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6th Annual NASA/Contractors Conference on Quality and Productivity

"Partnership for Continuous Improvement"

SUMMARY REPORT

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SUMMARY REPORT OF THE SIXTH ANNUAL NASA/CONTRACTORS CONFERENCE ON QUALITY AND PRODUCTIVITY

"PARTNERSHIP FOR CONTINUOUS IMPROVEMENT"

HOSTED BY:
NASA GEORGE C. MARSHALL SPACE FLIGHT CENTER
HUNTSVILLE, ALABAMA

OCTOBER 31-NOVEMBER 1, 1989

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THE WHITE HOUSE

WASHINGTON

October 26, 1989

I am delighted to offer my warmest greetings to Admiral Truly and all those gathered in Huntsville, Alabama, for the Sixth Annual NASA/Contractors Conference on Quality and Productivity. Congratulations to the deserving recipients of the 1988-1989 NASA Excellence Award for Quality and Productivity.

Excellence is and must continue to be the hallmark of America's space exploration endeavors. Both NASA and private industry have worked together to improve the quality of our space research, products, and services, as well as the productivity of the aerospace work force. The fact that this is NASA's sixth such conference reflects the dedication of government and industry to a partnership emphasizing quality, which benefits the entire nation.

Working together, NASA and its contractors have provided America with some of its finest moments over the course of the last thirty years. Mercury, Gemini, Apollo, Mariner, Viking, Voyager, and, most recently, the Shuttle have all contributed to our understanding of our place in the solar system; and all have enhanced our pride in ourselves and our country. We look forward to NASA and industry working together to build Space Station Freedom, to return to the Moon, and to begin the human exploration of the Solar system by sending men and women to Mars and beyond. The ambitious missions that comprise our space exploration initiative cannot be accomplished without NASA/industry teamwork. I commend all of you for your devotion and commitment.

Barbara joins me in sending best wishes for a productive conference and for continued success in assuring U.S. leadership in space. God bless you, and God bless America.

FOREWORD

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Our Nation's mission is clear, to remain a leader in the global marketplace. NASA's mission is clear, to gain preeminence in space. President Bush has challenged leaders of the space program to maintain a long-term presence in space exploration. NASA and its contractors are committed to quality and excellence that guarantees mission success.

In this time of rapid technological and social changes, preeminence in space is a challenge. NASA must continually strive for quality and excellence, and not compromise in this highly competitive world. NASA continues to emphasize quality performance within our organization and with our contractors. For six years, the annual NASA/contractors conference has provided a forum for representatives from government, industry, and academia to exchange ideas and experiences, encouraging total quality performance that results in high quality products and services.

Our contractors are striving for quality and excellence in performance and are recognized for outstanding achievements when named as recipients of the NASA Excellence Award for Quality and Productivity. For 1990, NASA has established a small business award to further encourage and emphasize the importance of quality performance from all of our contractors.

This "Summary Report of the Sixth Annual NASA/Contractors Conference on Quality and Productivity" highlights key points from the presentations and describes activities that have resulted in a broad range of improvements in products and services from government, industry, and academia.

Long-term commitment to quality is an essential requirement that ensures future success. That commitment reiterates our dedication to excellence in space exploration and to national quality and productivity improvement.

Richard H. Truly
Administrator

INTRODUCTION

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A "Partnership for Continuous Improvement" was further strengthened this year at the Sixth Annual NASA/Contractors Conference hosted by the George C. Marshall Space Flight Center in Huntsville, Alabama. On October 31-November 1, 1989, more than 800 attendees gathered to exchange ideas on their continuing efforts to achieve excellence.

The presentations and discussions served to strengthen the understanding between NASA and its contractors that we have a common goal. By thoroughly integrating quality programs into our organizational cultures, we serve our customers better, create positive work environments for employees, increase the quality of our products and services, and increase this nation's ability to succeed in a global market.

The NASA Excellence Award for Quality and Productivity was awarded to the Lockheed Engineering and Sciences Company, and all eight finalists were honored for their demonstrated commitment to quality. Efforts like these set the standard for all organizations.

The numerous successful space program missions in 1989 have provided the momentum for further accomplishments in 1990. Everyone involved can be proud of these recent achievements and can look forward to continued success if we remain committed to strive for excellence in all that we do.

The conference report summarizes the presentations and is not intended to be a verbatim proceedings document. You are encouraged to contact the speakers with any requests for further information.

George A. Rodney
Associate Administrator for Safety, Reliability,
Maintainability and Quality Assurance

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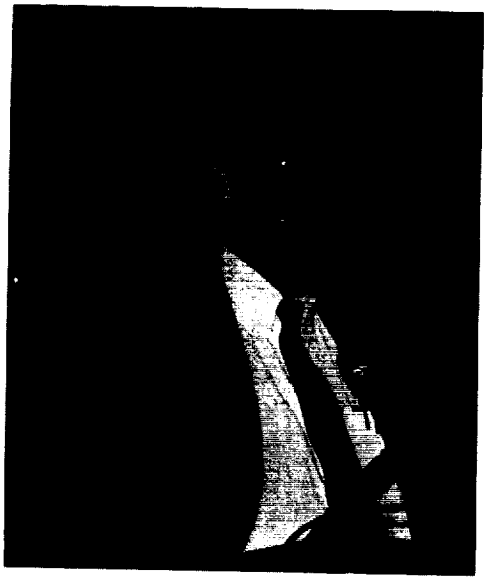


OPENING ADDRESS

James R. Thompson, Deputy Administrator,
NASA Headquarters

The evolution of the NASA/Contractors Conferences exemplifies how the quality and productivity improvement concept has developed over the past six years. In 1984 it required some effort to get a modest-sized group together, and many were introduced to ideas that were new to them. Today more than 800 of us are present and, in general, we are thoroughly familiar with the program topics because of involvement in ongoing quality and productivity improvement efforts in our own organizations.

It seems as if we've come a long way, and yet there is actually nothing novel about partnership for continuous improvement; we have, in fact, been working together for excellence all along. The striving for quality has always been there. These days, however, our approach is becoming more focused, in part because of growing competition from abroad. There are some advantages to the increased capabilities in other nations; certainly our space program will take on a more international flavor as we involve other countries in the development of programs such as the Space Station Freedom, President Bush's long-range space exploration plan, and the Earth Observing Satellite. We should keep in mind that to successfully compete with foreign technology we don't require anything new; we need only to remain clearly focused on the necessity to continually improve our performance.

Many important space exploration activities are under way at this time, and resources must be provided to keep them progressing in an optimum way; 1989 is not the time to blink. With continuing attention to quality and the very best effort at all levels, we will continue to fly the shuttle safely. The remarkable work involved in the Voyager, Magellan, and Galileo missions indicates the exceptional challenges we can meet. A wealth of useful information will be provided by these projects as well as the Hubble Space Telescope and the Space Station. We are sure to resolve problems that are involved in the course of these programs, because we're fully committed to realizing the enormous benefits of space exploration.

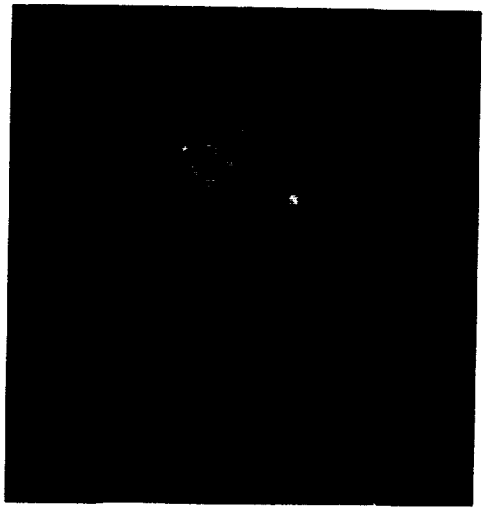
We started this effort a long time ago, and we always knew there were risks associated with space flight. We've persisted and learned, and in the course of time we've developed a strong working group. When the recipient of the NASA Excellence Award is announced this evening, we will be paying tribute to the cream of the crop, recognizing the vital contribution provided by the spirit of partnership and excellence. NASA will soon initiate several special programs to expand upon the potential of team activities at the centers. Johnson Space Center and Goddard Space Flight Center each now have their own excellence awards, and the Lewis Research Center recently received the OMB Quality Improvement Prototype Award. All the centers have been making strides in quality and productivity, and we intend to substantively encourage their efforts.

Although Total Quality Management (TQM) may be a relatively new term at NASA, we have been following its principles for a long time. I view TQM as a building block, one that we all need to use, not to compete with each other, but to reach common goals. TQM by its name implies that the process starts at the top and that it is applied in the early planning stages of a program.

We have tremendous competition for resources these days and must lay the groundwork at the beginning, well before implementation. This initial investment begins with educating our work force. We want to accomplish a great deal and we need to have well-equipped, highly motivated young people who can provide critical expertise. Certainly there are social implications to developing a strong educational system; youth will turn away from drugs if there are worthwhile, stimulating programs available to them. We need to become involved in educational incentives and to invest at all levels, including elementary, junior high and senior high school programs. This translates to getting students acquainted with our projects and communicating with them about our personal and corporate experiences.

I'd like to close with a word about leadership. We have relied too long on the safety, reliability and quality assurance people to run interference for us. They have been in the trenches fighting for improvement and frequently it's been an uphill battle. Now is the time that we all need to fully participate, including and especially the CEOs and NASA administrators. This participation will enable us to successfully build the Space Station and move ahead to establish ourselves on the

lunar surface and eventually on Mars. Through a total commitment to continuous improvement as partners, we will achieve our goals as a nation and as a space exploration team.



CONFERENCE OVERVIEW

Joyce R. Jarrett, Director, NASA Quality and Productivity Improvement Programs, Conference General Chairperson

This large gathering at the Sixth Annual NASA/Contractors Conference is the result of the efforts of many people. The participation of so many organizations attests to the value of developing good working relationships between NASA and its contractors. Those who have attended previous conferences will certainly observe how the quality and productivity improvement effort has gained substance and has come to have a very significant impact on our work cultures in the past several years.

One of the gratifying aspects of this year's conference is that we are able to accommodate all those who wished to attend. Today we have a record attendance of over 800 people. In past years we've been forced to turn people away because of limited facilities, so it's good to be able to welcome representatives from a great many organizations and agencies, including DOD and OMB.

I extend our special thanks to the Marshall Space Flight Center, our host, for assisting in obtaining this great facility.

Let us reflect for just a moment over what has been accomplished over the last six years in both government and industry. We've only to look at the Office of Management and Budget's recent call for Total Quality Management and the President's Executive Order to see that our nation recognizes the major impact that quality and productivity has on our future.

With only 60 days remaining in this decade, it is also time to look ahead to the challenge of the nineties, and beyond. We need to concern ourselves with the fact that America has gone from being the world's largest creditor nation to being the world's largest debtor nation. Our public schools are currently graduating 700,000 illiterate students each year. We are also dealing with more complex technologies, continuing

foreign competition, more foreign-owned U.S. businesses, education goals, and a movement to encourage national and international cooperation.

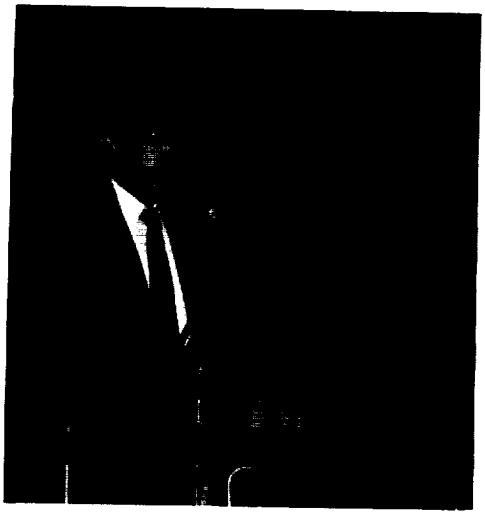
During the next two days, we'll hear a broad range of topics discussed by those who have met with success in their efforts to plan, implement, achieve, and measure. They will share with us their success stories as well as the pitfalls they have encountered. We'll be provided with an overview of key service industry techniques that ensure sustained customer satisfaction and ideas about improving the quality of our work places by providing an environment conducive to the growth and development of our human resources. Also, as J.R. Thompson mentioned earlier, we are taking a hard look at our programs designed to enhance the NASA/Contractor education partnership. Our NASA Excellence Award panelists will present their methods on sustaining customer satisfaction, employee involvement in continuous improvement, and organizational culture as it relates to productivity improvement and quality enhancement.

The "Partnership" theme is further carried out with our various panels looking at government initiatives pertaining to quality improvement, NASA center/contractor relationships, a specific look at Space Station Freedom, and contract Q/PI initiatives. We will also hear discussions on aspects of defining and measuring customer satisfaction, and improving technology management.

Our luncheon speaker today is Tom Young of Martin Marietta Corporation. This evening, after dinner, our NASA Excellence Award recipient(s) will be announced and Astronaut Bob Parker will be on hand to extend thanks and congratulations from the astronaut team. The keynote speaker at dinner will be Kenneth Leach of Globe Metallurgical, Inc., a small business winner of both the 1988 Malcolm Baldrige Award and the 1988 Shingo Prize for Manufacturing Excellence. Also this evening we will hear messages from both the President and Vice President of the United States.

We have a full two days ahead of us with information on a wide range of topics revolving around the "Partnership for Continous Improvement." We are particularly fortunate to end the conference tomorrow with Philip B. Crosby, author of "Quality is Free."

I welcome you all and invite you to use this occasion to share experiences and identify approaches that may be applicable to your own work environments.



Keynote Address - "Profile of a Quality Organization"

Robert D. Paster, President, Rocketdyne Division, Rockwell International Corporation

The key initiatives that were the basis for Rocketdyne's selection as recipient of last year's NASA Excellence Award were based on a serious commitment to maximizing quality and productivity throughout the organization. Each employee was involved in this effort, and although the thrust for excellence was not new at Rocketdyne, applying for the award fueled the fire and drove a process of detailed self examination regarding ways to improve. Through repeated participation in the award competition, an insight into organizational priorities emerged.

It became very clear that employee involvement is the backbone of the continual improvement. The essential steps are management commitment, employee involvement, effective measurement, and ongoing programs for education and recognition. Pursuit of quality should be so integral to an organization's environment that everyone feels personally accountable for the company's success. Communication must be carried out through varied channels so that goals are fully understood. Rocketdyne believes in management by walking around. This is a demonstration of commitment that will bring about 100% involvement and individual ownership of the overall effort.

Team activities have enhanced the effectiveness of work groups by identifying areas for improvement and implementing needed changes. The drive for excellence must also involve recognition and reward programs. At Rocketdyne this has included direct payment to employees who provided cost-saving improvement suggestions. Immediate response is provided for all employee input; it may be in the form of a medal or plaque in return for an improvement suggestion. Work performance must be

tracked and the results should be published regularly so that everyone has feedback on how the effort is going.

Rocketdyne sought to develop the capabilities of its work force by increasing opportunities for technical skills training and expanding the management pool capabilities. We kept the suppliers and subcontractors involved in improvement initiatives. The top priority is customer satisfaction and attention to this principle was probably the single most important ingredient in winning the award. The key is to work in partnership with the customer. The good record of shuttle flight successes is a strong statement regarding customer satisfaction.

Rocketdyne has benefited greatly by competing for the award, but since then the effort has not slowed in any way. TQM offers a new set of goals and continuous improvement entails relentless attention to maintain the momentum. There are always opportunities for further improvement.

Keynote Address - "Quality First"

A. Thomas Young, President and Chief Operating Officer, Martin Marietta Corporation

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The impressive number of successful manned and unmanned flights by NASA is a powerful testament to our quality and productivity improvement efforts. We can be proud of our achievements, but there's much more to be accomplished.

It is interesting that quality and productivity have become such visible issues recently, not only in NASA but in all areas of industry. It has helped us realize that we had set aside some of the fundamentals of leadership and neglected the essential attention to detail. We had a rather narrow view of what constituted quality, losing our way regarding the attitudes that are fundamental to excellence. There is a lesson to be learned about complacency; it does not work; once you are satisfied that you have completed your quality program, you have been compromised.

Certainly Total Quality Management (TQM) is a concept that can foster improvement, but it shouldn't be viewed as something extraordinary; it should be an automatic way of

operating, something carried out as routinely as turning off the lights at the end of the work day.

A few years ago we were disappointed with the quality rating received by our Martin Marietta Orlando facility, where we produce a missile every 10 minutes of a work day. While we were meeting our schedules, it was a struggle and we were not seeing and substantial learning curve cost benefits. The first step in our improvement was to stop defending what we were doing and to start paying attention to what was actually going on. We needed to switch our focus away from only the end product and on total quality. In seeking improvement we went to where the action occurs - down on the factory floor, in the design rooms.

We thought quality was one of several key aspects in our operations. We learned that it is the only aspect, period. If necessary, cost and schedule had to be sacrificed to ensure that quality came first. This is an approach with high risk and it can create some anxiety for management, but we made the commitment and stood by it. We gave awards to people who stopped production lines to correct an error and to people who refused to work with an outmoded tool. We made a significant investment in training and top-grade equipment, abandoning the old "supply your own tools" policy in favor of providing the tooling ourselves so we could ensure quality control and effective calibration.

We established performance measurement teams, much broader in composition than quality circles. These were employee groups that developed measurement criteria that could be used to keep everyone aware of the current work performance statistics. Employees knew what the problems are and they had the solutions. Management commitment and employee involvement together have a remarkable effect. In a very short time, we were able to turn around a situation that had been ongoing for an extended period. Our data demonstrates these positive results and proves that the learning curve is not flat. And, in Orlando, we subsequently received the highest quality rating awarded by the Army Missile Command.

TQM is good for industry because it leads to a more competitive, more profitable operation; it is good for the customer whose needs are more fully met; and it is good for employees in that it brings about pride in one's work, an extrodinary motivation. Quality is an attitude based on doing

it right the first time and continually seeking improvement. If TQM went away tomorrow, it would not alter anything at Martin Marietta; we would continue the commitment we are carrying out because we have learned that when quality is the first priority, other elements such as cost and schedules will be met with success.

Keynote Address - "The Evolution of Quality at Globe Metallurgical"

Kenneth E. Leach, Vice President, Administration, Globe Metallurgical, Inc.

Globe Metallurgical, which is a company that was in existence at the time of the American Revolution, is very proud of having won the Malcolm Baldrige Award. Our evaluation for this competition occurred at a time of considerable turmoil in the organization. In 1984 we were sold and then two years later we were part of a leveraged buy-out. Our union subsequently went on strike so that the award evaluators had to cross picket lines to tour our facility.

The pressures that we had experienced necessitated our changing from a detection- to a prevention-based approach to quality assurance. The customers were the incentive for this change; we were being required to meet demanding new standards. Since we are a small company of 210 employees, we couldn't draw upon vast resources to implement the transition. We bought the Deming tapes and showed them to the front line people. We needed to demonstrate a strong management commitment to improvement; you can't institute a focus on quality from the bottom up; it begins with committed leadership. Our customer relationships were useful in that we obtained copies of customers' audits of our operation. These were readily available and didn't cost a dime. Many of our customers have had the benefit of well-known management consultants and, by reviewing the audits, we were able to take advantage "second hand" of guru expertise.

We trained hourly employees in new approaches to quality assurance and for this we did invest in professional assistance. But we made sure that the training involved actual work data so that the application was direct. In this way, we hit the

ground running. Since we launched on our new program, we've established a Quality Efficiency Cost Committee that meets once a month to review the performance record and identify any areas that need attention. A Quality Efficiency Cost meeting is held at the beginning of each work day so that the plant manager can briefly advise employees of current issues.

Employee participation is based on four different types of teams. We have quality circles for both hourly and salaried personnel, and their ideas are not put through an extended review process but sent directly to the plant manager. We encourage the plant manager to implement as many of the ideas as possible and to do it quickly; this keeps the interest up. We also have project planning teams comprised of hourly and salaried personnel. Our inter-plant teams have probably proven to be the most successful of all. It has been a great idea for groups of employees to make the drive between Beverly, Ohio, and Selma, Alabama, to exchange technology and discuss mutual concerns. Communication has broken down the barriers between hourly and salaried individuals.

Now on the weekends our operation may sometimes be carried on without the presence of a supervisor; the morale is high and our level of quality is excellent. We have extended our effort to our suppliers. Globe employees have gone out to supplier sites and trained their personnel in our quality control techniques. In turn we are getting back good data from suppliers, the kind of information that substantiates top-grade support. We measure the benefits of our program by customer satisfaction and also by significant reductions in absenteeism and accidents.

We don't have a fancy installation by any means, but we have an impressive assortment of awards on display that attest to the success of our program and serve to remind us that continuous improvement pays off. The challenge never ends.

Keynote Address - "The New Faces of America in the Science and Engineering Pipeline: Actions for Industry"

Jaime Oaxaca, Corporate Vice President (Retired), Northrop Corporation and Co-Chairperson, Congressional Task Force on Women, Minorities and the Handicapped in Science and Technology

Our national need for scientists and engineers has become so great that we can no longer consider this to be an Affirmative Action matter. We know that women, minorities, and the handicapped will make up 85% of the work force of the future.

