminar has proven to critical to its success. The time that it takes to teach facilitators how to help a group function effectively as a team takes time and the time factor is usually underestimated. We have learned that skilled facilitators become a real resource to the organization and in many cases can make or break the success of the teams. We should have done a better job with our facilitators.

3. **Organizational Development** - We have learned that training can be more than imparting knowledge; it can be an organizational development strategy. An organization's strategy for TQM integration must provide the necessary education and training to enable teams to function effectively in a total quality environment.

4. **Team Arrogance and Dissidence** - We have found that it is sometimes necessary to overcome the arrogance of team members who assume that, "We're already a team and we don't need training." Training helps clarify how the team will work together, what tools the team will use, how they will make decisions, what goals they will pursue, how they will share the workload, etc. We have simply underestimated at times the energy it takes to develop a team.

5. **Structured Feedback Process** - There is immense value in using a structured feedback process in team training. The feedback process provides the teams a clear perspective of where they stand relative to a set of characteristics that are known to be associated with superior teams. The survey tool used for the team's feedback has been very effective in re-surveying the team at some point in time after the seminar to evaluate if the team is improving relative to the set of superior team characteristics.

6. **Team Centered Training** - We believe strongly that training should be conducted in a team format. Teams should be trained as teams and provided with skills and tools that can be immediately applied in their own work environment. It is highly efficient to train the people **together** who must work **together**.

Summary

Teaming within EG&G Florida and teaming with NASA and our fellow contractors at KSC for continuous improvement are primary objectives in EG&G Florida's TQM initiative. KSC's TQM Seminar has contributed to this objective and has yielded such benefits to EG&G Florida as: team development, improved work processes, improved customer satisfaction, and improved quality of work life for our employees. Our integrated teams are providing win-win-win situations for NASA-Contractors-Customers; it is through the integrated team activity that we actually translate the need for closer integration and cooperation among all organizations into specific initiatives that results in overall improvement in how we conduct our business at KSC.

Conclusion

KSC's TQM Seminar has made a significant and quite special contribution to the TQM initiatives of NASA and its contractors at KSC. The seminar has produced a host of specific improvement initiatives and has led to the organizing of many integrated teams that can truly represent a joint NASA-Contractor TQM initiative. But perhaps the most lasting contribution that the seminar has made is that it has established a precedent for joint NASA and contractor TQM training and it has proven that such training works.