A Congressional Task Force has been developing a definition of what America has to do to jump ahead and be in first place in science and technology. This group will present its first report in January 1990 and certainly it will address TQM. But we have to be aware in applying TQM that there are differences in how the Department of Defense and the commercial world work. The transfer of this concept isn't possible at every point, and some incentives are going to have to change.

However, we certainly should consider how TQM could be applied to education. Some school districts are experiencing a 70% dropout rate; this cannot be considered as "zero defects." Our world is becoming smaller and more complicated, so skilled people are essential to cope with a great number of new technological challenges. In Korea students attend school six days a week and follow a program that is heavily geared to math and science. One begins to wonder how a comparable expertise will be found in the United States. If we import technology, it means that we have less need for scientists and engineers in America, but it also means that we're less competitive and less able to cope with our own problems. We need a great many more scientists and engineers, including social scientists who are able to include the human factor in their work.

The projected shortfall is alarming in that our current trend is to move away from manufacturing in favor of service and information-based careers. Fifty percent of our nation's present university faculties will retire within 10 years, and

60% of those earning Ph.D.s in the United States are now foreign-born. We subsidize foreign Ph.D. candidates, the majority of whom will return to their homelands to work and essentially become our competitors. It takes 28 years to grow a Ph.D. and so we're now on the cutting edge of obsolescence.

American kids don't really want to spend much time studying, and it's obvious that there are very few crack addicts that are Ph.D.s. So the social climate doesn't favor educational excellence and, without a well-educated electorate, our political system is certainly at risk. The Asian cultures assume that everyone has the capability to succeed and the only requirement is work. We Americans, on the other hand, say that we're not capable and we need pampering. The universities wait for the jewels to show up. That's not going to work anymore; they're going to have to pull students up and work with them to overcome the deficiencies of the high schools and elementary schools. Industry, which at present invests a very small, hardly measurable amount in education, must contribute substantially more.

The solution lies in development of a national agenda driven by the Administration with a substantial amount of local control. The effort won't succeed if it becomes a battle for turf; we must all work together. We can no longer tolerate the great number of dropouts and the heavy administrative infrastructure. University professors must abandon their traditional stand-offish attitudes in favor of outreach programs, and a concerted effort must be exerted to improve the conditions of early childhood, including prenatal care. We can't expect to have healthy, bright babies from poorly nourished mothers.

This is a two-decade effort that involves bringing more talented people into education because we are surely eating our seed corn when the vast majority of outstanding graduates now hire into industry. TQM as applied to education would identify America as the customer and would require accountability from educators. We need to join together to plan a strategy for coping with this alarming national crisis.

Keynote Address

Philip B. Crosby, Chairman and Creative Director, Philip Crosby Associates, Inc.

One definition of quality today is "doing what you say you're going to do." In the past the prevalent attitude in government and industry, which could be described as "that's O.K." was characterized by a lack of concern for how agreements were fulfilled as long as the paperwork looked all right. For a time we were able to succeed in spite of their lack of accountability, but the situation changed. It became apparent that the Japanese didn't subscribe to a "that's O.K." standard. Since their attention to detail and delivery of superior products began to impact U.S. industry and economy, it was time to re-evaluate our definition of quality.

The business of quality is to assure that things are done correctly. This is a very simple, basic concept, but in some cases we have gotten so far from it that concentrated instruction is needed to reach a clear understanding. My company is involved in teaching executives what their organizational roles are and how to go about teaching others in the organization what their roles are. We maintain that you can't just talk about quality, you have to act on it. From the CEO on down, excellence must be demonstrated in terms of fully meeting commitments; doing exactly what you've agreed to do.

The price of poor performance is extremely high. Many executives are unable to cite the cost of nonconformance in their companies, but the figures can be calculated readily by a controller; it's a matter of determining what you're paying to have work redone. Common examples are seen in parts that must be re-soldered and insurance policies that must be rewritten. Approximately 25% of manufacturing company revenues are for doing things over; the figure is higher, approximately 40%, in the service industries. People need to be given the tools and instruction so they can do the job the right way the first time. Zero defects, an idea which has been taken lightly in the past in the United States, must become a reality.

Implementing a quality-based organization can threaten the executive's comfort zone. It seems easier to say, "that's O.K.;

that's close enough," rather than assure that products and services are outstanding; and it may be appealing to turn surveillance of quality over to the quality assurance people. In the long run these strategies don't work. Management must be fully involved and communicate a commitment to excellence throughout the organization.

MSFC Productivity Complex Genesis and Realization - Overview of the Marshall Productivity Enhancement Complex

Robert J. Schwinghamer, Deputy Director for Space Transportation Systems, George C. Marshall Space Flight Center

If we went back to 100,000 B.C. or, more recently, in Old Kingdom days in Egypt, we would find that, even then, people banded together in trust and cooperation for productivity's sake. People overcame mutual suspicions and hostilities to band together for the common good; to slay the mighty mammoth or build the prodigious pyramids. They didn't have the tools that we have today, but I wonder if what we're building in America today will last as long as the pyramids. The concept we're addressing is nothing new.

Today, we recognize the productivity crisis in our country. Numerous survey results show that many areas need work and actions must be taken to position this nation for increasing competition. The United States is only beginning a truly concerted adjustment to come out of the crisis.

Both positive and negative forces presently influence American industrial prowess. The positive forces include efforts by education and businesses to equip our nation for a productive and prosperous future, and the U.S. Government's emphasis on technology development and application.

The Marshall Productivity Enhancement Complex functions to meet some of the challenges posed by the productivity crisis. Innovative manufacturing and design methods are researched and documented for implementing materials/design/manufacturing TQM. People at the complex are developing space flight hardware by adapting new technology and information to the process.

An optimized technique underlies the manufacturing activities at the complex. Joint efforts with contractors on various shuttle and space station projects succeeded in savings/costs avoidances in the millions of dollars. The payback has run 10-15 to 1.

The MPEC industry/government TQM cooperative venture provides many important advantages in cost reduction; binding multi-contractor projects together as a system; encouraging innovation; realizing central economies of scale; enhancing technology transfer by direct industry participation; and maintaining a cadre of experienced government personnel maintaining continuity in changing contractor participation.

1.0 NASA PANEL

An overview of the NASA focus and thrust under the new Administrator and Administration. Discussion of planning as a result of the President's view of future NASA missions as well as comments on NASA's organizational structure for manned space flight activities, NASA's continuous improvement activities, and Lewis Research Center, recipient of the 1989 OMB Quality Improvement Prototype Award.

1.1. Introduction

James R. Thompson, Jr., Deputy Administrator, NASA Headquarters, Chairman

Today there are a great many opportunities at NASA, as well as some notable constraints. We are in a tight environment in which we have to make the most of our resources; we have to "get the bang for the buck."

We recognize the risks of the shuttle program and they've forced us to re-evaluate ourselves in order to continue flying. With so many ongoing projects, it's important that we don't lose sight of the need to balance our efforts. This is a time to assure that we are expending our efforts appropriately on the programs that are under way and also being aggressive in identifying the work of the future. It necessitates a great deal of planning and a very firm commitment because it's no longer acceptable to initiate a major activity and then abandon it as we essentially did with Skylab in the early 1970s.

In retrospect we seemed to lack continuity in that effort. Now we're very much aware of the need for that element as we address the ambitious Space Station project. There are many drivers in the Space Stations, such as science and propulsion, and from the vantage point of each aspect the challenges are tremendous. The bottom line is planning; we have to have the resources and the strategy firmly set in order to move successfully into implementation.

At present the Space Station is in an active re-phasing stage. We've made significant progress in coordinating with the international partners, and it appears to be on a well-organized track that will deliver results in the mid 1990s. The budget must be worked out very carefully because resources are limited; we must communicate clearly with Congress to assure that our needs are understood. It's essential to guard against diminished capabilities as we re-phase the program.

In many cases the solution lies in using technology that has already been developed. The Russian space program is impressive in this regard; they have consistently built upon what was at hand. This is a very practical approach and one that we will need to apply as we move ahead to long-range efforts such as the mission to Mars.

The current task at NASA is to assure that our programs are in balance and that we judiciously divide our efforts between the manned and unmanned projects. If we put our resources to work effectively and guard against over-extending ourselves, we can make tremendous strides in the projects before us.

1.2 Panel Presentation

Aaron Cohen, Director, Lyndon B. Johnson Space Center

To overcome the hostile environment of space requires a high degree of teamwork. We have made notable progress in the past few years in nurturing this essential teamwork concept. A number of recommendations from the prior NASA/Contractors conferences were implemented and have greatly contributed to this progress. These include making the conference itself an annual event and establishing the NASA Excellence Award which has attracted substantial contractor participation.

As we've progressed in understanding the concept of quality and productivity improvement, new words such as "vision" and "culture" have come into frequent use. On the 20th anniversary of the Apollo mission, President Bush spoke of his vision for the future of space exploration. It is now our task to implement this vision in which opportunities and uncertainties abound. We can influence the shape of the future if we maintain our vision even as the details are debated.

Because we will be in a position of pursuing multiple goals, it is clear that our work load will increase. We must start now to apply our energy and commitment to mobilize for new assignments while we continue to carry out the work at hand.

At the Johnson Space Center, our Total Quality Management approach focuses on strategic planning, team excellence, improvement projects, and a cultural survey process. The strategic planning activity involves employees at many levels because we've found that a wide source of input is very useful. Getting people involved in the overall goals of the organization provides substantial benefits. It results in a pervading sense of common goals that maximizes individual and group potential.

Through the team excellence concept, we are encouraging the involvement of employees at all levels in achieving measurable improvements throughout the organization. We carried out two cultural surveys to identify the values and attitudes of our work force and found that these fundamental perceptions have a very strong effect on individual and team dynamics. Based on what we learned in the survey, we are moving ahead to enable people to be most effective by providing additional training, career development programs, and open lines of communication.

Four major challenges lie before Johnson Space Center; actually, these are the same challenges that we face on a national level: (1) to deal effectively with concurrent multiple programs, (2) to prepare for technology-intensive programs by developing the technical capabilities of our work force, (3) to update systems and procedures, and (4) to develop innovative ways of working together and opening new channels of communication. A compelling vision will bring out our inherent capabilities. President Bush's challenge for the future of the space program will require endurance and confidence in the days ahead. Our commitment to quality and continual improvement will enable us to meet the challenge.

1.3 Panel Presentation

Arnold D. Aldrich, Associate Administrator, Office of Aeronautics and Space Technology, NASA Headquarters

We are now in a time of considerable activity and a great deal of success in both the shuttle program and the various unmanned space missions. When the Hubble Space Telescope and the Space Station are launched, the density of flights will be increased even more. This will present significant challenges in maintaining our record of success and incorporating technological advances.

Some changes have recently been made in the shuttle's main engine, and other advanced solid rocket capabilities will be incorporated in the future. While the current programs are dramatic, much is ahead as we move toward development of the orbiting maneuvering vehicle and the first implementation of the Space Station. These are complex projects that involve many organizations, including the international partners, all depending heavily on teamwork to reach established goals.

The current re-phasing of the Space Station Program has involved changes in user capabilities and we are now addressing numerous options and approaches. This translates to a very broad scope of activities, particularly in continually integrating new technology into our programs. We can look forward to tremendous opportunities for growth. We need to be constantly mindful of maintaining the highest standards of excellence as we move ahead.

1.4 Panel Presentation

Dr. John M. Klineberg, Director, Lewis Research Center

As we reiterate the basic conference themes of how much we have to do and how many challenges lie before us, it's good to bear in mind the sense of vision that was conveyed by President Bush in his recent speech at the Air and Space Museum. We need to be aware of our long-term purposes in maintaining the preeminence of the United States in space technology and increasing our understanding of our environment. When we say that we have a lot to do, we must recognize that the luxury of choice does not exist; meeting our long-term objectives is essential to our survival.

Although Lewis Research Center recently received the OMB Award, there is nothing really unique in our program; all the NASA contractors have made notable achievements in quality and productivity improvement, and the contractor community has contributed a great deal to them. When OMB looked at Lewis Research Center, they saw an extensive teamwork structure, a focus on customer satisfaction, and a clear, concise understanding of what the Center contributes to NASA's vision.

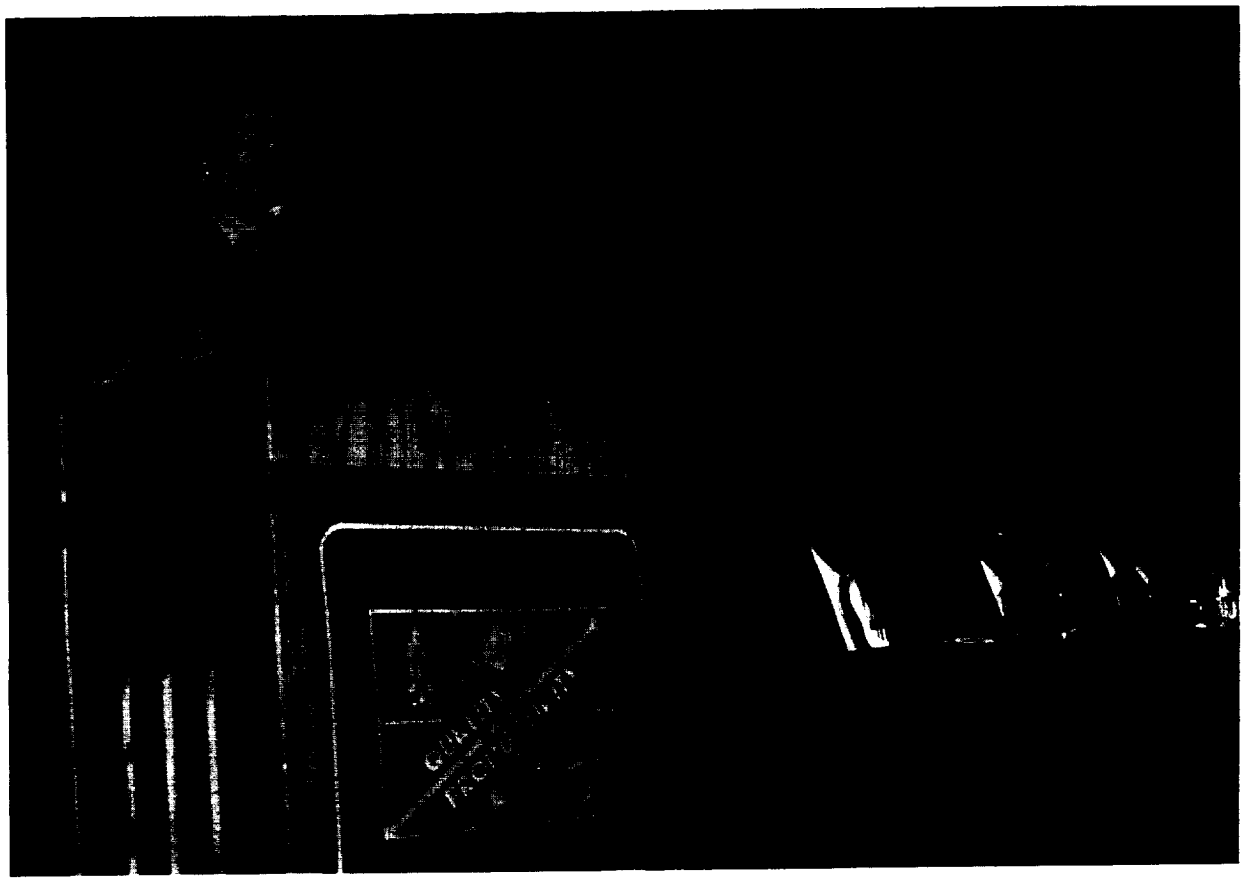
A great deal of strategic planning occurs at our Center and all employees are called upon to identify areas that require improvement. We use employee input as the basis for specific improvement actions in regard to meeting the needs of both internal and

external customers. The effect of soliciting and acting on ideas for improvement is that everyone works toward the same basic goal. At LeRC there is a strong commitment to participative management; we provide lots of training in this concept and employees apply their skills to actual Center issues. We document the ideas that are generated and provide feedback on implementation to the employees.

Participation is also fostered through a process of rating supervisors as well as ongoing suggestion and recognition programs. We are fully committed to open communication and in the course of a year each employee is invited to a breakfast forum with upper management at which a free exchange of information takes place.

Obviously this is a very time consuming effort for management, but the bottom-line results are substantial. We have experienced increased employee involvement and productivity improvements, clearly indicating that the investment pays off.

We are all in this together. With reduced resources and broadened responsibilities ahead, we must continue to emphasize quality and productivity improvement to meet our individual and joint objectives. We must remember that this is a continuous process; quality is not a destination; it's a journey. TQM is our commitment to the future.



Joyce R. Jarrett, Director, NASA Quality and Productivity Improvement Programs, introduces the NASA Panel. Seated from left to right: J.R. Thompson, Jr., NASA Deputy Administrator; Aaron Cohen, Director, Johnson Space Center; Arnold D. Aldrich, Associate Administrator for Aeronautics and Space Technology; John M. Klineberg, Director, Lewis Research Center.

2.0 NASA Excellence Award Session - Partners in Excellence

Highlighting the NASA Excellence Award criteria, these panels of award finalists will discuss significant methods and accomplishments used in achieving performance excellence.

2.1 Sustaining Customer Satisfaction

An overview and specific examples of key service industry techniques, measures, and approaches to sustaining customer satisfaction. The discussion will range the gamut of defining customer requirements; measuring quality in the service industry; customer/contractor team; quality achieved through effective problem resolution processes and effective communications; and work force involvement to achieve excellence.

2.1.1 Introduction

Dr. Robert Rosen, Associate Administrator for Aeronautics and Space Technology, NASA Headquarters, Chairman

Welcome to our panel on "Sustaining Customer Satisfaction." We all know that in order to have a successful business, you have to achieve customer satisfaction. We all focus on that and it is our goal. But achieving customer satisfaction and maintaining it are different matters. I think maintaining customer satisfaction is more difficult; it requires a true dedication to quality. This panel topic and the subject of this conference are intertwined.

We have leaders from three companies among this year's NASA Excellence Award finalists. They are going to present an overview of the service industry and their techniques in providing customer satisfaction. These panel members are respectively responsible for a variety of NASA support contracts: Johnson's calibration and repair laboratory, Goddard's network and missions operations support, and Space Shuttle processing at Kennedy Space Center.

2.1.2 Measuring Productivity and Quality for the NASA/JSC Instrument Calibration and Repair Laboratory

Emyre' B. Robinson, President and Chief Executive Officer, Barrios Technology, Inc.

Our customer is the JSC SR&QA directorate, but we serve all technical organizations and R&D at Johnson. We also serve many JSC contractors off site; the Texas Air and National Guard, the U.S. Coast Guard at Ellington and LaPort, and we are now in the process of providing calibration and repair services to the U.S. Navy Diving Team.

We cover a broad spectrum of the required calibration which is spelled out in the metrologies requirements manual for JSC. We support all components of the organization whether or not they are associated with manned space flight. The dedicated JSC facility includes all the reference standard laboratory requirements, and these standards are directly traceable to the National Institutes of Standards and Technology. Once the standards are traced to the NSTI they are transferred to the secondary laboratories, which are separate functions.

We have an electrical electronic lab, a physical mechanical lab, and a separate area for repairs. The electrical electronic lab has a special multi-user environment and easily transportable communication. The physical mechanical lab has permanent setups for hazardous measurement processes, and the environment is strictly controlled for temperature, humidity, and sound isolation for noise creating measurement processes. The repair lab is proximate to these other two labs, but they also preserve capabilities to perform operations that are not

calibration oriented. Our clean room environment enables us to provide calibration service required to support the manned testing programs instrumentation associated with life support systems.

Barrios assumed this contract in 1981 with 36 people and have increased that by 16 percent to 42 people. We have increased the laboratories' productivities by approximately 46 percent. We started calibrating at the rate of 13,000 instruments and have increased that to a present rate of 19,000 annually. Our new contract requires a turnaround time of six days or less, as opposed to the previous contractor's 10 working days. We are currently running at about 4.5. We have also added schedule pick up and delivery calibration services for equipment that is too large to transport or too sensitive. Our automated recall systems enable us to keep the calibration process moving in a timely manner.

We owe our various improvements to a number of automation factors.

- We have worked with the customer in equipping the labs with state-of-the-art equipment that we feel is essential in running a calibration lab of this category.
- We have integrated five major automatic calibration systems to complement a number of minor and smaller automatic and semi-automatic systems.
- We have a fairly new fiber optics calibration capability.
- We maintain a computerized data base to track the reliability of the calibrated instruments. This data is used to generate documents/reports for internal and customer use.
- We use priority request control which establishes specific criteria that the customer has to meet before his instrumentation is calibrated on our priority criteria.

In addition to process automation, we're identifying the equipment with bar codes, and we're batching like-instrumentation in order to reduce redundant setups.

We're in the process of establishing the capability to perform the NASA Measurement Assurance Program (MAP) which, when fully operational, will be offered to all NASA metrology centers and will save NASA a considerable amount of money.

We have developed a comprehensive random spot check program, approved by NASA, and a statistical quality assurance program.

This involves comparing past data gathered with present data to ensure continuous improvement. We have productivity and quality objectives, inspections, follow-up inspections, verified proper calibration procedures, and documentation verification on the completeness and accuracy of the calibration documentation. We make sure that everything has been noted, and noted correctly, in the documentation package. Various methods are used to test the actual performance of the technician and correct that performance, when needed, until that performance is at 100 percent.

We report our failure rate to the customer through a technical managers review to the director of SR&QA. We also maintain a table that numerically tracks this failure rate, and a control chart gauges each week's raw failure data against average data kept for two years previous. We have cut our failure rate in half (from 0.4 to 0.2 percent), and our objective, of course, is to reach zero. That may not be humanly possible, but we would be glad to reduce that by the same factor again.

We are gratified that we are one of the first at JSC to form this joint NASA/contractor team that has been active since 1983. We had three NASA people in the beginning and now have one NASA and seven Barrios people on the project. We have developed formal training to which other centers are looking and hope that it will be implemented NASA wide. We have also issued a customer service handbook.

We consider our communication with the customer as a primary factor of our success. Our corporate management and calibration management interact with the customer so that any problems can be corrected before they become serious. The major success factor is the great support given to us by our customer. They manage in a way which allows us to create an environment which allows for our employees to be creative and innovative. Our people can also take tremendous pride in and be committed to performance excellence. This situation, for a company of our size, has been the best shot in the arm our people could get, because this recognizes their great efforts and commitment.

2.1.3 Partnership -- Transitioning Continuous Excellence

Philip H. Johnson, Vice President, Space Operations, Bendix Field Engineering Corporation

I believe in a few basic tenets in sustaining customer satisfaction. First and foremost, you must know your customer. You have to know their thoughts and priorities. You have to know where they put their

emphasis, and you don't get that out of a statement of work or a contract. When you make key decisions, you must put yourself in your customer's place.

In our experiences, if you follow a couple of those basic rules, you build a mutual trust; the kind of trust where your customers know that you will be truthful with them, and you know they will be fair when you are truthful.

At BFEC, we focus on four elements.

- High level performance
- Problem resolution and communication
- Role of subcontractors
- Quality measurements

We were the prime contractor on a contract implemented at Goddard in 1987. This contract involved a monumental task of consolidating a number of working elements, including subcontractors and new contract work, from many different locations, into one customer support organization. In the four months we had to structure ourselves, we recruited 450 people in one area. We also had new responsibilities for some $40 million in property, and more than 7,000 documents from four locations which we had to inventory and bring into our library.

In the Information Processing area, a contract we picked up, our basic approach was to leave the organizational structure in place, because the customer was satisfied with the operation. We did some centralization in this consolidation contract obviously to reap benefits of combining like functions to pick up efficiencies. Our early consolidations were in documentation and hardware engineering functions.

At this point, we know transition is a component which never stops evolving. The programs and emphases change so that we really need to think of transition in a more global sense than the transition phase of a contract. This phase must be done in concert with the customer in order to maintain a level of satisfaction, and flexibility is a word to remember here.

The NASA Communications area, we believed, required a number of changes. The error rate in NASCOM operations before we assumed responsibility was more than 8 errors a month; too high, in our opinion. We made a number of supervisory and organizational management changes. We implemented a number of programs in employee recognition and upward mobility, and we formed a productivity enhancement team. We also negotiated with the union in areas where we upped the qualification standards, made changes to the recertification process, and upgraded labor grades.

When we look at our progress post-initial transition, we see that we brought operators' errors down to 2.5 per month from the 8.3. The translation of 99.9 percent proficiency gives you a better perspective on those figures. The other measure we used in NASCOM is system availability. We presently have our system availability up to 99.9 percent as well.

The next area of importance is problem resolution and communication. Working closely is something that is absolutely required if you're going to sustain a good customer relationship and a level of trust. In many cases, we get hung up on our companies' positions, or have other background items on the agenda, and we never quite reach the performance level of openness that we need. A critical element here is teamwork, on both the parts of customer and contractor. We are fortunate at Goddard in that they endorse our quality commitment. We've been there many years, have had good interaction over those years, and that has built up the trust level to where it should be. We keep in mind that the customer's problems are our problems, and we hope that our solutions are our customer's solutions.

In an attempt to build a relationship with a new customer, we developed a joint transition plan for the contract's transition period. It was signed by all three parties; NASA, Bendix and the incumbent contractor. This included communication meetings with all the incumbent employees to bring them on board smoothly.

Briefly, on subcontractor involvement, the badge someone wears is not important when providing support or solving a problem. To this extent, we have included this as part of our award fee performance evaluation plan. Subcontractors participate fully in all our activities, especially from a quality and productivity level. Everybody on the team must march to the same drummer.

The measures we use tell us if our organization is performing well and if we are sustaining that performance. The two I mentioned earlier, operations proficiency and systems availability, are key. Quality and productivity are measured in terms of service functions performed; cost reduction/avoidance, training and certification, tests and simulations, safety, and operational readiness. We have been fortunate and pleased to receive recognition for our efforts with the U.S. Senate Productivity Award for Maryland in 1988 and the Goddard Excellence Award in 1988 and 1989.

Achieving high levels of performance is difficult, and maintaining that level is even more difficult. But all of us -- the prime, the subs, and the customer -- must work

together every day to help sustain a good relationship. There is no magic to it; if everybody takes a straightforward approach, the communication could be there to help you succeed.

2.1.4 Golden Handshake and Teamwork for Excellence

Jarvis L. (Skip) Olson, Vice President and SPC Project Director, Grumman Technical Services Division

I will focus on three aspects in sustaining customer satisfaction:

- the peculiarity of the support environment;
- defining customer requirements; and
- the customer/contractor teams at KSC.

Unlike the manufacturing world, we do not have finite things to measure, like number of units produced or rejected, quotas met, or standards or benchmarks established. In truth, our customer is best satisfied when we go completely unnoticed especially on launch day. Our situation at KSC is further complicated on the shuttle processing contract, because we have two customers to satisfy, both NASA and Lockheed. The ultimate measurement is the semi-annual award fee evaluation. However, again, as a part of the Lockheed team, we do not receive a separate determination of award fee. Areas for which we are responsible are included in the Lockheed determination. Consequently, measuring our customer satisfaction is difficult.

Recognizing the criticality of understanding total customer requirements, we instituted Grumman and NASA planning sessions on a semi-annual basis to define appropriate award-fee objectives. Based on these objectives, detailed schedules are developed to include interim progress reviews and firm target completion dates. In effect, we developed the Golden Hand Shake to directly measure our performance on a continuous basis, day by day.

Customer satisfaction is further assured through continuous communication through morning telecons, open-item reviews, and a daily scheduling meeting. Customer concerns and user requirements are addressed and, if necessary, appropriate action plans are developed or modified to assure maximum support.

On customer requirements, we know that they are not always well-defined by the customer or understood by the contractor; in many cases they are disputed for the life of the contract. Both parties must agree on requirements for a successful customer/contractor relationship. In 1983 the SPC was the largest service contract ever awarded. Defining the high, top level requirements (to support shuttle launch schedules,) was easier than defining the lower level tasks. Recognizing this, NASA allocated an extensive fact finding period at KSC for all contractors to investigate all center operations. Grumman observed existing conditions by talking to incumbents and to our NASA counterparts. As a result, the following requirements were identified.

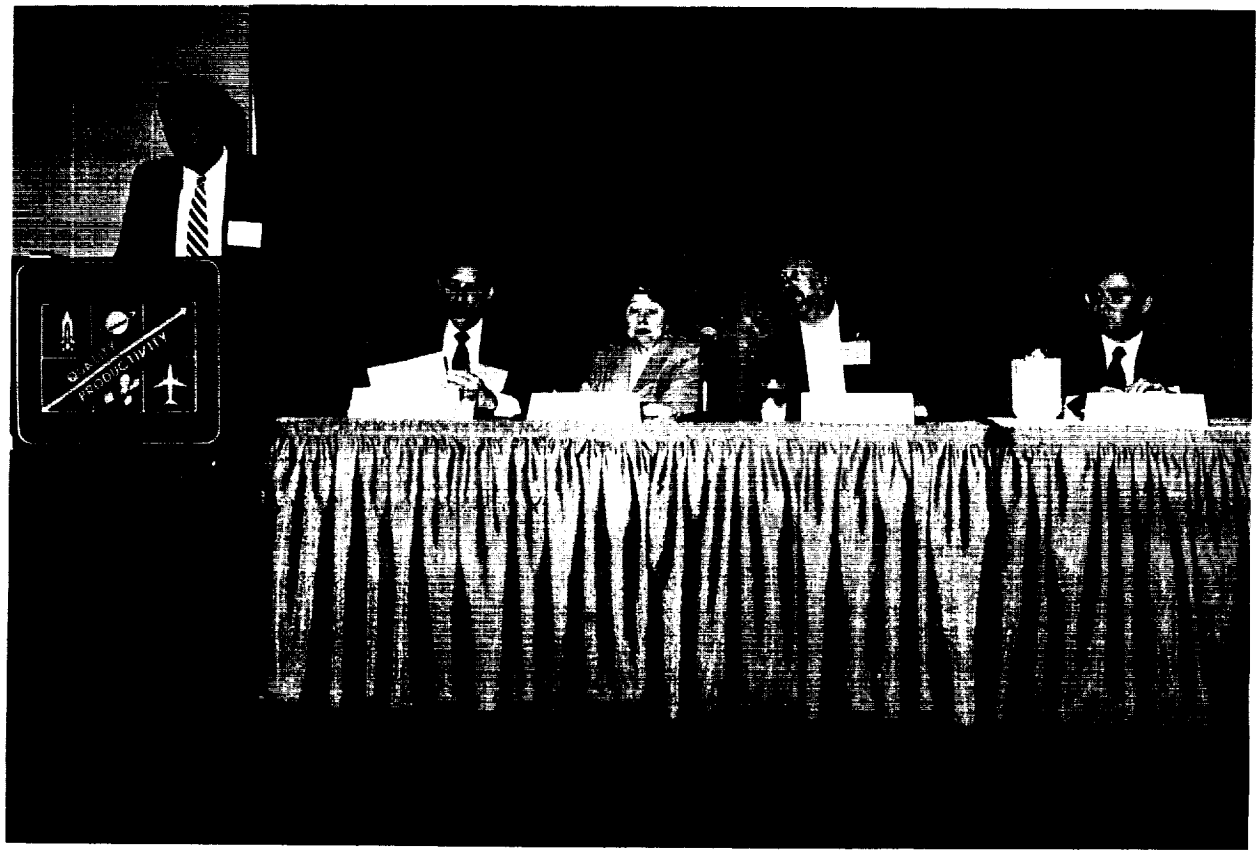
- Hardware survivability was the most critical factor in meeting launch schedules. Existing equipment had to be made to last well beyond its designed life time, which incidentally has gone by.
- New test systems and procedural and maintenance innovations were an absolute requirement if the hardware was to support shuttle processing at a projected rate of 1 to 1.5 per month. This early identification of problem areas led to the development of an evolution plan. This plan addressed recommended action items, like automated scheduling systems, production tracking systems, artificial intelligence applications to on-line and off-line systems, and upgrades and specialized test tube development of our off-line capability. This was the beginning of Grumman's four-phase PIQE process, although it was not identified as such in 1983.

At NASA and Lockheed, we recognize the need to improve the shuttle processing systems and processes from the very beginning of the contract. Continual assessment of requirements has proven to be essential to the support of ever changing payloads, vehicle modifications configurations, and survivability. The key to our four-phase quality and productivity initiative is team work. Customer/contractor team work on the SPC really came together in 1985. Grumman took advantage of the stand down period between launches to improve all our systems.

Joining with Lockheed and NASA to develop PIQE team objectives, from common goals in previous independent survivability and evolutionary requirements, and working toward a common goal, we accomplished a great deal. The accomplishments include man-power reduction through automation, process improvements, new technology application, and enhanced quality and reliability of existing systems. A specific team project example was an effort to resolve the earlier mentioned requirement to extend the useful life of installed hardware in the LPS. All team members were brought together to a common

work area; each task was assigned individual responsibility and priority; and we established, reviewed and committed to schedules to meet the return to flight schedule. Design reviews were conducted quarterly to ensure completion of all milestones, and final implementation and system acceptance was integrated with SPC NASA Quality Assurance.

This and other team projects helped solidify NASA and SPC team relationships and resulted in a can-do attitude in our employees. NASA team awards and performance ratings have reflected the overall success of this and other team projects. The customer/contractor team approach of defining requirements and working together daily to reach a common goal is how we sustain customer satisfaction at KSC.



Panel 1 - NASA Excellence Award Session - Sustaining Customer Satisfaction: (from left to right) Imants (Monte) Krauze, Bendix Field Engineering Corporation; Dr. Robert Rosen, NASA Headquarters; Emyre' B. Robinson, Barrios Technology, Inc.; Philip H. Johnson, Bendix Field Engineering Corporation; Jarvis L. (Skip) Olson, Grumman Technical Services Division

2.2 Involving Everyone in Continuous Improvement

Effective continuous improvement processes require a quality of emphasis from both top management and an involved work force. Both are critical to developing and maintaining the entire organization's commitment to continuously improve products and services. This panel will address implementation methodologies from each of these two perspectives.

Robert D. Paster, President, Rocketdyne Division, Rockwell International Corporation, Chairman

2.2.1 Commitment and Teamwork for Sustained Improvement

Robert G. Minor, President, Space Transportation Systems Division, Rockwell International Corporation

Rockwell International Space Transportation Systems Division is headquartered in Downey, California, employs 12,000 nationwide, and provides operational support to NASA centers across the country with the design, development and production of a wide range of aerospace hardware.

We are very fortunate in that we provide a diverse range of services, so our employees are challenged in a variety of arenas. We are involved in the integration, building, and design of the orbiter; the new heavy lift launch vehicle; and the initiatives associated with the SDI program. Our improvement process began with a strong commitment from top management, to a number of corporate initiatives on product integrity and productivity. Also, a natural complement to the focus on quality was a look at cost.

In the late 1970s we formalized our product quality plan and focused on improving each shuttle orbiter production process by critiquing the previous effort and making adjustments. This was the first time we enlisted the input from people on the floor.

In the 1980s the plan expanded to involve manufacturing, logistics, engineering, and quality assurance people. We formed teams for the first time to improve the efficiency of our processes, and this was also when we first became aware of the potential for quality improvement by improving the work environment and increasing employee involvement.

Following the Challenger accident, we, as many organizations did, really stepped back to take stock of our hardware, operations, processes, production and repairs. We made a new commitment to improvements and revitalized our teams.

Today, we do business in line with a vision developed about one-and-one-half years ago taking into consideration our competitive positioning. More than ever, we involve our employees in everything we do. We have assessed our strengths and weaknesses, fine-tuned our direction, and now involve employees in business pursuits and the division's future direction. Very importantly, we listen to our employees about issues which, if improved, would make them more efficient in both attitude and in their work. The key to all of this is communication.

From top leadership to his direct reports, to managers and supervisors to first level managers, each must highly prioritize the program and commit to team excellence. Our key managers and directors form improvement councils which come up with the thoughts and ideas for our employees to work on. The employee action circles are empowered to come up with their own ideas and thoughts of how to make things work.

Involving individuals helps them identify with the program as well as making them feel that they are part of the big picture and that they can influence the future. Successful programs instill a positive, no-fault environment in which people understand that as they come forward with ideas, they are not penalized if the idea is rejected. Each individual has improvement ideas as evidenced by our very active employee suggestion program. Between 1984-88, we averaged about one improvement action per person. In fiscal year 1989, we averaged more than one improvement action per person. We are very proud of that record. A possible key to this success is a highly motivated work force. Active management participation can instill the necessary positive feelings in the work place.

The following elements in our production process serve as examples of our entire program:

- The number one priority is error prevention. Multi-functional teams (engineering, manufacturing, quality assurance, etc.) were formed and given the priority of error prevention. Of course, errors happen, so corrective actions must be already in place and implemented to prevent the errors from recurring.
- Reassess our focus. This involves suppliers as well as in-house personnel. Where did we want to invest our time and efforts?
- Examine the evaluation process and determine guidelines within which to work. Our

multi-functional teams, most often the manufacturing or quality engineering managers, lead the efforts. The improvements that came out varied in nature from control to training, to new requirements, to new planning, or, as in many cases, new tools.

- The improvements are put into place as a team effort, and the process ends again with error prevention.

Also, we need to remember that the process, from planning to implementation to results, requires time.

The results of our process have shown us cost savings, process improvements, evidence that people on the floor have something to say about how we do business, and what they say can benefit everyone.

Our challenge is to sustain vigorous improvement, and sustain it from year to year. This will require:

- aggressive, participative management that motivates employees to take part in the efforts;
- an enthusiastic work force committed to the team concept and made aware of their influence on the future;
- recognition and awards; and
- communication.

2.2.2 Quality Leadership Starts at the Top

Michael R. Hallman, President, Boeing Computer Services

Boeing Computer Services, a division of the Boeing Company, has two missions; the satisfaction of internal and external customers.

Seventy percent of our 12,000 people provide institutional computing and telecommunications service for the Boeing Company. Externally, we have three major contracts, NASA being the largest customer.

We have experienced many phases on our TQM journey: an awareness stage, realizing the importance of quality; a learning stage in which we tried to learn as much as possible from many different sources and, most importantly, allowed the newly trained employees to apply the knowledge immediately; the leadership phase where line management assumed ownership of processes; and where we are now, the recognition that continuous quality improvement, the total quality concept, is not just a program. Continuous quality improvement must be integrated into the business' strategic plan, and be a way of life. The cultural change deals with people; they need to understand the company's vision and their roles in the quality efforts and the culture. The company mission states:

"In accordance with the highest standards of integrity, the mission of Boeing Computer Services is to satisfy our customers' requirements by providing information services of superior quality. Quality includes meeting or exceeding our customer's requirements for technical, cost and schedule performance."

In developing our strategic approach, we locked away 90 senior managers for a few days and followed a process which was developed by an outside consultant. They were forced to focus across the entire organization and agree on a plan they could all work with. Over the next six months, we extended the plan to our entire management system and, in the end, touched 1,400 managers who each had somehow affected the process. We are taking the notion of participative management to a massive scale. This process simplified communications and captured the enthusiasm, energy and excitement of the whole organization.

We have created a quality council, implementation councils within each organization and across organizations, and individual improvement teams where work force involvement plays a role. We also have a quality support center which provides the tools and assistance to all levels, whether that be education or consulting, to enable the process to continue. These groups ensure the flow of communication so that all participants are aware of the direction and all levels can share in the organization's vision.

Our overall strategy toward continuous quality improvement involves:

- Leadership from the top; not direction, but involvement. The importance of this is that when a conflict exists between what the ranks hear a manager say and what they see him doing, they remember the actions, not the words. Management at all levels must take an active role in the entire continuous improvement effort. We also need to instill the feeling of ownership at the middle management level, because they are responsible both for producing on a daily basis while also maintaining a strategic view of quality improvement.
- Quality must be an integral part of the business plan. We have concluded that the highest quality and low cost are synonymous. Doing things a second time is much more costly than doing things right the first time. Quality is defined as not just correctly building a part or servicing to

specification, it also considers cost, schedules, and serving the customer.

- Focus on high leverage business processes. We identify those mission critical processes that are fundamental to our success in satisfying the customer. From that we select a process owner from a relevant organization which drives continuous improvement activities across all involved organizations. During a review, process owners are reporting on what they are doing, not on what someone else is doing. This forces the involvement and accountability at the senior levels and throughout the entire organization.
- Our strategy is driven by the customer. The customer is the final arbiter of our performance. The ownership and management of key customer services processes needs to be developed. We need to be responsive to users' change of service, relocation of equipment, and installation of new equipment. Our improvement efforts, including the combination of operations, have resulted in being able to support a ten-fold increase in systems support with 30 percent fewer people providing that support. At the same time we've seen a 14-fold increase in the time between service interruptions, which brings in the issue of measurements.
- We support all our efforts with relevant, consistent key measurements. Relevancy is the key here. Rather than trying to sort the hierarchy of defects, we are beginning to look at total defects. For example, when assessing our telephone system, we count all troubled calls equally. We don't differentiate between a line that doesn't work, a light bulb that burned out or a person who didn't know what button to push. From the customers' perspective, all these things interrupted service.

Looking at the continuous improvements process in our program at Marshall, one key element to our success has been in the area of department task analysis, the ownership and management of the key customer service processes. I want this team to identify with and focus on the customer.

Our future challenges will focus us on:

- emphasizing leadership by involvement;
- ensuring that our middle managers embrace quality and assume ownership of the efforts;
- empowering the people in the process to select their relevant measurements;
- weaving continuous improvement into the organization's fabric; and
- emphasizing simplification of our processes and structure.

(Pictured Below: Panel 2 - Involving Everyone in Continuous Improvement: (from left to right) Leroy A. Mendenhall, Boeing Computer Support Services; Robert D. Paster, Rocketdyne Division, Rockwell International Corporation; Robert G. Minor, Space Transportation Systems Division, Rockwell International Corporation; Michael R. Hallman, Boeing Computer Services)

2.3 Impact of Organizational Culture on Productivity Improvement and Quality Enhancement (PIQE) Activities

Organizational culture is an integrated pattern of knowledge and beliefs which provides a context for organizational activities. Three award winning companies will describe how their unique organizational cultures facilitate the development of productivity and quality improvement activities. Elements of organizational culture which will be addressed include top management commitment and involvement; goals, plans, measures, and dissemination; open communications; training; work force involvement; rewards and recognition; and involvement of subcontractors.

2.3.1 Introduction

Roy S. Estess, Director, John C. Stennis Space Center, Chairman

The impact of organizational structure on productivity improvement and quality enhancement activities is quite a broad subject. As I look through the panel subjects, I expect that culture relates to PIQE as much as any other factor that we could talk about. What is organizational culture? How does it establish for the mechanisms of change and how is it passed on? You see in our libraries and hear in the business schools about books and case studies related to organizational culture; most visible are the high profile founders like Sam Waldran or Lee Iacocca, who have set the style for organizations.

Government and industry are known for varying cultures in varying organizations. While we think that we do have a NASA culture, which in a composite sense is rather unique in government, but likewise is familiar to those who have been around NASA for a long time. We are aware that we have subcultures from the agency and varying cultures from center to center.

We have three outstanding representatives from three excellent companies who will discuss organizational culture with us. The issue is not organizational culture in the greater sense, but what role culture plays with respect to productivity and quality enhancement.

2.3.2 PIQE Council: A Framework for Cultural Change

Bill F. Barry, Vice President, Central Region, Computer Sciences Corporation

One key element to organizational culture is top management commitment to the program or activity at hand, whether this be a PIQE activity as a contractually performed task for a client, an R&D program, or a company sponsored project like the United Way.

Without management involvement and commitment openly observable to non-management staff, most processes would be unsuccessful.

I would like to talk about a commitment that CSC management made to the establishment and continuance of a formal PIQE program. Specifically, I will discuss the establishment of our PIQE Council, which provided the framework for the cultural change we needed to successfully effect PIQE activities at our Houston operations.

In the 1980s we recognized a national imperative and NASA's strong leadership for improved productivity and quality. To facilitate an aggressive but organized response, our Houston management team commissioned what I call a strategic planning study to clearly identify key drivers for a successful PIQE program.

Our next step was to set up a PIQE organizational structure that would address and integrate all the key drivers. The PIQE Council was formed and chartered to plan, steer, and monitor all PIQE program activities. Panels were formed in correlation with the key drivers. To ensure top management participation, we require our top managers and senior staffs to serve as panel chairpersons. This is an example of our top-down element. Concurrently, we encourage our technical staff to serve on each of the panels so that groups throughout the organization are represented.

The council, chaired by either Houston Director of Operations Ken Nickerson or me, meets monthly. The council chairmen ensure commitment and empowerment. We also have a manager of productivity programs, Ted Pykosz, who is devoted full time to the PIQE program and keeps our program moving. The panels and their functions are:

- PIQE Awareness Panel -- increases employee consciousness of our PIQE program through posters, memos, internal and NASA newsletter articles, and other circulations or displays. They also developed our unique logo.

- Quality Circle Panel -- focuses on team group involvement. Quality Circle leaders comprise this panel and meet monthly in real-world, lessons-learned discussions.
- Suggestion System Panel -- focuses on individual participation. Suggestion evaluators, who represent each department, strive to evaluate all suggestions in a reasonable turnaround time. We have learned the importance of evaluating all employee suggestions within a reasonable time. Delinquent evaluation of suggestions are highlighted at our monthly PIQE council meeting.
- Training Panel -- oversees training of all Quality Circle leaders who, in turn, train all members. Training consists of problem solving and recommendation techniques.
- Incentives Panel -- comprised of members from each department, uses the peer voting method each month to select the PIQE employees of the month and of the year. This panel, during the program's upstart, also designed a rigorous nomination form.
- CSC Policies/Procedures Review Panel -- determines the potential impact, if any, of the quality circle and PIQE suggestions and then makes recommendations for modified or new CSC procedures.
- NASA Joint Activities Panel -- coordinated by our productivity manager with other managers added as needed. We began by supporting JSC's five-year plan which eventually evolved into Team Excellence. We are today still involved with Team Excellence in the areas of contracts incentives, measurements, training, and strategic planning groups. We participate annually in the NASA/Contractors conferences, contribute PIQE newsletter articles to the NASA Headquarters and JSC newsletters, and this year we were extremely pleased and honored to be selected as an Excellence Award Finalist.

What lessons have we learned? First, PIQE requires a full-time dedicated administrator. We also have recognized that the people on the job are the best ones to provide PIQE recommendations. We added a Management Initiatives Panel to sustain PIQE focus from the individual management perspective. We found that managers in the process of doing a good management job and making management decisions were unable to recognize the application of their efforts to our overall PIQE process. Out of the Management Initiatives Panel came recommendations for and implementation of individual PIQE programs at our operating department level.

Lastly, we learned that our employee recognition programs are important. We choose employees of the month and year and hold ceremonies in their honor. We also have an annual PIQE banquet and a professional recognition PIQE display case prominently displayed in our building lobby.

Our PIQE Council has undoubtedly provided the cultural change needed to accomplish our goals.

2.3.3 Mutual Trust Enhances PIQE Activity

James R. Dubay, President and General Manager, EG&G Florida, Inc.

EG&G Florida has served Kennedy Space Center for about seven years as base operations contractor. Everyone at Kennedy is our customer. Everyone.

We run the central mainframe computers, including payroll. We provide security and fire protection, and all emergency and medical services. We also handle all fuels, propellants and such materials at KSC.

Given the emphasis on PIQE activities, we really began with the Challenger incident. We, as a service organization, have entered the era of the full partnership and if it is to succeed, that partnership must be based on the de facto equality of the partners. Equality, as you know, demands trust. Our premise is that trust is the bedrock that underlies any meaningful relationship. I defy you to think of any meaningful relationship you have that is not based on trust. I can't think of one.

We found a very interesting scenario at KSC when we started in 1983. We saw that the day before had been operated by 13 contractors, in which we found every conceivable management style in dealing with problems and issues, and 14 unions. There had been a history of turnstile contractors and loyalty was hard to find. My job was of paramount concern. What does one do in such a situation? You have to develop an attack, a thrust, or an approach which will cause that unseemly mass to coalesce. I don't have to say that this kind of diversity is the most difficult aspect of bringing an organization together based on quality and trust.

Change has to come from management. Our belief, when we got to KSC and for many years, is that we were and we are different. We were going to prove that the employee as an individual was valuable. We were going to allow the employees to express their talents and exercise their brains. We were going to make clear to employees that without them, we had no intention

or ability to succeed as a contractor. Our first job was to meet customer needs.

Training would be used on an as-required basis and as the need developed. We first needed to demonstrate that our company held a set of values. That set of values was centered on the customer and the employee, and we believed that whatever else was important would naturally flow if we succeeded on these two fronts. We published our set of beliefs which embodied those two aspects of our commmitment, both to the customer and to the employee. We also found that "excellence" is more than a term, initiative, or a scattered program of demanding performance. Excellence is a fabric composed of many threads. A primary thread is consistent policy in all areas; consistent toward the employee both positively and negatively. The policy also has to have a demanding quality consciousness.

Embarking on a program founded on trust always poses a challenge. You really have to know the customer; talk with and listen to the customer. You have to utilize the work force's awesome talent, and of course, we knew that if we gave them any responsibility, they would accept accountability. You have to set high goals for the company and the employees. Finally, you have to demonstrate genuine care and concern for the employee, not only in the work place, but in the context of the individual.

We talk about maximizing our primary resource, and that resource is our employee on the floor who's doing the job. This approach literally applied in daily operations is a substantial variance on traditional philosophies of management and by definition, threatening. Any attack on the culture or management tradition is hostile to the manager who has been told for too long that managing means to direct and control.

We have turned that over. Our managers are told to listen rather than to direct; to encourage rather than threaten; to seek advice rather than to assume that the answer is wholly within his province; and to recognize the employee as an asset rather than a hireling entitled only to a paycheck. We are asking them to believe that this reverse culture can be successful for the team, and that "good" is no longer enough, because the competition won't permit it. Lastly, with most difficulty we are asking managers to change and accept the challenge of a new mentality.

We have involved the employee at every turn, and that involvement translates to commitment. This commitment shows in the hundreds of substantial program improvement ideas we have heard and acted upon; every aspect of the program has been enhanced. The customer is now a team member with whom we talk before, during, and after to confirm that we did what we committed to do. Labor is now a team member whose comfort zone at KSC has reached a point at which seven of the original 14 unions have voluntarily decertified and others may do so in the future. Decertification came about when the unions' members realized that we really cared, and they no longer needed artificial representatives to get what they needed. If a company effectively responds to employees' needs, the union architecture becomes redundant.

We run a number of programs which fortify another cultural element; communication. Communication is real, frequent, substantial, and targeted to the employee. My door is always open, and an employee coming into my office to talk is no longer a threat to managers. We have a suggestion program, "Express," which provides the anonymity for which the employee wishes. Only a small percentage of total suggestions received come through Express. Nevertheless, an employee submitting sensitive issues needs answers without necessarily divulging his or her identity. We commit to answering to Express issues within 10 days. "Trading Places" has been an extremely valuable program. I took this idea out of a book by a former Florida governor. On a very regular basis, he would spend a full day shadowing a state employee, in uniform with a state patrol officer, for instance, to meet the people, learn of their experiences first hand, and listen to their problems. I have adopted this program and visit, on a regular basis, various aspects of our operations. With time I will get through each operation, from computer assistance to security to getting behind a machine. This is the only way to know the experience of a machinist who runs a 35-year old unit, and accurately compare the estimated cost to correct something with the benefits of economy and employee morale.

As critical as any other element in our program is employee recognition. The human element is one that demands recognition, responds to it, and prospers in it. Genuine and substantial recognition has no limit, whereas frivolous recognition is worse than no recognition at all.

In conclusion, I can say that trust is difficult to define or measure, but when you have a level of trust in your organization, you know it. We believe we have built a trust, and one current measure of our success is that we are here today.

2.3.4 Proactive Paradigms: Key to Successful PIQE Cultures

Robert B. Young, Jr., President, Lockheed Engineering and Sciences Company

Culture can be defined as the climate for productivity enhancement, or productivity and quality improvement enhancement. People who want to excel will excel, so that a culture of productivity and quality allows people to just act upon their inclinations.

We seek to meet various objectives in culture development and quality and productivity performance. We strive toward a proactive culture in our organization. We want our people to build in quality in their daily business, rather than have it inspected in. The employees' desire, capability, and willingness to contribute already exists. It awaits the opportunity to take action, so we try to maximize the available opportunities. We also want to be recognized for our performance.

In the area of recognition, this is our third year as a NASA Excellence Award Finalist and we will continue to go through the process until we get it right. But we have made numerous gains through our participation by taking ideas back each time to apply them and build on what we have.

I am approaching the proactive paradigm in terms of looking for excellent performance in an environment dominated by requirements. Most of our everyday actions, individual or organizational, are done to fulfill a job requirement. The requirements come along, we commit to fulfilling them, we deliver and check to see how we did, we did alright, so we're seen as competent. In a proactive paradigm, we need to look beyond just meeting requirements; we need to look at the issues that have not yet been resolved or the issues that haven't been understood enough to become requirement, as perhaps they should be.

In a proactive paradigm, we're looking for our people to make offers against the issues. As they make agreements to meet requirements, and they see issues that nobody has tended to yet, they make an offer to resolve the issue. If the offer is accepted we then have a non-issue that has been turned into a requirement on which somebody will deliver. But, what we've noticed is that when we make offers against issues, perform and perform well on that offer or deliver on what we committed to deliver, the evaluation is one of excellence. We make agreements in response to somebody else, but we generate the offers. That's proactiveness. When merely performing in agreement to deliver on a requirement, the review is competence; a reactive situation, not proactive.

One major point to remember when seeking proactiveness is that your ideas or offers will not be heard if present requirements are not being met and not even at the competence level. Competence is the price of admission for excellence. People don't listen to the offers, to the extras, to the things we like to put additionally on the table if we're not already delivering on what we're committed to deliver.

We started a few years ago with programs to develop our culture. We had top-down and bottom-up programs. We started with communicating values to the organization through various publications. We also did situational training in which managers who saw their people in a good guy/bad guy image were told to notice people more on a situational basis. We did a culture change program where we helped senior management prepare for culture change; how it looks, what disruptions to expect. We did leadership training, coaching, coach training, and we put a standing focus on a number of areas that we're particularly interested in.

Our bottom-up program first took shape in the form of an employee survey which revealed all the skeletons in our closet; everything people didn't like and what they wanted us to know they didn't like. We did skip level meetings in which levels of management were skipped to bring employees to communicate their ideas and thoughts openly without being hampered by the presence of their bosses or their bosses' bosses. We also had upward performance appraisals. Employees evaluated management while management appraised itself, and the results were compared to see the difference in opinions. Interestingly, managers were nervous about this, but the results showed that employees had a relatively high regard for management while management thought employees' regard for them was much less.

We have ongoing employee teams, and we do a lot of co-training with management. We conduct much of our training making no distinction between organizational levels or position. We mix clerks, technicians, senior managers, engineers, Ph.D.s, and paraprofessionals in the same organization in much of our training.

We've experienced substantial employment growth in the organization, and at the same time we've had substantial growth in our PIQE programs participation; from 25 to 40 percent. More than 50 percent of our people participate in employee development; we expect about 800 people from our Houston operations alone, to participate in our technical development programs (a 60 percent increase over the last couple of years); and a 100 percent participation rate in our ethics training program. We also have a wellness program that sees

a 45 percent involvement rate. This program, as well as the methods of making it financially viable, was conceived by the employees.

Employee development activities take place on an employee's own time, so in those terms, they are actually employee initiatives. We may have made it available, but employees have taken advantage of the opportunity in large numbers. When something the employees want is not available, they tend to invent the program themselves and participate.

On the financial side, we've had a 40 percent salary growth of personnel, and yet held our labor rate constant. That means we didn't pay exorbitant amounts of money to bring people on board. We've held our labor rates, run our GNA rates down, and run our overhead down as well. Our cost reduction program has resulted in reductions of more than 100 percent. These are all very favorable financial changes.

The American Productivity and Quality Center recently included us in a survey they were doing on selected top performing companies and the top performing units within those companies. Our results showed that in the areas of teamwork and trust and credibility, we were above average; in performance against the common goals, we were substantially above the average; and in organizational functioning, we were slightly below the averages. What that tells us is that our program is serving us very very well; we're doing well against exceptional performers. That is a credit to our people, and I'm proud to be associated with the kind of people we have at Lockheed Engineering and Sciences Company.

Panel 3 - NASA Excellence Award Session - Impact of Organizational Culture on Productivity Improvement and Quality Enhancement (PIQE) Activities: (from left to right) Roy S. Estess, John C. Stennis Space Center; Bill F. Barry, Computer Sciences Corporation; James R. Dubay, EG&G Florida, Inc.; Robert B. Young, Jr., and Sherry H. Prud'homme, Lockheed Engineering and Sciences Company

3.0 PROCESSES FOR CONTINUOUS IMPROVEMENT

This panel will examine the concept of continuous improvement from several perspectives: the government's initiatives, the planning necessary to implement continuous improvement, examples of successful processes, and the importance of commitment and participation at all levels of an organization.

3.1 Government Initiatives: NASA's Quality and Productivity Improvement Program (Q/PIP) and DOD's Total Quality Management (TQM)

Executive Order 12637 directs all government agencies to implement continuous process improvement initiatives. This panel will discuss the status of this order from the Administration's perspective and examine the efforts of NASA and the DOD in carrying out this order.

3.1.1 Governmentwide Quality and Productivity Improvement Efforts

Dr. Carolyn M. Burstein, Chief, Quality Management Office, Office of Management and Budget, Chairman

Most of us who work in the quality and productivity arena are convinced that quality and productivity improvement strategies that work over the long term have three major characteristics: 1) they change the core technology and operating systems and processes used to make products or deliver services; 2) they alter the authority and responsibility structure of the organization; and 3) they challenge our assumptions about the role of people in the process.

The majority of quality and productivity improvement efforts across the government ignore these three elements. They are technique driven, short-term in focus, and unidimensional in thrust. The groundwork for long-term quality and productivity improvement will not be laid until federal managers focus on the guts of their operations and change the way they do business.

Guidance to federal managers on the long-term efforts and means to improve quality are provided in Circular A-132. The message in Circular A-132 communicates the governmentwide objectives as 1) federal agencies implementing and weaving total quality management throughout their respective organizations, and 2) making continuous incremental improvements in quality, efficiency, timeliness, and effectiveness, resulting in efficient and timely delivery of high quality products and services to the American people. Our efforts are presently focused through the 19 largest government agencies, accounting for about 95-96 percent of the entire federal government, and broadening in the future.

In order to achieve these long-term objectives and, very importantly, sustain improvement, cultural changes must permeate an organization. An example of a desired cultural change, especially in the government, is in the human resources area; an area to which the government has not paid adequate attention in the past. In the new culture, employee involvement, empowerment, recognition, education, and teamwork will take the place of a tall hierarchical structure. The suggested action is to diffuse power, information, knowledge, and rewards downward in the organization. Again, an environmental, structural change driven by education with a long-term outlook must support all improvement efforts; initiatives and projects which do not penetrate the structure will reap merely short-term improvements.

The Office of Management and Budget offers assistance in many ways to help organizations evolve their TQM programs. A few examples follow: 1) we run two formal agency award programs, The Quality Improvement Prototype Award and The Presidential Award for Excellence; 2) we sponsor an annual information sharing conference for federal employees; 3) we have established a Federal Quality Institute as

a consulting resource for training of senior executives in quality awareness; 4) free workshops and national seminars; and 5) regional networking groups. There is also a move to push the TQ effort to other bodies in government including Congress.

3.1.2 Total Quality in Action

Colonel Ronald A. Fullerton, USAF, Assistant to the Commander for TQM, Wright-Patterson Air Force Base

We have only been working on a truly formalized TQ plan for about 15 months, so we know we have a distance to go, but we are taking this very seriously. One of our main efforts right now is to establish the structure of our Total Quality (TQ) program; to create an environment for the TQ principles and plans to become part of our culture. Our definition of total quality is that it is a leadership philosophy, an attitude, an environment, our work ethic. I call it a six-inch challenge; the challenge between our left ear and our right ear.

The Aeronautical Systems Division (ASD) leadership developed a vision for us after a surveying all our operations. The bottom line is that we want to preserve the American way of life forever.

Here are a few examples of our TQ efforts:

- We are establishing a structure in each of our forty subordinate organizations, the engines which drive our TQ implementations, who report to General Loh. This seems like an incredibly broad span of control, but we are very decentralized in that General Loh tells me he makes fewer decisions now than any commander has in the past.
- Four subdivisions exist within each of the forty TQ teams; corrective action teams, measurement teams, an education subcommittee and the Idea System. The Idea System serves to process employee input for quality improvement. Sometimes, the Idea System can address suggestions and problems easily; in less complex cases by phone or handwritten note. If a complicated issue needs attention, the Idea System ensures that the action teams are in place to address the problem.
- ASD employees created 30 critical process teams which exist from three to four months to more than a year depending on the process being critiqued and improved.

Training is a main concern, and it needs to be an ongoing program. No one who has attended just a single TQM training course is prepared enough to help change an organizational structure. Formal and informal training, seminars, workshops are a continuous activity at ASD. Training can be a part of the culture itself. Here are some other present ASD TQ priorities:

- Cultivate TQ in 11,000 employees.
- Set initiatives in partnership with industry to fix processes.
- Involve and get the commitment from top management.
- Be prepared to invest considerable time into the TQM effort, bearing in mind that team activities are in addition to participants' work functions.
- Recognize short term successes to maintain enthusiasm for the long haul.
- Define meaningful measurements.

Most of all, we must have patience.

3.1.3 Continuous Improvement At NASA Lewis Research Center

Frederick P. Povinelli, Director, Administration and Computer Services, Lewis Research Center

Lewis Research Center's 4,500 employees, through 550 research facilities, provide research, technology and hardware for NASA and the aerospace industry. We pride ourselves on being vertically integrated in some of our key technologies. Space power is one of the areas where we have been successful. But we have not always been a successful operation.

Back in the late 1970s, we had no direction and a declining aeronautics program. Andy Stofan, a dynamic leader, then joined Lewis with a TQM conviction to participative management and employee involvement. As a result of the management style and its continuation by Dr. John Klineberg, we were able to achieve recognition in receiving the OMB Quality Improvement Prototype Award.

Cornerstones to our TQM and quality improvement programs are:

- Continuous commitment to total quality and continuous action by management in a participative environment for employees at all levels.

- Focus on customer satisfaction including an external peer review group and internal surveys/questionnaires to assess our processes.

The underlying factor is strategic planning to provide an outlook and direction. A number of employees from all levels were involved in 1988 to develop, from a "clean sheet of paper," strategies for the Center. They came up with, and management approved, a vision which places equal emphasis on research/technology and products. The elements are related in that technology leadership emanates from the research; institutional health comes from all areas; and a positive external image is derived from our high visibility projects.

The Lewis symbol and principles of operation are: 1) we manage our center to excel in both research and technology and development projects; 2) we work hard to know our customers, meet their needs and treat them right; 3) we have a "can do" attitude in getting a job done to produce top quality research; 4) we get people involved and communicate to them our direction.

Some elements of our TQM program are:

- Employee training in collaborative problem solving, motivation, feedback, and management styles. For instance, the successful implementation of an organizational flattening plan came from an idea which came out of our training program. Management had approved the idea and decided to let each organization implement their own reduction plans to dissolve one level of their respective hierarchies.

- Team activities which provide a structure for various work groups -- 46 quality circles out of which 29 work groups were created; productivity improvement and quality enhancement teams, chartered by top management, make recommendations on specific problems. One team project pertained to reward/recognition methods for contractor involvement in the Lewis suggestion program, and the other was the expansion of a mentoring program.

The results were noteworthy:

- A 63% increase in the Dual Career Promotion Ladder participation rate enabling 200 scientists and engineers to earn salaries commensurate with management positions.

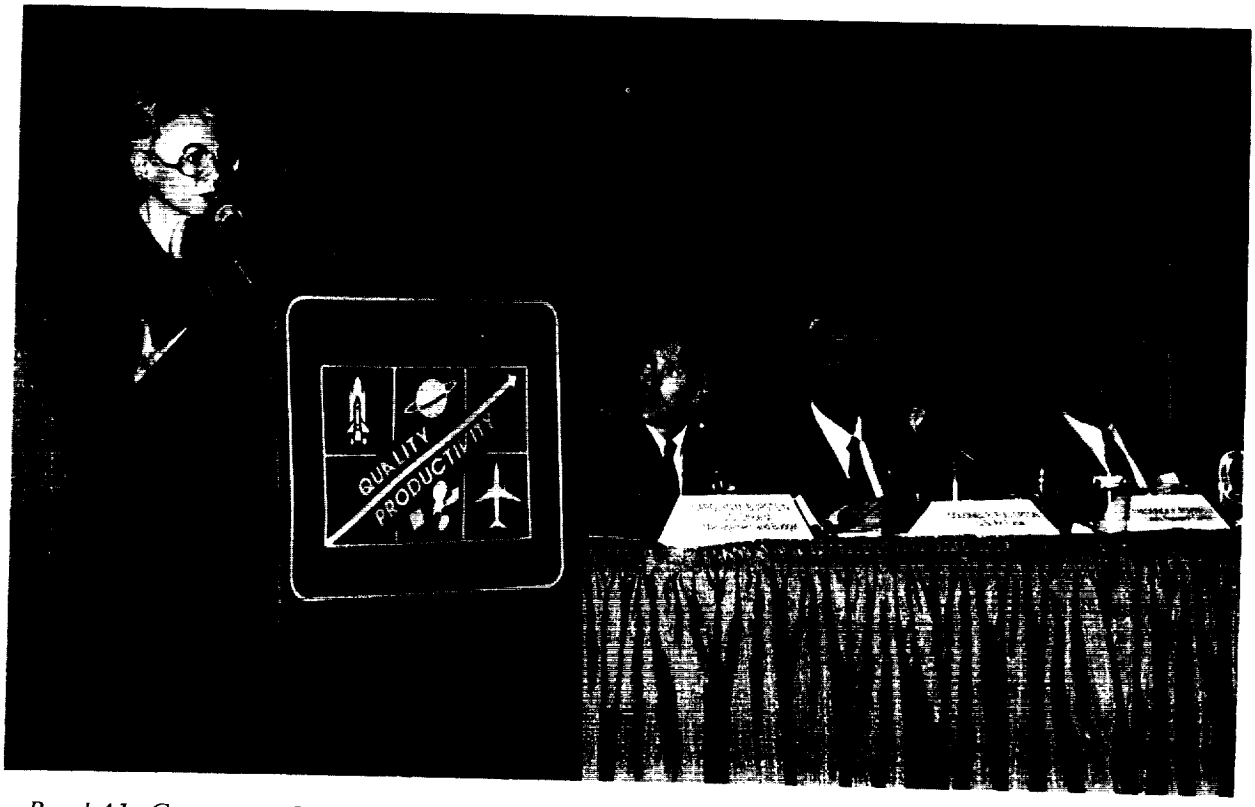
- Contractor incentives developed to consider their productivity and quality programs in award fees.

- A much improved employee suggestion program which has been around, but under-utilized in the past. Now, we have ideas submitted from every sector, and we are now expanding to recognize support service contractor suggestions.

- An awareness function which serves to bridge communications between all employees in a directorate. Each director delivers a State of the Directorate address to his/her employees throughout the year and directorate chiefs conduct their own issues and answers sessions throughout their organizations.

We have found that research quality programs and participation in award processes and research publications (process improvements in engineering and in fabrication, data analysis) lead to quality. Strategic planning that came with preparing reports resulted in improved processes. Additionally, we experienced a decrease in time taken to disclose inventions, and a process improvement in numerically controlled machines. Computer Aided Design (CAD) improved design efficiency by more than 50 percent and automated control in research saved $500,000 every year.

Progress has been made. We have changed the culture at Lewis, instilled a process and a feeling, a participative and involved management style, customer satisfaction, and a firm belief in utilizing strategic planning. Of course, this is a continuous process. We have additional centerwide programs in embryonic stages; in career development for instance, an area which demands more attention. We also need to become more aware of valuing and understanding diversity in the workplace in response to demographic changes and cultural exchanges. We are training our top managers and firstline supervisors to better understand and appreciate the changes in this continuing challenge.



Panel A1 - Government Initiatives: NASA's Quality/Productivity Improvement Program (Q/PIP) and DOD's Total Quality Managment (TQM): (from left to right) Dr. Carolyn M. Burstein, Office of Management and Budget; Col. Ronald A.. Fullerton, USAF, Wright-Patterson Air Force Base; Frederick P. Povinelli, Lewis Research Center; Dr. Dean R. Lee, Unisys Corporation

Panel A2 - Planning for Continuous Improvement - Space Station Freedom: (from left to right) P. W. (Gus) Ludwig; McDonnell Douglas Space Systems Company; Owen K. Garriott, Teledyne Brown Engineering; Richard L. Grant, Boeing Aerospace and Electronics Company; Dr. Phillip J. Cressy, Jr., NASA Headquarters; Donald H. Hutchinson, McDonnell Douglas Space Systems Company

3.2 Planning for Continuous Improvement - Space Station Freedom

Planning for continuous improvement includes developing an appropriate strategy and technique, and keeping the user's requirements in mind. Quality and productivity improvement requires a vision, a focus, a method, and a measure. This panel examines how these concepts are being applied to the Space Station Freedom Project.

Owen K. Garriott, Vice President, Space Programs, Teledyne Brown Engineering, Chairman

3.2.1 A Total Quality Management Approach for Space Station

P. W. (Gus) Ludwig, Director, Manufacturing, Test and Logistics, Space Station Division, McDonnell Douglas Space Systems Company

We know that TQM must be supported and acted upon by our CEOs and other upper management, every day. I can assure you that the TQM commitment is corporate wide at McDonnell Douglas. It affects every component and level of the organization.

Our vision is to achieve the highest quality at the lowest possible cost. Our focus is customer satisfaction, internal and external. Our means of achieving this vision exist in the quality of our people, systems, and environment.

The roots of our TQM program were developed in the 80s by Sandy McDonnell. They are Five Keys of Self-Renewal: participative management, development and tapping of human resources, working productively and measuring everything we do, thinking strategically, and being fair and ethical.

In the last five years, we have changed the entire structure of McDonnell Douglas so that the large corporation is now divided into small autonomous companies which focus on specific markets. The tallest organization is merely four levels between the president of that company to the plant floor. Within those companies are self sufficient divisions aimed at specific customers or programs.

Organizationally, by building teams horizontally, we cut the vertical lines of communication, and because of more flexibility and lower response time, we can better serve our customers.

In each McDonnell Douglas company, we try to create an environment that stimulates and rewards quality, excellence, teamwork, and continuous improvement. In Space Station Work Package II, for instance, employees share in award fees.

This is an outline of how we meet a customer requirement:

- Form a development team composed of people in logistics, production, engineering, business, and whoever it takes to complete the project. This team is chartered to design, develop and deliver the product.
- We stress ownership of their tasks. We give them resources and the forum of open communication for expressing their progress and needs. We expect accountability.
- Functional directorates supply the people and the systems to meet the team's needs.

This powerful process lends empowerment and communication, brings out entrepreneurship, and, I believe, first-time quality.

A significant savings in the Space Station Division has been realized through networked, automated information sharing which enabled all employees to increase productivity and quality in their work. User-friendly systems and processes empower people and provide benefits in simplification and standardization. Linked schedule tiers assure integration and control of a project. We have used three-dimensional computer-aided designs on Space Station to assure first-time quality in flight hardware, support equipment, and tooling. We work hard to empower our people to use systems and resources of our company to achieve our TQM goals.

I can testify that giving the people tools and empowerment reaps as many benefits as there are people creatively using those tools.

3.2.2 Challenges in Implementing Continuous Improvement

Richard L. Grant, Vice President, Space Station Program, Boeing Aerospace and Electronics Company

Planning with a common understanding of business strategies is an important first step. In the enthusiasm we have for quality programs and going into action, we must remain focused and organized to be successful.

We need to identify values and communicate unambiguous commitment. Going outside for ideas

looks good on paper, but the lasting improvements come from inside the organization, inside each individual. We must articulate our resources to reach our goals.

The continuous improvement process comes out of technology, management, our people, and corporate commitment. Ultimately, these things flow into the integrity of our product. By product, I mean anything from a piece of paper being circulated through the organization, to a videoconference set up, to the Space Station.

Unique to Space Station are a few requirements that demand unique quality programs. The demands of a thirty-year life requirement, protection from obsolescence, on-orbit repairability, a unique environment in which the Space Station operates, the inhabitants' needs, and many other science-based objectives. These things all evolve. Our customer focus then is on NASA, the ultimate users in space, and the scientists on Earth using the information gathered.

These are some examples of what we know our customer needs and the actions we have taken; the customers' requirements and the demands that will be made on technology and our continuous improvement methods:

- Productive use of crew time. We know the crew is limited in size and working time to perform experimental, maintenance and various other tasks. Computerized systems in place are essential.
- We are using a microgravity computer animation program to help computer designers think in terms of the environment they are designing for, microgravity. This interactive program translates his designs into the end-users' microgravity environment. Also, a three dimensional program is a part of the computer improvement effort.
- Automation is essential to the continuous improvements needed to meet our customers' needs. A robotic welding system, for instance is a technological improvement.

Strategies for success must evolve from the specific project. Specific demands from the Space Station are our road map. In the management arena, product development teams include all components needed (including subcontractors), rather than a project being handed from one process to the next process. This also provides participation for all elements from day one.

On the people side, we have adopted new ways in thinking about our human resources. Flattening hierarchies, for example, keeps the TQM program intact and continuous improvement going. When we consider how important educating and training our work force is, think about this: everyone who will be working on the first day of the next century is alive today. What we'll get is what we make of what we have. In efforts to communicate with youth today in the midst of the drug problem, we suggest a "high": that is the Space Station program.

Subcontractor management is a newer area to focus on since more than 50 percent of the work we'll be doing is done by subcontractors.

A chief scientist role is new for us. We are an engineering company. The science aspect is mindboggling on this job. We can't do a good job without them to answer to the scientific needs of our client. From this, we have technical staffs who report directly to the chief scientist as opposed to the traditional structure which sees technical staffs in their own environment.

In product assurance and quality, we have separated reliability and maintainability functions. They are separated and charged with putting the other out of business. If one succeeds, then I can say we were successful. The product integrity function has a direct line of communication with me so there is no misunderstanding.

Integrity in all we do is the bottom line as we compete in a changing business environment. Our success and growth depends on the quality of our products and services and the elimination of waste as we meet customer expectations. Our corporate commitment to intregrity, to our customer, and to our employees is essential so that all may take pride in the results of our program.

3.2.3 A User's Point of View

Dr. Phillip J. Cressy, Jr., Chief, Space Station Utilization, Office of Space Science and Applications, NASA Headquarters

NASA's Office of Space Science and Applications (OSSA) expects to be the major user of the Space Station manned base. It is essential that its use of the Station be efficient and productive because of scarce research resources. OSSA must thus maintain and continuously improve the effectiveness of its utilization, and must influence the development and evolution of Space Station accommodations to support that utilization.

The quality issue is a large issue in this mission, but by focusing on some of our space station applications, there is a carryover of quality enhancement to the overall project.

The OSSA strategic plan and a multi-year outlook/projection, our foundation, is distributed each year to our directorate and each division director signs off on it signifying their understanding. The reason for this is that, as Dr. Lennard Fisk, the Associate Administrator of the Office of Space Science and Applications, puts it, "If you're not in the plan, you're not in the budget."

Our Space Station goals are:

1) To study the effect of zero-gravity or gravity on:

- Life sciences - long-term human exposure in space, low gravity effects on life processes.
- Material sciences/processing, fluid processing, crystal development, fluid and combustion physics processes.
- Attached payloads area - includes all OSSA scientific areas, collecting cosmic dust.

2) Rapid Response Research - Exploring more rapid access to space for experiments which are less expensive, less ambitious and less sophisticated, but still valuable. We would be able to avoid spending millions of dollars and years of time waiting to do experiments.

3) Repetitive Access to Payloads - One valuable attribute of the Space Station is that, over a period of time, we can conduct various experiments by taking advantage of the free-flying facility's flexibility. We're able to visit, maintain and rotate experiments.

4) Accommodations requirements - with Office of Space Station, we seek to provide an environment for long-term experiments.

5) Crew - Six payload trained crewmembers operating 60-70 racks of equipment for 45-90 days before they are relieved. Training is of bigger importance than ever. We recognize scarcity of appropriately trained personnel as a resource.

With our strategic plan in place, we have a traceable set of requirements and experiments. We expect to update our models controls at each budget review. This strategic plan is recognized not as something steadfast but it serves as a frame of reference, flexible for changes that will help us work smarter or improve.

Many customers exist and will form in our work with Space Station:

- We focus internally and externally to work with various groups, including scientists who are working on present projects who can carry their experiences and lessons learned to Space Station.
- We have agreements with domestic science agencies to represent, work with, and support them in their access to OSSA, and together we could improve our utilization of Space Station in the order of 30-50 percent.
- We work with the international science community to collaborate and plan future experiments and share laboratory resources.
- We have end-users in the science community whom we have not reached yet for collaboration, as we wait for the point in the project when we can reach out for commercial payloads.

We need to set a reliability guidelines for Space Station payloads. The bottom line is to bring these factors into configuration control. Our two most significant requirements are that we need to have a certain level of control, to manage and trace the requirements and to promote them. Communication must be open; a dialogue with developers, designers, and planners so that we have a continuous system-check in place.

Space Station utilization must be continuously viewed in the context of overall priorities. The special advantage of the Space Station environment for the many science disciplines are reviewed frequently. Lessons learned from previous programs, especially Spacelab, are incorporated into Space Station plans. The key themes are control and dialogue. OSSA requirements are established through a rigorous process of review and analysis, carefully articulated, and controlled at a high level to maintain consistency, rredibility, and traceability.

3.3 Improving Excellence: Implementation of Continuous Improvement

Continued quality and productivity improvements require continuous process modification. Organizations which have been recognized for their quality and productivity achievements present their methods.

3.3.1 After Malcolm Baldrige, What?

Ralph Ponce de Leon, Vice President and Director, Group Operations, Government Electronics Group, Motorola, Inc.

The customers forming the base of today's world market are sending a clear, undeniable message to corporate America. They are demanding higher levels of product quality at a lower cost, greater responsiveness, and added value. Motorola, Inc., has heard the message and has risen to the challenge. This

was formally acknowledged last year when our company received the Malcolm Baldrige National Quality Award.

The process we went through in applying for the Malcolm Baldrige Award entailed submitting our programs in seven measurement areas: leadership, information and analysis, planning, human resource utilization, quality assurance, quality assurance results, and customer satisfaction, and then touring the examiners through our operations for validation purposes.

Motorola, along with the entire U.S. electronics industry, has been in an economic war. This was an emotional experience for our business which prompted us to pay attention to quality. We used to be in the consumer electronics business, but in 1974 we sold that business division to the Japanese because, in my opinion, we couldn't hack it. The Japanese are formidable competitors, their quality was far better than ours, therefore their productivity, thus they beat us. In 1978, at a Motorola officers meeting, the individual who runs our largest business unit pointed out that he felt our quality was inferior and that if we didn't take action, we would go out of business. That changed our entire focus.

We started with a quality program, stressing the following concepts.

- What is most important about a meaningful quality program is that it must have management backing and participation.
- Quality must be the foremost priority.
- Objectives must be set and they must be measurable. What is uncommon, perhaps, about our objectives is that we do not believe these points are supposed to be attainable. We set standards that are very tough and exceptional enough to cause our people to change the way they think. One example of this came in the shape of a decision from the top in Chicago stating that in the Government Electronics business, we had to improve our quality by a factor of ten! This seemed like an impossibility, but after we realized that our management was serious about this, we carried out the necessary steps to meet that goal.
- You have to do more with less. Reward managers who do more with less human resources. This shows productivity enhancement.
- Training and education is a necessary investment. Our policy setters in Chicago handed us a requirement that one-and-one-half percent of our payroll was to be put into training and education. We thought this was impossible, but realized we had to do it and we made it work. Our quality and productivity improvements paid for it. Today Motorola is able to spend $80 million a year on our training and education through a formalized program.
- Another business strategy we had to take was to target world-class customers; Japan for example. The paging business was assaulted by the Japanese dumping their pagers in our market. Combatting this required an innovative approach; we decided to turn the Japanese into a customer of ours. Our strategy was to make our pagers even better than theirs by improving on our pager deep in the product's design. Now we can claim a virtually fail-proof product, and we are the largest foreign supplier of pagers to the Japanese.

After taking on these quality initiatives, we have enjoyed the payoff in the form of a 20 percent increase in sales per year, and a 40 percent growth in return in 1987-88.

The future holds more improvement initiatives for Motorola. By 1992, we are shooting to be a six-sigma corporation. That's 3.4 defects per million units, in everything we do, administratively to manufacturing, and we are measuring everything we do.

In an effort to reduce our cycle, we are mapping out our factories in great detail to ferret out any non-value-added processes, and allocate our human resources efficiently. We want to continue to be product and manufacturing leaders (by participating in technology sharing, for instance), to improve profits, and the continuation of our participative management policy.

Motorola's success is based on a single objective which drives our business operations: customer satisfaction in terms of technical performance, schedule, and cost expectations. An initiative of process characterization has been effective in carrying out product parameter definition, analysis, optimization, and control. This is a scientific and deductive method for structuring a manufacturing capability problem. The strategy emphasizes deductive inquiry and repeatability, two central issues associated with scientific investigation. In this sense, process characterization constitutes working smarter, not harder. It enables an organization to capitalize on its strengths and overcome its limitations.

3.3.2 Quality Service to the Fleet

Commander Robert Malcolm Fortson, USN, Norfolk Naval Shipyard

I'd like to relate a story to you that I heard at a TQM symposium. It may or may not relate to customer satisfaction, but it is about an Air Force guy and a Navy guy up on the Arctic polar cap putting up a weather station. It was a beautiful day and they were quite a distance from their post as they looked into the distance to see a large polar bear charging toward them. The Air Force guy didn't know what to do, and the Navy guy was strapping on his snow shoes getting ready to run. The Air Force guy said, "You don't think you're going to outrun that bear, do you?" The Navy guy said, "No, I'm sure not going to outrun him, but I sure as heck am going to outrun you."

I think that story relates to the competition situation we are facing today because we have to compete with eight other naval shipyards, and convince the taxpayers that the Norfolk Naval Shipyard is a worthy investment. TQM, or any quality program under any name which serves as a strategic plan to continuously improve, at the Norfolk Naval Shipyard is, "Quality Service to the Fleet." The Norfolk Naval Shipyard has implemented and carried out a quality management program for the same reasons other businesses adopt their plans and for the same reasons this nation's business community is increasing its focus on quality.

Our function is to repair and overhaul ships in the U.S. fleet, but our business is to earn our customers' trust and our community's respect. Our TQM program is a strategy for continuous improvement with guiding principles which involve all employees and guide our day-to-day business activities.

The program came into being when the Shipyard Commander and senior managers faced an outlook which promised increased competition for business. This meant that in order to survive, the shipyard had to embark on a plan which would ensure that we satisfied our customers in quality of products delivered, and met schedule and cost requirements.

The main tenets of the Norfolk Naval Shipyard TQM program are as follows:

- The underlying strategy for continuous improvement involves all employees and requires that our objective be to strive for perfection, to continuously improve the quality of our work and of our work life.
- The strategy supports all management initiatives as guiding principle.
- The initiatives tie improvements to goals and keep the future in perspective.
- We stay within a disciplined structure: the structure involves all employees in finding and fixing problems. TQM is the common structure for improvement of problems and processes that are unique to a single work group, and issues that are shared by hundreds of persons from different areas of the organization.

We have four TQM organizations which bring everyone into the problem solving process:

- Quality/Productivity Improvement Council, chaired by the Shipyard Commander and is composed of top level management representatives and union officials. The QPIC is responsible for policy setting, implementation planning, and support for cross-functional process improvements.
- Quality Management Boards (QMBs) include senior managers of all shipyard organizations. They are a permanent body which oversees continuous process improvement helping solve problems between various NNSY units.
- Performance Action Teams (PATs) are comprised of individuals working on a specific issue, problem or process. A PAT is formed on a situation-by-situation basis.
- TQM Advisors serve as consultants to both PATs and QMBs. Advisors attend all meetings, provide training, and work with PATs and QMBs to help achieve group success.

These teams along with a 10-step process improvement/problem solving plan serve to identify, define and analyze problems; recommend and implement improvements; monitor, measure and evaluate processes; and most importantly continue the improvement process regardless of any initial improvements gained.

In summary, NNSY TQM encourages participation, innovation, and pride in ownership by individual employees. It uses a range of tools and techniques that help each organization in the shipyard better understand its work methods and how to improve our services. These methods are used to collect information, analyze causes, determine corrective actions and monitor improvements. Solving problems as teams and always striving for quality performance are how we work to give quality service to our customers and employees.

For the Shipyard's adaptation of total quality management principles to the various processes of its

business, we were honored to be named one of the Government's 1989 Quality Improvement Prototypes.

3.3.3 IBM Software: Continuing Excellence

Anthony J. Macina, Manager, Onboard Space Systems, IBM Systems Integration Division, Chairman

IBM Systems Integration Division/Houston has been involved in the nation's space program since Project Mercury and has produced over 9 million lines of code in support of the Space Shuttle alone. The Primary Avionics Software System on board the shuttle is responsible for functions related to vehicle flight, systems management, and interface between the crew and ground communications. The life of the crew, vehicle expense, and the high visibility of this national endeavor require the software to be defect free.

Quality permeates the organization that develops the onboard software. This organization has evolved over the past fifteen years. The software passes through six steps where, at each step, it is under configuration control by a software development environment which includes a simulation facility. Each department which works on the software is a quality team with its own measures, process controls; in essence, each takes ownership of the project. They define their own measures, and present their results to management periodically. Our quality program goes from management to the grass roots.

Since we were recognized for our quality program in receiving in 1986 the NASA Excellence Award for Quality and Productivity, we have surveyed the quality of our product, that is, the occurences of errors in our software.

We are presently at 10 errors per 1,000 lines of code, while the industry as a whole is at 20 errors per 1,000 lines of code. This is an improvement over time, and we are still working to improve upon that.

Early detection is a focus for us because you can't test quality in, you have to build it in. As our processes have evolved, we have moved our quality focus to the front end. We spend a lot more time looking at the design. The early detection rate measures how many errors we find before we commit them to software code, before submitting it to a build which takes them into the configuration control process. We are finding 85-90 percent of the errors before they are committed to code.

The process error rate measures problems that our internal verification organizations discover. This shows us how well development is doing, and how well our verifiers are doing.

The gross product error rate is a very important measure in that it tell us how many errors we are actually delivering to the customer. Our goal in this area must be "error free." In 1986, we were around 1 error per 1,000 lines of code. We are now down to near zero on a number of systems.

Automation has increased our quality and productivity: we cut the number of people involved in half as the software is developed through the automation, and the product is virtually error free. NASA has been able to eliminate a development contract and integrate the development process into an operational part of the shuttle program.

How have we improved in our various software programs? The bottom line is commitment from all levels of the organization, as well as from vendors, to zero defects. We believe that employee involvement and empowerment works better than having various "quality" patrol bodies watch over the processes.

The other part of the bottom line is the process. Our software development process has been thoroughly examined and understood.

Whenever we find an error, we will first fix the problem so that the software that has been delivered is fixed, then we find out why our process has missed it. The departments then present the findings to management and the actions required to fix the problem are executed. We are constantly auditing our process. Finding an error in the software and in the process is viewed as a positive event. We communicate this attitude to all employees.

The future management challenges that we are facing include:

- How do you maintain a stable, motivated workforce for a long extended project such as this? The answer is that we plan for attrition. We are on our fourth generation of experts allowing a 50 percent attrition rate. That brings up concerns over the loss of our skill base. We have developed special documentation which contains rationale behind our developements. Attrition is a factor that must be expected in a project that goes on for this long and the documentation is able to guarantee smooth transitions.
- Technology Insertion -- How do we insert new technology into a process which has been so structured? Engineers want to use the newest technology and build their own tools. Line management does not want to see the processes dissembled. Originally, we thought technology insertion was possible. I adopted an attitude that said, "We will have technology insertion. Just come back to me in six months and show me what you have done." Six months later, I saw that

nothing was done. This kind of undertaking required a grass roots action. Representatives from various levels of the organization came up with their own strategy and prototyped the technology in their respective departments. The technology insertion has since kicked off successfully.

NASA is helping in this cause with the modernization of its Shuttle program. The Shuttle is evolving in many aspects and we have a vision for our purposes that we will see more use of commercial products; more commonality with the Space Station.

This helps our people see the project positively with something to offer for the future.

The quality keys are:

- A commitment to quality from management and throughout the organization.
- Creating an error-free culture keeping in mind that the product will never be truly error free.
- Focus on the process, monitor it, understand its failures, and constantly refine it.

Panel A3 - Improving Excellence: Implementation of Continuous Improvement: (from left to right) Ralph Ponce de Leon, Motorola Government Electronics Group; Barbara G. Kolkhorst, IBM Systems Integration Division; Commander R. Malcolm Fortson, USN, Norfolk Naval Shipyard; Anthony J. Macina, IBM Systems Integration Division

3.4 Commitment and Participation: People in the Process

This panel will focus on the aspects of obtaining commitment and ownership from all the people in an organization starting with the CEO, flowing down to the mid-level manager, and integrating all employees and subcontractors to form a unified partnership.

3.4.1 Introduction

Fred C. Sheffey, Director of Productivity, LTV Missiles Division, Chairman

We often forget some of the people involved in our companies. They are not perhaps the most visible, but they deserve recognition, respect and understanding. The speakers today have three perspectives on how we appreciate people, but each is aware of the importance of training, trusting, and respecting our labor force.

In examining company costs such as labor, overhead, materials, and various indirect costs, the most outstanding costs in most of our highly technical organizations is labor. This means that as one of the highest expenditures a company invests in, it should be valued, developed and nurtured.

3.4.2 Effective Performance Objectives Matrix and The People Process

John F. Adams, Manager, Pasadena Operations, Deep Space Network Maintenance and Operations Support Contract, Bendix Field Engineering Corporation

Bendix Field Engineering Corporation Pasadena Operations' principal products are services provided to JPL and the Deep Space Network. While we constantly search for productivity opportunities and the associated cost savings, our primary concern is to constantly improve the quality of the services provided as perceived by the user.

The Performance Objectives Matrix (POM) is used as a control tool. It identifies target standards, the performance against those standards, and provides management with an overview of department progress toward selected goals in performance, quality enhancement, and productivity.

Management action, interest, and visible involvement is essential to any quality enhancement program. Managers are responsible for creating a climate in which the importance of productivity and quality enhancement are appreciated, especially in terms of customer satisfaction. Equally important, managers should involve the work force in the planning process so that employees become aware of department outputs and their influence over the quality of those outputs.

When the groups involved in the various processes select department targets, a better understanding evolves in the prioritizing of output products. For this reason, personnel in each department were encouraged to participate in the development, implementation, and monitoring of Pasadena Operations' quality enhancement program.

The operations manager and each department manager together identified management targets. These department targets, for which the department manager is clearly accountable, are usually budgetary or administrative in nature. The current standards of performance were determined, and long-range objectives (one year) and mini-objectives (one month) were negotiated.

The negotiation process involved selecting an appropriate performance algorithm which left no debate as to its meaning or accuracy. Guidelines were established by which all measurements would be tested. They had to be simple and understandable, easy and economical to collect, and had to use existing data where possible.

After completing the management phase of the POM development, department managers were better able to communicate to employees the POM's purpose as a quality enhancement tool.

Each departmental group was invited to participate in the technical target selection process. This point in the design process is most critical in nature. Some employees may be apprehensive and fear that their performances toward the mini-objectives will be formally and critically evaluated. If this happens, you may find that employees take fewer risks and contribute little innovation to the planned process improvement. For this reason, performance against the objectives should only measure group/department outputs. (Processes involving one or two people are not a part of this program. Where the employee has significant control over an entire process, a separate annual evaluation or review is recommended.)

Each group, working with the department manager, selected targets of opportunity for productivity improvement and quality enhancement applicable to

their group/department. The groups then reviewed the efficiency and effectiveness of each target's process to identify specific areas for improvement within each process.

Effectiveness was defined as the extent to which the process developed the products.

- How can the process be modified to provide a better product in terms of user satisfaction?
- Where in the process will the quality be most affected?

Efficiency was defined as the baseline cost (in total resources) of current products or services.

- Can we provide fewer input resources and expect the same or more output?
- Where in the process will a change result in more output (or better service) using the same resources?

Further analysis provided understandable and meaningful objectives acceptable to the work force. Each process was evaluated in terms of:

- Work versus productive work (was the work necessary at all?)
- Differentiating carefully between activities and useful results
- Working "smart" as opposed to "hard"

A measurement plan was then developed for each selected target. These plans started by asking, "Why measure this," and, "What is its purpose?" The answers to these questions identified quantifiable criteria that are indicators of each target's performance and were, therefore, identified as "current performance" (equal to line three of the POM). A realistic goal was established for each target, agreed upon to be achievable within 12 months. Mini-goals (monthly) were defined to represent achievable steps of improvement during the year.

The yearly review process is critical to the entire program. Employee inputs must be considered when tuning POM at the beginning of each performance reporting period.

3.4.3 Quality Initiatives in Start-up of a Major Program with Subcontractors

Dr. Pat Reynolds Odom, Program Manager, NASA Marshall Space Flight Center, SRM&QA Contract, Advanced Technology, Inc.

I'd like to comment about how we see quality in professional services and major NASA support programs, specifically about the Mission Services Contract for SRM&QA at Marshall Space Flight Center.

Start-ups face many challenges, particularly in a new client situation. These challenges usually include subcontractor issues; successful quality initiatives in the start-up process; measurement and feedback in a cost-plus-award-fee contract; and status reports relative to these initiatives.

Mission Services is really people serving people in a partnership. We have a customer, but also a partnership in that customer. The subcontracting partnership is also very important in serving NASA.

We see quality as meeting or exceeding requirements, customer expectations. Responsibility starts at the top, but the contributions also come daily from the floor. The measurement of success is customer satisfaction, and our goal is continuous improvement.

The core formula for success is:

$$\text{Customer Expectations} - \text{Contractor Team Performance} = \triangle$$

The goal is for us to make $\triangle = 0$, or even try to drive $\triangle$ to a negative value meaning we have exceeded expectations. We want to be able to continue the "quality journey" throughout the life of the service contract.

Achieving quality performance is a sequence of actions; understanding what the quality requirements are in our performance and what the process involves to get us there. The contractor team management then commits to a quality program to ensure participation on the part of every project team member to the point of ownership. Ultimately, a new culture evolves.

The SRM&QA contract involves support in various Marshall SRM&QA activities on the Shuttle, Space Station, Hubble Space Telescope, Spacelab, other space flight experiments and payloads. Our team includes two subcontractors, Ebasco and Technical Analysis, Inc.

The quality task in a start-up contract such as ours involves assembling the team, getting to know the

customer and its needs, defining contractor and subcontractor roles on the team, and formation of a management review board, which includes management from the three companies, who meets quarterly to assess quality programs performance.

We have done much team building. We believe that when the three companies act as one in providing services, as well as in other business and social activities, a strong support team contributes to quality performance. Examples of our team building efforts include: integrated staff meetings, common project orientations, integrated progress reviews with NASA, integrated social and community activities (a successful United Way campaign, a championship softball team), co-location, common identification badges, and shared imprinted stationery.

The award fee process provides a natural framework for evaluation of our performance quality. There is a team self-evaluation that also helps us formulate our performance evaluation. We also get feedback from all our Marshall interfaces. This is how we improve; make corrections to our processes based on the feedback we get and share the bottom line with our subcontractors.

Our start-up contract was extremely successful at Marshall using these methods. We are evolving into a quality organization providing quality services, not just quality work. The difference lies wherein an engineer can do quality work, but does not necessarily serve the customer well. We are trying to get our people to understand that.

Our first evaluation period was excellent, and we're in the process of the second evaluation hoping that it will be stronger than the first. We focus first on quality service and then quality work.

3.4.4 PRC's Quality Commitment in the 80s and into the 90s

Wayne Shelton, President and Chief Executive Officer, Planning Research Corporation

At Planning Research Corporation, quality is our top priority. I am going to use PRC as a mini-case study and talk about our present quality program and what our future plans are.

"At PRC, Quality Starts with Me." This is our slogan. For seven or eight months each year, we invite all 2,000 Washington, D.C., area employees to a weekly social event on the patio of our PRC headquarters campus in McLean, Virginia. Prior to one of these "Patio Parties," senior executives in our quality area approached me with an idea that we use "Quality" as the theme for one of these events. Buttons were made, a banner was made for signatures, various other items were printed with the slogan and given to the partygoers to take home with them. This is one example of communicating the importance of values in an organization.

PRC is a professional services company, founded in 1954 by some scientists and engineers, which now employs about 6,500 people. The original founders left the not-for-profit Rand Corporation to begin this profit venture, and because of this, the media characterized PRC as a, "for-profit Rand," recognized for being a high quality, but not inexpensive, systems analysis and operations research organization. Currently, our primary areas of expertise are in computer-based information systems and engineering support services. About 70 percent of the work is for the government with a little more than half of that for DOD. The company operates in a generally decentralized mode with three operating groups. One group has no government work while the other two groups work across defense and non-defense agencies.

PRC has been working chiefly with government organizations, assisting them to adapt to a rapidly changing environment that is characterized by increased user expectations, pressing economic considerations to fully exploit technological potentials, and growing quality awareness.

Competition has been fueled by these increased user expectations, the satisfaction of these expectations in an environment of increasing productivity, and by using technology to supplant human labor. As a result, both the suppliers and the users of professional technology services have created a never-ending environment of more for less.

The complexity of technology applications has both created the need and the mechanisms for greater quality assurance. Methods of buying professional technical services have changed, primarily in the government where there has been a regression in the consideration of quality in the acquisition of these services.

Two examples have had a significant impact upon quality assurance policy and procedures at PRC involving the operating group which provides fuel services engineering support. The other involved the operating group responsible for information systems development and systems integration.

PRC won a large design engineering support contract at KSC in 1974. The center director at that time did not believe quality work could be achieved solely through a system of extensive checking or inspections. This belief was also held at PRC, having found root in the early years where work was accomplished by assigning teams of people to accomplish small projects. The question was whether

such a human resource utilization could work in a project as large as 1,000 people. Partially in response to KSC management, PRC set out to try it.

The first step was the organization of task teams where each team and each individual was held accountable for the quality and compliance with requirements documentation. Quality assurance was not viewed as the responsibility of project management or a quality assurance manager. This was unusual 15 years ago. Techniques and procedures were set up leading to quality documentation that assigned the responsibility to the lowest level. For example, each engineer was required to sign off on his/her own drawing with a mere check as verification. PRC developed and implemented a design audit system that traced each design back to the requirements, verifying as built/designed, tested as planned, working as required, and incorporating all elements of the interface control documentation. This was commended by the GAO and NASA. PRC still carries on the concepts of team approach, individual responsibility, and traceability to requirements.

Another example affected the operating group responsible for information systems development and systems integration. There were three concurrent intelligence agency contracts which were underfunded, highly dependent upon government actions, inadequately staffed and poorly managed. The contracts experienced schedule slippage and budget overruns. The government finally notified PRC top management that the three contracts were not acceptable. Corporate management scrutinized these contracts and removed and dismissed management. Corporate management delivered a strong message to replacements that the only priority, above profit making and new business generation, was to restore quality and performance to the business.

The projects were then put back on track with revisions made in all areas; personnel and actions on the government side, cost projections, scheduling, and staffing. Interface checkpoints were implemented and quality review procedures and reporting mechanisms were established. This sweeping change was commended by government.

Several strong messages and institutional policy and procedural changes arose from these experiences. Better reporting procedures were needed to top corporate and government management, more review in planning and conduct standards, and top management of complex projects were given guidelines. Management was serious about responding to quality problems. Quality performance became the company's highest priority, over profit and growth.

Quality is a way of life at PRC, manifest in the content of our in-house news organs, training programs, management objectives and reward systems. Other components of our quality culture are carried out in various ways:

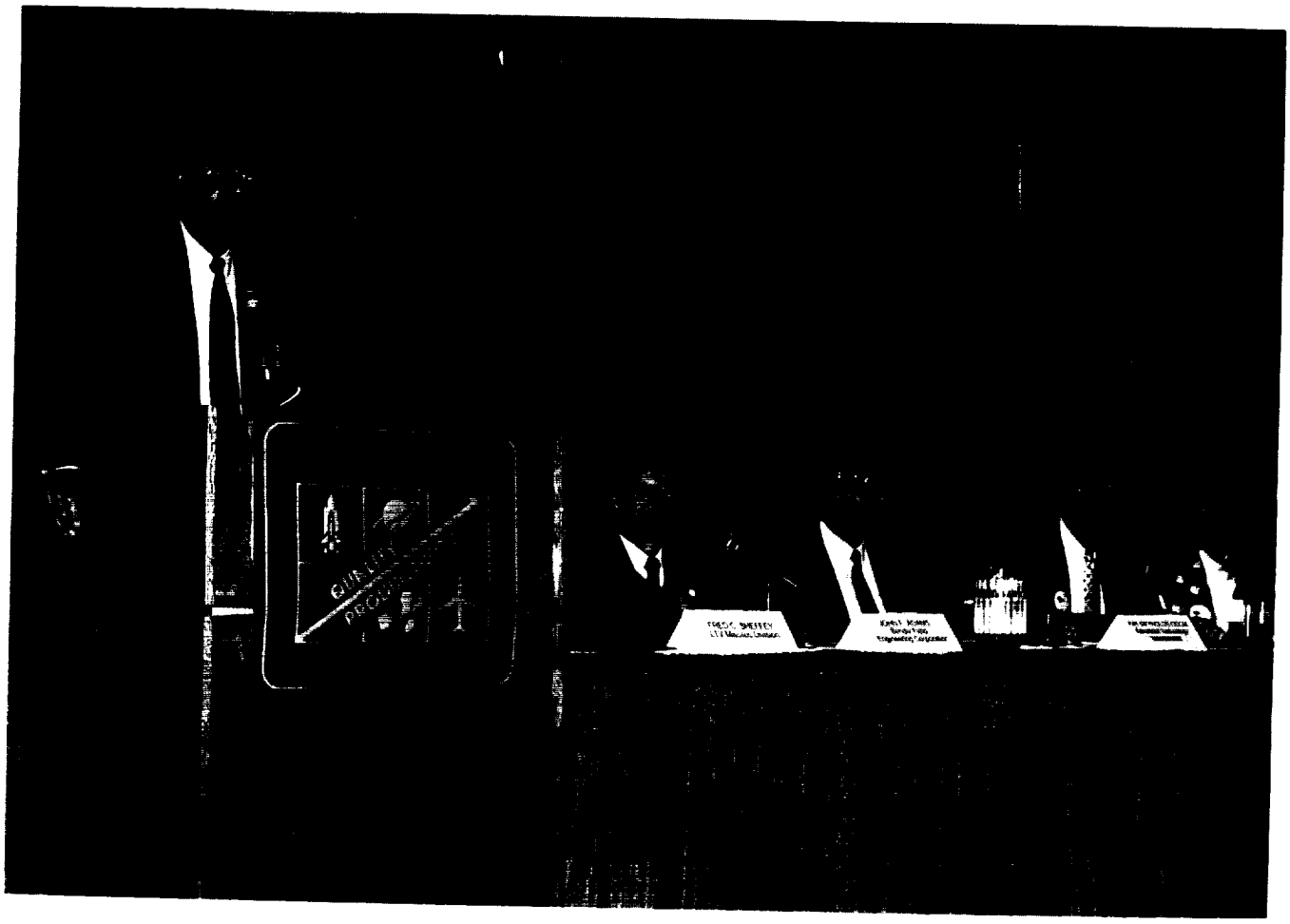
- quality is a prominent topic on the agenda of internal and external activities, including a focus on "quality" in our corporate advertising messages;
- we have instituted our project conception program emphasizing quality from the beginning;
- we formalized and standardized consultant and peer quality reviews of ongoing development and integration contracts;
- we assign quality managers on all major projects and imbed quality assurance advocates at all management levels (corporate, group, division, department);
- we committed corporate resources to the superstructure and the infrastructure necessary to support quality assurance in all aspects of operations and support.

PRC management believes that quality, productivity, growth and profits are linked. Management communications and strategic business planning documentation support planning as the number 1 priority. Management embraces TQM as a formalization of PRC's quality programs linked to government's emphasis on the importance of quality.

The rationalization of PRC's ongoing programs and TQM implementation is occuring; new training programs are in process and new quality and productivity metrics introduced. Quality in a professional services firm is not automatic. Quality is not free; it's just less expensive than non-quality.

We must recognize that the government marketplace presents some barriers to quality, apparently in the over-emphasis on apparent cost. Communication of an organization's values, goals, and objectives must support quality work. People want and need direction and will respond.

This is the sad but bare truth, in my opinion; government procurement procedures' focus on cost and lack of real emphasis to quality may drive quality professional services providers out of business or, even worse, out of quality performance. People are the critical element in quality and we all know that committed and participative people cost money. We can't have them without adequate resources.



Panel A4 - Commitment and Participation: People in the Process: (from left to right) Fred C. Sheffey, LTV Missiles Division; John F. Adams, Bendix Field Engineering Corporation; Dr. Pat Reynolds Odom, Advanced Technology, Inc.; Wayne Shelton and Dondie A. Stephenson, Planning Research Corporation

4.0 Human Resources: A Capital Investment

The United States will not remain a competitively productive nation unless it continues to prepare, with dependable regularity, a future work force of the right size, with the right skills, and of the right quality. This panel focuses on current actions taken by industry and educators to develop math, sciences, and engineering students for the future; select, enculturate, and develop employees; manage work force diversity; and to approach human resources as an asset critical to the success of any business.

4.1 Quality in the People Pipeline

Industry employs two-thirds of our scientists and engineers. Your productivity will be affected by students now preparing for such careers. Aerospace and other leaders describe their innovative involvement with education, helping to 1) inspire interest in math/science/engineering careers and, 2) ensure sufficient quality and quantity of candidates for the future work force.

4.1.1 Business/Education Initiatives in Northern Virginia

Lynford Kautz, Director, Fairfax County Public Schools Education Foundation, Inc. Chairman

Business and industry together have made significant contributions to precollege education during this decade. Always concerned with the college graduate eligible to enter our respective businesses, we did not look at the years it took to develop that graduate or ask the question, "Did business have a role to play in elementary and secondary education?" Major cities like Los Angeles, San Francisco, Dallas and Boston met the challenge nine to ten years ago.

Schools in these cities saw an increase in drop outs. Alarmed at the significance of a poorly educated population, school administrators took their case to local businesses. They in turn, translated the situation to an inadequate work force only a few years down the road. Business and industry in these cities are promoting the theme, "keep kids in school." They provide mentors to work closely with students, many taking the place of absent parents. One necessary action that stands head and shoulders above the rest is to lend encouragement. Too many young people see no reason to try.

Let me bring to your attention another dimension where business and industry work together to support elementary and secondary education. It is a suburban area, the tenth largest in the nation. It is among the few wealthiest areas in the nation. Its citizens believe its school system to be among the best in the nation. So, what can business add to such a system?

Let me direct your attention to competitive nations. Are their schools better than ours? Are we satisfied with the quality of our schools as they prepare students for the work force? If not, we do have a role to play. In this suburban area the superintendent of schools called a group of executives together in 1983 and presented them with a plan to improve the study of mathematics and the sciences that would better prepare our young people for tomorrow's technological challenges. The superintendent had the school board's approval to form a magnet or regional school, the Thomas Jefferson High School for Science and Technology, that would offer specialized studies in technological subjects, and offer a greater than normal series of studies in the humanities. It was a challenge to the 130,000 Fairfax County students and young people in the neighboring county school system at the secondary level. Fairfax County is interested in quality education and saw specialized, regional schools as one of the answers. Lacking in the plan were dollars for laboratories designed to support the curriculum and student research. The superintendent's challenge to business and industry was to assist him in building the curriculum,

recommend the kinds of laboratories in support of the curriculum, and then to equip the labs.

Opening its doors to its first 400 freshman students in 1985, we witnessed their graduation this past June. All but one student went on to higher education. The magnet school concept to improve science and math in Virginia's schools was the idea of Governor Chuck Robb, now Virginia's senator. He believed training the students within the state would have the result of many of them working in the state. His concept may prove correct. One hundred sixty students of the 385 graduating chose Virginia colleges and universities after being accepted by the nation's best known institutions.

We have learned that there are advantages in bringing together the best young minds in a locality. They stimulate one another resulting in a new level of achievement not possible if left to their own development and direction. Let me back up that statement with statistics. Last year the number of Merit Scholars from that school equaled the total number of Merit winners in the state of Maryland. This year, 58 students qualified, with Langley High next in number with 15 semifinalists in the annual Westinghouse Science Talent Hunt, dwarfing the showing of every school outside of New York. The significant achievement was the school yielding a team to win the supercomputer in the national science competition sponsored by ETA Systems, a subsidiary of Control Data Corporation. It is the only supercomputer in a high school in the nation, and carries a value of more than one million dollars.

Though other high schools have access to laboratories, Thomas Jefferson's laboratory arrangement is unique and constitutes its distinguishing characteristics. The labs are designed to support instruction and curriculum in the biological sciences, and provide unique opportunities to learn about current equipment, procedures, and scientific and industrial processes. The laboratories recommended by business and industry (following the formation of the Fairfax County Public Schools Education Foundation which was formed to equip the laboratories), and adopted by the school system, are:

- The Chemical Analysis Laboratory
- The Computer Systems Laboratory
- The Energy and Engineering Science Laboratory
- The Engineering Graphics and Computer Laboratory
- The Industrial Automation and Robotics Laboratory
- The Life Sciences and Biotechnology Laboratory
- The Materials Science La ratory
- The Micro-Electronics Lab tory
- The Optics and Modern Physics Laboratory
- The Telecommunications Laboratory

To keep pace with world competition, we must bring into our business operations young people educationally equipped to grow with our firms. In Fairfax County, we find a school system wanting advice and assistance from business. School personnel must think of ways that we can be of assistance. The Jefferson High experience can be duplicated in most American communities. When we look at what these students have accomplished, and have been excited about doing, we realize a great waste among talented young people nationwide that are offered only average studies. Quality education is the result of educational challenges.

4.1.2 Educational Activities of NASA

Dr. Robert W. Brown, Director of Educational Affairs, NASA Headquarters

Scientific Literacy for the 21st Century (SL-21) is an extension of NASA's existing Five-Year Educational Affairs Plan. It concerns how NASA can play a more active role in helping to increase scientific literacy among the nation's classroom teachers, students, universities, and the adult general public. The major impetus for SL-21 was the President's July 1989 announcement of the Space Exploration Initiative. The initiative calls for the completion of Space Station Freedom in the next decade, returning to the Moon to build a human outpost for space research, to be followed by the human exploration of Mars.

To accomplish these goals, the nation must have an adequately trained and continuing supply of scientists, engineers, and other technical personnel, and a knowledgeable and supportive adult general public. NASA's Educational Affairs Division has proposed SL-21 as an expanded NASA educational resource to support the Space Exploration Initiative.

Among the demographic and science education problems that must be confronted are a reduced population of college-age students; a decline in the number of science, math, and engineering majors; increased under-represented minorities, women, and immigrants in the U.S. work force, representing groups who have traditionally had low participation rates in science and engineering; significant numbers of teachers with inadequate education and training in

science; and an aging university science and engineering faculty.

SL-21, using aeronautics and space as a catalyst for learning, sets forth a series of space science education programs strategies that address four targeted groups of teachers, students, universities, and the adult general public.

4.1.3 Close Encounters in the Academic Trenches

Joel R. Stone, Vice President, Human Resources and Communications, Rockwell International Corporation

It is apparent that we are faced with an incoming work force that has an alarming rate of illiteracy, and many potential employees will require remedial training to become effective participants in industry. At Rockwell we are addressing this situation through an agenda called Partnership for Progress that is carried out through a Community Interface Program. This is a four-point plan that is geared to educational enrichment, private sector initiatives (urban enrichment), customer relations, and small business development. The Community Interface Program focuses on student needs in terms of drug and gang diversion efforts, encouraging students toward scientific and technical disciplines, sharing new technology and equipment with schools, and acquainting educators with the needs of industry. The scope of the program is large; in 1988 over 33,000 students were involved in our educational, vocational and special programs.

Rockwell's REAP (Rockwell Education Advancement Program) reaches students at all levels:

- In elementary school, students are exposed to the exciting technological world of aerospace through activities such as science olympics and career day projects
- In middle schools, emphasis on is placed on counselling and motivational activities, including tours of Rockwell facilities and conferences. Encouragement to continue education is very important at this age, since the middle schools are very much affected by the dropout rate.
- In high schools, Rockwell focuses on supplementing teaching, providing students the opportunity to visit their facilities and take hands-on courses related to aerospace fields.
- At the community college level, REAP participates in cooperative and internship programs.
- At the university level, REAP keeps in contact with college units and summer programs.

The result of these efforts is a "Rockwell-cultivated" student, ready for employment at a professional level.

Advanced career training and adopt-a-school programs provide two-way benefits as students develop critically needed technology awareness and aerospace skills. We will continue to implement programs such as these in the future because educational and community partnerships will play an essential role in the future success of our programs.

4.1.4 Beyond Child Care: An Elementary School on Company Property? Who's Doing It? Why? How?

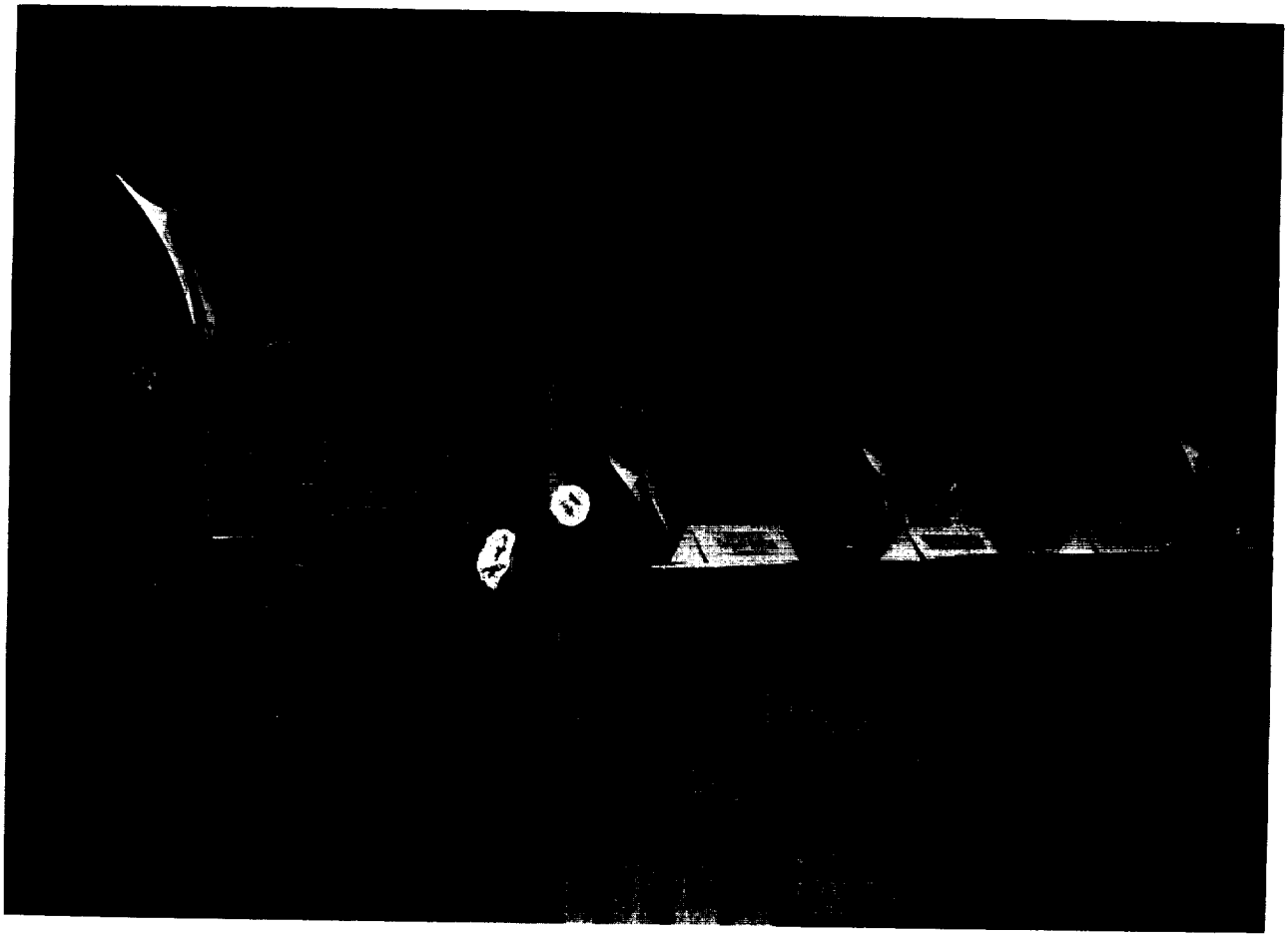
Roberta L. Keiser, Lead Teacher, American Bankers Insurance Group Learning Center, A Satellite School of the Dade County Public Schools

Dade County Public Schools, the fourth largest school district in the United States, has been challenged to address educational needs of a contemporary society with changing demographics, two career families, and students with diverse cultures, languages, abilities, and needs. Under the auspices of the Satellite Learning Center Program, the school district initiated and established a partnership with the American Bankers Insurance Group (ABIG) in 1987 to provide a kindergarten-through-second-grade public school for the children of the ABIG employees at the worksite. The school district supplied staff, curriculum, equipment, and supplies. ABIG provided the facility, maintenance, and custodial/security services.

Benefits have been realized by all participants. ABIG has experienced reduced employee turnover and absenteeism along with improved morale and a valuable recruitment tool. The school district was relieved from significant capital expenses and overcrowded facilities in addition to strengthening the bond with the business community. The parents and children have benefited from increased contact, teacher-parent communication, and an outstanding educational program in the formative years of school.

Satellite Learning Centers represent a unique form of partnership for continuous improvement in education and the future work force. This innovative

concept has been replicated in Miami with centers at Miami International Airport, Miami-Dade Community College, and negotiations for centers in a hospital complex and major industrial park. The success of this venture has initiated similar programs for GE in Largo, Florida; Department of Transportation in Tallahassee, Florida; two centers in Minneapolis, Minnesota, and numerous national and international prospects. Satellite Learning Centers improve the quality of early childhood education and maximize professional performance for the future by combining the resources of industry and education.



Panel B1 - Quality in the People Pipeline: (from left to right) Lynford Kautz, Fairfax County Public Education Foundation, Inc.; Dr. Robert W. Brown, NASA Headquarters; Joel R. Stone, Rockwell International Corporation; Roberta L. Keiser, American Bankers Insurance Group, Satellite School of Dade County Public Schools; Charles P. Boyle, NASA Headquarters

4.2 Building a Partnership with Employees

In a highly competitive environment for quality employees, it is important for new employees to feel that they are a valued part of the organization. This panel explores programs that are being used to help employees adapt to the work environment and to build loyalty between the employees and the organization.

4.2.1 Introduction

Gerald Sandler, Senior Vice President, Information Systems, Grumman Data Systems, Chairman

Management's partnership with employees is crucial to designing, building, testing and operating high reliability systems. We will hear how this partnership has helped companies increase sales and productivity. My own experience on space systems dates back to the beginning of the Apollo program with a dual partnership between NASA and its contractors, and between the companies and their employees. These partnerships were probably most crucial to the success and safety of the mission when one considers the short time span within which thousands of new employees joined the program.

In management circles, we hear a lot about partnerships, jointness, participative management, employee involvement, and self managing teams. In cultural approaches, we hear about family and community participation. What do we really mean when we talk about a partnership with employees?

- The sharing of a vision, a set of values and common goals. As it applies to space programs, the goals of each employee has been the personal commitment to mission success and safety.
- We're all in it together. This means customer participation, top management involvement, the participation of each individual employee, and personal commitment; communicating to employees the importance of their individual roles in the process and the consequences of their non-performance. This buy-in to the effort ensures that the right things are done right, the first time.
- A broadened employee perception of the insufficiency of just performing their tasks correctly. They must understand what inputs they need, the quality of those inputs, who will be using their output, and how their output will be used. The real problems generally occur at interfaces. Therefore, total quality means that each employee understands the total process, understands his or her role within it, and cares about quality results. This builds commitment.

On the other side of the coin is management's role. Management must communicate to employees that employees are important not only for the sake of the process, but also as individuals. This requires a proactive human resources management approach.

During this panel presentation, we will hear many examples of successful human resource management approaches.

4.2.2 Start the Partnership Early

Robert L. Pike, Chief, Human Resources Division, Ames Research Center

Why do we want to build a partnership with employees and start that partnership early? To be successful and competitive, to retain employees, to accomplish the organization's missions. By recognizing employees as customers and providing a service to them. These are a few elements active at Ames in building successful partnerships:

This first element can be compared with a trial marriage. We have 200 potential employees on site at any particular time: co-op students, Ph.D.s working on their doctorates, high-school or college interns, and joint programs with local university students. These are potential employees and our efforts to begin a partnership must include them.

Our new employee welcome program includes a variety of services: home finding, an introduction to the community, loans, contact making, and mentoring. Ames determined this to be a vital function requiring a full-time person's services. This human resources/ personnel contact is mentioned in every offer letter as one who can answer any relocation questions like moving, housing, travel, etc.

This person also coordinates details with real estate agents, our relocation service contract, and local apartment houses. For students, we work out loans (to help them in the first few weeks before the first paycheck), roommate finding, and special housing. One way we help employees who are relocating involves a special arrangement we have with some local apartment houses. By backing the employees with a "deposit fund," we can save them from paying the sometimes costly initial deposits.

Also in the offer letters is the name of an on-the-job contact who can answer questions about the job itself. We like to have either the human resources contact or the technical contact greet the new employee on the first day to give a tour of the facilities, a briefing on job requirements and expectations, and insights into the organization.

Another element of our employee partnership is offering educational opportunities. These opportunities are available in many areas: graduate programs, vocational classes, self improvement classes, and computer training. For the professional staff, both on- and off-site career enhancement courses and graduate study are available in conjunction with the nearby universities and colleges. Similarly, other staff can tap the local community college resources for college credits or certification in their areas. Of the 2,000 employees at Ames, 300 are potential candidates for these programs and more than 150 of those 300 are now working part-time on their masters degrees.

Our four interactive television classrooms are a unique feature of our educational program whereby employees at Ames are plugged into classes held at an educational institution. With a press of a button, they can actively participate in the classroom. We will soon double the number of these facilities.

Our childcare program was a successful project developed by a parent employee team who recruited staffing for the facility while Ames provided the resources, land, utilities, and maintenance support. This program presently serves 80 children, and we have 85 on the waiting list. This program enables parents to feel extremely comfortable because their children have quality care within walking distance.

Two other programs which build our relationship with employees are the Ideas Program and the Ames Alliance. In the Ideas Program, new employees put together their own training programs for a year. We give them general guidelines and they set up and run courses off-site with mentor supervision. Thirty to forty new employees go through this program at a time. This provides a networking and learning opportunity both for the trainees and the mentors. The Ames Alliance supports social events like group attendance to a sporting event, ski trips and other networking opportunities.

How do you measure success? You can look at customer response, turnover rates, and acceptance rates for new offers. Based on customer feedback, low turnover rate and the high acceptance rates, we conclude that the programs are indeed serving our customers. We hope that the new employees use and can appreciate the services for as long as they need; two or three years, if necessary. Our ultimate partnership objective is to retain the employee, build loyalty, develop a sense of community, and create a positive working environment.

4.2.3 Employee Programs that Build Long-Term Commitment

Amy M. Schumann, Manager of Organizational Development, Fel-Pro, Inc.

Since 1918, Fel-Pro has been a family owned, family oriented business. Fel-Pro's first products were gaskets for the Model-T Ford and now, in the fourth generation of family leadership, we provide a wider variety of the products for industrial and automotive purposes. Because our company is located in one facility and the family element is in place, we are able to enhance that sense of family through the rest of the organization.

More than half of our 2,000 employees meet the legal definition of minority status. Our work force is two-thirds blue collar and one-third white collar. We encourage our employees to introduce their family members to the company and often hire employee family members. I will touch more on this later in the presentation.

We've experienced phenomenal growth in sales and employment and, at the same time, have been recognized for our unique employee relations and benefits program. We have also earned many quality awards from our customers.

Here now are descriptions of employee programs Fel-Pro offers which effectively promote excellence in work force performance:

Our benefits are historically derived. We encourage family members to work at Fel-Pro; more than half of our employees have or have had a family member work at Fel-Pro. We find that this encourages excellence in performance.

We were cited in Harvard Business Review for having no layoffs. This philosophy is demonstrated, in part, by our recently issued policy on AIDS and illness which communicates a strong commitment to our employees. We believe that as long as employees can fulfill job responsibilities, they can stay on. We give this commitment and support employees at a time when they are under great stress in coping with illness; when job security is very important to them. More and more we see employees who are being treated for cancer, and they are able to work long and productively after their treatment.

Our employees are able to take advantage of a wide range of services provided by our personnel department. This modestly sized department assists

employees in tax and financial matters, certain legal matters like writing letters to foreign countries to help family members come to this country, social security matters, and other personal concerns.

Present value benefits are strong in the standard areas of insurance and such, but extra distributions given to employees help families share in the company's success; Easter hams, Valentine's Day candy, pistachio nuts at Thanksgiving, Christmas bonuses, a special vacation check on June 1, and paid-days off on birthdays and anniversaries.

A unique family oriented benefit is granted in the event of an employee's marriage; the company gives a wedding check as a gift. (If the two who are marrying are both Fel-Pro employees, they get a bigger check!)

The costs are not high for programs likes this; only two cents per employee, and the benefits are numerous. We get a loyal and motivated work force.

Another example of Fel-Pro's efforts to promote family involvement and a philosophy of RRR (rest, relaxation and recreation) is our 300-acre ranch. This facility is available for a day-camp for the children of our employees. When we hire our employee's college-age children, they often act as counselors at this camp. About 300 kids come to the plant with their parents on summer mornings and catch busses to the ranch. The cost to the employee is only $15 per family regardless of how many children are in a family.

We are one of only two companies in the state of Illinois who offers on-site daycare. This is a sad fact. Quality and safety were primary concerns in the development of this facility. The center is staffed with certified teachers, and other measures have been taken to ensure smooth operation of the facility.

Employees can take advantage of an emergency child-care benefit which provides agency referrals and subsidies so employees can bring in professional care for their children who are sick at home. The benefit to parents is obvious, and the company gets employees to work enabling us to meet our very important production schedules.

Statistics show that 33 percent of Americans have responsibilities to care for an elderly family member. Fel-Pro has responded to this situation with an Elder Care benefit which is offered through a contract with a local community services group and provides for information and referral services. Once a month, the organization comes on site and holds counseling sessions on topics like evaluating nursing homes or retirement planning. They also will work with individual cases.

We are a non-union company, but since 1935 have provided support for employees through an employee forum. Each company function sends a delegate to bring employee concerns to company leadership and owners. Managers are highly encouraged to resolve forum issues within one month. Formerly, managers worked on a "check and report" basis with forum issues, but now we encourage forum delegates to resolve as many issues as possible without bringing in supervisors. The forum delegates are rewarded with vacation time for the personal time they spend on breaks and lunch hours to resolve employee complaints.

Twenty percent of our employees are involved in quality circle activities and have saved the company about $250,000 over the life of the program.

Communications activities have included a newsletter to inform workers on the "people" issues like new births, weddings, bowling league scores, and the like. A new publication which I now edit is focused solely on the company's business issues. With a primarily blue-collar work force we haven't placed a premium on communicating the company business issues. This publication contains information on the marketplace, our customers and activities of various company functions which our employees may not see. This function has positively impacted our employees in that they can feel more a part of the business as a whole.

An element of our office environment facilitates open communication in that we have literally an open door policy. The four presidents have doors but most others don't. We have an egalitarian environment where our presidents open their own mail, answer their own phones, and write their own speeches. We have very few secretaries, and no executive cafeteria or parking places.

Community involvement is the final area which I'll address. I think all companies can get involved in such activities that yield numerous benefits. An employee administered foundation exists to help employees who volunteer in their communities get grants for their respective organizations. The employee group processes all the requests and makes the funding decisions. At the respective community groups, our Fel-Pro employee is a hero and he or she can feel the gratification of helping the community. The Fel-Pro name also gains wide community exposure. Almost no one in Chicago knows exactly what we make, but they have heard the name.

We also offer a training program in automotive repair for economically disadvantaged youth. This benefits both the trainee and our company in that these people become future users of Fel-Pro products. Other considerations Fel-Pro has taken to provide a good work environment and a positive culture are a fully air-conditioned factory, a health and fitness facility, a matching gifts program, and a corporate foundation.

We don't have a PR department. These benefit programs bring us more attention than we would get with such a function. Fel-Pro may sound more like a charitable organization than a profit making entity, but Fel-Pro is, as is every other business, in existence to make profits. We are profitable as evidenced by our sales figures. Our underlying philosophy is communicated very well by one of our owners, "I found that no one buys from us because we may be nice guys, but all things being equal, business may be resolved in our favor because we are nice guys."

We seek to create a family atmosphere in the workplace and communicate a sense of concern for employees' well-being. We want to develop a sense of the work force's involvement in the fate of the company. To the extent that an employer can accomplish these things, a company will be more than repaid with employee loyalty, creativity, hard work, and concern for high quality.

(Pictured Below: Panel B2 - Building a Partnership with Employees: (from left to right) Gerald Sandler, Grumman Data Systems; Charles Zimmerman, Westinghouse Defense and Electronics Center; Robert L. Pike, Ames Research Center; Amy M. Schumann, Fel-Pro, Inc.; John L. Reiss, Ames Research Center)

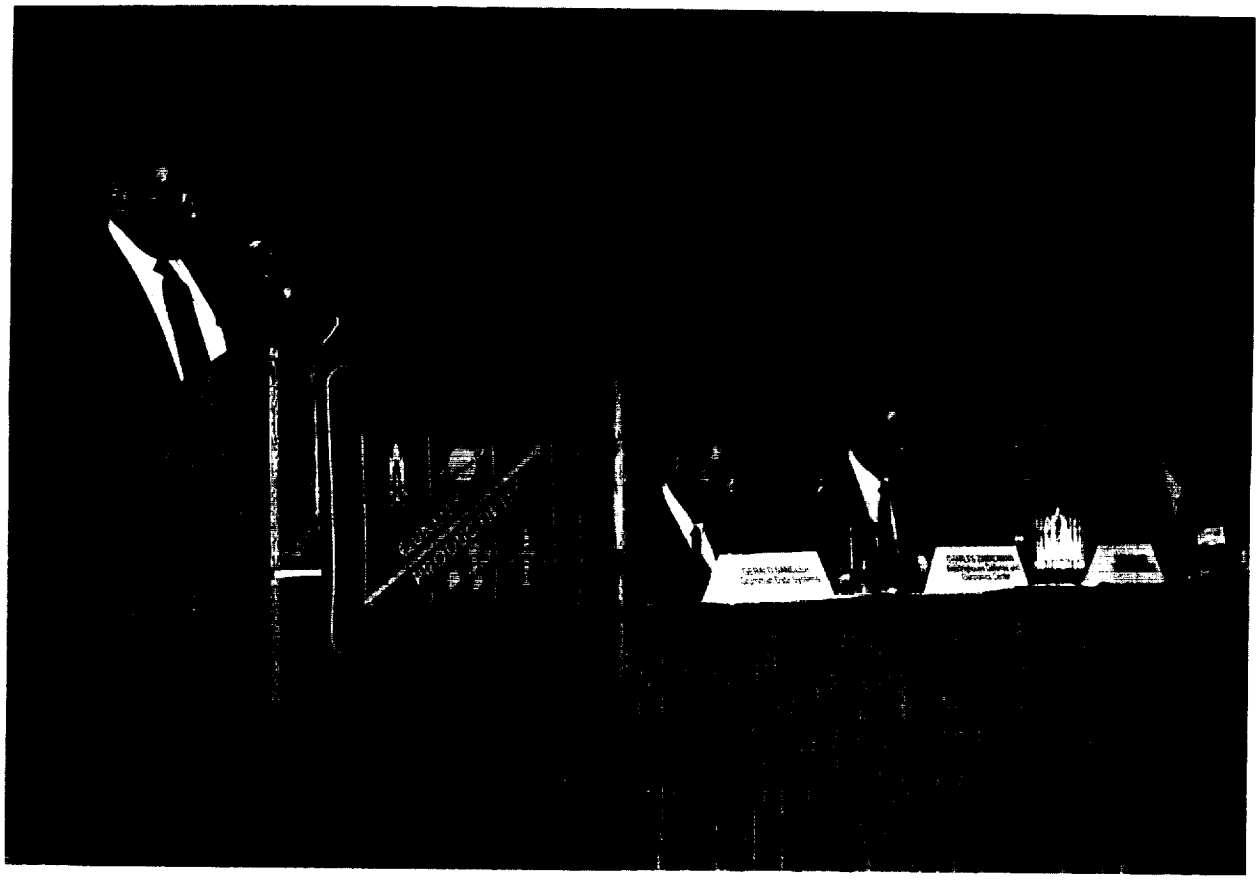
4.2.4 The Manager's New Role in the Partnership

Charles Zimmerman, Manager, Education, Training and Development, Westinghouse Defense and Electronics Center

Managing diversity is one of the biggest challenges facing managers in the 1990s. Projections show that 75 percent of those entering the work force in the future will be minorities and women. This change drastically alters the demographics that managers will face in the workplace and requires changes in our thinking.

In terms of total quality management, the manager will be faced with great challenges will have to become the following: dynamic team leaders, facilitators of the total quality process, the best communicators, and developers of many different people. We better gain a sensitivity and appreciation to the diverse needs of a diverse population, and value that diversity.

In addition, skilled technical talent will be in short supply. Managers have to learn to develop and retain a work force that is no longer predominately white male. For many of today's managers this is a radical departure from the norm, requiring development of new attitudes and values.



4.3 Investing in Employees--A Capital Idea!

Companies planning to remain competitive and in business in the twenty-first century are viewing their employees as assets, not simply expense items to be minimized on a profit and loss statement. These presenters will demonstrate how their organizations have made the investment in human capital a long-term business strategy, and will describe some innovative processes and adjustments their companies have made to enhance the performance and potential value of their employees.

4.3.1 Triple Parallel Progression

Glenn D. Norfleet, Senior Vice President, Sverdrup Technology Inc.

Sverdrup's business mission is to provide professional services with a dedication to technical excellence. At Sverdrup, people are the key to that technical excellence.

The literature in existence on productivity, quality and R&D attributes excellence in the work force to many things. We have found that maintaining a productive, high quality, and happy technical work force depends upon us providing challenging work, performance recognition, and performance-based compensation.

This starts at the cultural level. When new employees join the company, they receive an 8-10 page booklet called, "Shared Values," which contains what we believe to be the shared values of the company. One example of what's contained within is something that says, "One of the great strengths of the Sverdrup organization is that individuals have room to grow, our company encourages creativity, welcomes initiative, seeks excellence and rewards improvement."

With the cultural goals communicated, we then need to implement programs which bring these concepts to real life. Svervrup has four formal programs for enhancing employee performance and potential:

- Triple Parallel Progression System
- Career Development Program
- Performance Evaluation Program
- Educational Assistance Program.

The Performance Evaluation Program is an annual review which correlates fairly strongly an employee's performance evaluation and his merit increase for the year. The Educational Assistance Program is a highly incentivized program which encourages technical people to pursue higher education in technical areas up through the doctorate level.

The objective of our career development program is to ensure the continual development of our most important resources; people. Two basic components make up this career development program: 1) Career Planning -- the employee's self-development efforts and development of career paths, and 2) Career Management -- the company's provision of opportunities for promotion. We are committed to promote from within as much as possible. We also provide educational opportunities.

In the Triple Parallel Progression, what we want to do is provide a choice for technically skilled personnel; not to force them into management, but still give them the opportunities for advancement.

How do we do that? We provide three separate career paths: Project Management Ladder, Technical Ladder, and the Supervisory/Management Ladder. The progression is on a semi-annual basis which means the opportunities are available semi-annually, not that a promotion is guaranteed semi-annually.

The benefits derived from the Triple Parallel Progression System are:

- The technically superior employee's talents are not lost as he/she advances. It encourages technical excellence as a path for advancement, alleviating the strong-engineer-to-weak-manager problem.
- Personnel motivation is increased in that the engineer is not in a dead-end career. Self improvement can lead to advancement.
- Technical personnel develop, grow, and improve because of the opportunities.
- When technical people see in Sverdrup a path to the top, they become very interested. This is then a powerful recruiting tool, especially for mid- to upper-level engineers who are either facing a dead end or working in a non-technical/managerial role which they were forced into for advancement reasons.

This system does not create positions for anyone. It is a mechanism by which we fill the needs of our organization and advance our employees.

The finer elements of our Triple Parallel Progression System are the progression to the senior engineer levels are automatic based on the meeting of certain

criteria; and progression to higher levels are based upon technical expertise, a policy committee review of nominees, and organizational needs. If no positions need filling, no new positions are created.

The results of this system are evident in that we started with 400 technical employees and have successfully recruited 600 to 700 technical people in the past seven years. Our attrition rate is 30 percent below the national average. Another improvement is more subjective, but I know it's apparent; there is an increase in prestige of those upper level technical positions because of the institutionalization of the technical advancement program; the technical ladder progression is growing healthily; and finally the pressure to become a manager has been greatly reduced.

4.3.2 Human Resource Planning: A Total Quality Approach to Managing Human Resources

Kirk L. Froggatt, Manager of Corporate Training and Development, Silicon Graphics Computer Systems

Only 20 to 25 percent of organizations that I've come across in my past experiences and research have formal human resource plans in place. Those that had programs tended to focus primarily on either one of two areas; the man-power planning approach which determined organizational staffing needs in a highly quantitative way, and the career management/succession planning approach. Both of those are applicable, but the one I will outline today is broader in scope.

Why the need for human resource planning? The function is organizationally demanding so why do companies determine that it is vital? What are the results? Most importantly, how we can implement change based on those results?

The reason for human resource planning is that the environment calls for it. Our organizational contexts are now put under numerous demands like doing more with less; a need to initiate/manage technological and other changes quickly; make radical improvements, not just incremental refinement, in our processes, products and technologies based on market situations.

Managing these changes are critical to an organization's success and human resources is a critical factor in dealing with these changes. When I was at Hewlett-Packard in the early 1980s, we found that a lack of focus on the people side of these issues created major work force imbalances. They were so serious that at one point, we were over-employed by 1,500 employees in the U.S. alone. Those employees were not equipped to do the job we needed done. The struggle was painful because it strained HP's philosophy of providing job security. The resolution of this problem cost the company more than $40 million for two programs that resolved the problem in a way that did not compromise that company's values.

The cost of unpreparedness is high, and this experience forced us to include human resource planning as a management element for the future.

We first defined a human resource planning purpose: to help the company achieve its business objectives through better anticipation of the changing organizational context; not only anticipating pro-actively, but being prepared with the appropriate human resources programs in place to meet any future needs.

With that purpose in mind, we built a model which appears very straightforward at the macro level. We first determined what critical factors or inputs were important indicators for the future in respect with human resources; we identified critical human resource issues and developed plans to address the priority issues; and changed the organization in ways conducive to quick response to the market. On the macro level, as I said, this appears simple. But a plan like this requires an organization's commitment of much time, energy and resources. It also requires the involvement of all the people in the organization.

The following elements were crucial factors or inputs we required in understanding the business and the human resource implications:

- The Business Outlook - market entries or exits, divestiture or expansion of product lines, internal development or acquisition of new technology, etc.;
- Technology Forecasts and our responses to them;
- External Environmental Scan - work force demographic changes, socioeconomic and political factors affecting work force availability;
- Internal Environmental Scan - culture surveys;
- Current Human Resource Issues - new compensation programs, performance evaluation programs, training;
- Profile of the Work Force - an evaluation of our current human resource allocation in numbers and functions.

This was a lot of information to digest, but we needed to gather information and summarize it. You can break the inputs into two large groups in that the first

three are future oriented and the final three are current assessments.

The next step is to identify and prioritize the human resource issues, and find the gaps. The gaps are the differences between where we would like to be and where we are. An example of this is when the company decides that a new product line should be developed to complement an existing product line and the existing work force is not skilled in the design or manufacture of this newly needed product line.

After determining the gaps, we prioritize them and then go into action making the organizational changes to meet the objectives. An important step at this point is to set measurements, and set measures which accurately illustrate progress. Also progress must be monitored and checked to see if the desired results are being achieved.

When you look at the human resource planning scheme as a system within an organization, you can see that many business decisions have implications for an organization's people: the structure of a division, the skill mix required, and job design structures which enable various groups of individual functions to work together efficiently. A business move such as the phasing out or introduction of a product line also has implications for human resources in work force morale, motivation and productivity.

The theoretical model can be operationalized divisionally as well. All divisions in across an organization bring their summaries and results together, and corporate management would prioritize and identify key issues, and the actions determined necessary would be communicated back to the divisions.

One thing to keep in mind when surveying the environments in the planning stages, either corporate or divisional, is that the survey results may contain information which call for a change in business direction. For example, strategies may have to be altered for human resource reasons if the external survey shows that such a strategy would be unworkable. When we considered starting an R&D concern in the United Kingdom, our external survey showed that the technically skilled body of workers we needed were more likely found in areas near Germany, and to convince them to work in the U.K. was highly unlikely. That prompted us to reconsider our business location decision.

Continuous Process Improvement in the area of human resource planning is vital to Silicon Graphics, especially since we presently experience an average annual increase in revenues of 75 percent. Systems must be in place for the long term and, growth must sometimes be controlled so that systems can be implemented and institutionalized.

Taking a TQM or CPI approach to achieving the desired organizational behavior through human resource planning involves training, recognition, evaluation, the consideration of CPI values in promotion decisions, and other elements which reinforce the CPI values. A clear and strong message must be communicated to all levels of the organization that these values are a part of the system and consistent across all elements of the system.

How is this a total quality approach? First, it is customer focused. We help managers focus on the employee as a customer, and managers are Human Resources' customers whom we serve by helping them meet their objectives. Human Resources is an ongoing process to facilitate improvement in management processes. The results are improved management practices.

Another way of viewing HR management as a total quality approach is that HR management is designed to define and understand customer needs with respect to the future and the company's business objectives. The outcome of this process is the understanding of the opportunities for improvement in the areas of organizational values and behavior and management practices. The changes implemented based on the identified opportunities are very similar to Deming's P-D-C-A Cycle; make plans, implement plans with measures and objectives; actions are checked with customer. If the customers' needs are not met, corrective actions are taken. If needs are met, institutionalization of the change can begin and the plan moves on to address the next opportunity. This cycle represents a process improvement activity.

Human resources planning is not inexpensive, but neither is a $40 million expenditure for correcting an imbalance after the fact. I would like to close with three key points: 1) HR planning should be positioned as a process improvement process; 2) HR planning must be integrated with other planning processes; and 3) focus on the qualitative versus the quantitative. HR should be viewed as a fluid process and the entire organization should think of the business in systematic terms with respect to preparing the work force for future challenges. Finally, use a systems approach by implementing change in the fundamental systems, rather than supplementing the fundamental systems with activities that usually send contradicting messages.

4.4 Quality in the People Pipeline (Continued)

The quality of the technical people you hire depends upon the caliber of those who teach them. The number of recruits available to you depends upon teachers who inspire technical careers. Teachers make your hiring pipeline possible. Industry has a huge stake in helping to create, develop, support, and retain high quality math/science teachers. Leaders discuss proven and experimental involvement by industry.

4.4.1 Educational Incentives at Lockheed Missiles and Space Company

Dr. Richard F. Hartung, Vice President, Information Services Lockheed Missiles and Space Company, Inc., Chairman

People in the Pipeline addresses a critical issue for all of us. That is the future supply of well-trained people in science, engineering and mathematics. Companies in these fields know the importance of this issue, but people outside of these areas need to know as well. We must especially reach today's youth.

Using the "pipeline" theme can be effective in illustrating the problem. Let's say we start with huge pipe at the beginning of the process and we start pouring in kindergarten aged kids. At the other end of the pipeline is what we're interested in: science, engineering, and mathematics. Along the pipe's length, the diameter has continuously shrunk to a small opening at the end. So let's look at the process of pouring in large amounts of kindergarten aged kids, flowing them through the pipe until we squirt out the scientists, engineers and mathematicians who ultimately fill our industries' needs.

First, at the supply end, the amount fuel which has served the pipeline in the past has decreased. There are now fewer people entering the pipeline than in the past. Interestingly, the demographics have changed in a second way; the kinds of people flowing in have changed. For example, the white male is taking a minority role at pipeline entry, more minorities and women compose the stock of people available for the positions we seek to fill.

As we move down the pipeline to the college entry point, there is a bifurcation; those who go to college and those who don't. Just a little further into college, another bifurcation occurs; students interested in sciences and the students who aren't. A disturbing trend has occurred recently in that less and less students go into science study. Eight percent of the entering freshman class expressed an interest in computer science only five or ten years ago when it was a "hot" area to pursue. The rate of interest expressed now is a mere 2 percent. That's a four-fold reduction at the beginning of the college pipeline. In mathematics, the rate of entry has, in the past 20 years, gone from 4 percent to 1 percent; in physics, from 3 percent to 1.5 percent. We see not only fewer people entering the pipeline, but a decreasing interest in the science and math areas.

Now as we shift our focus farther down the pipeline and look at the output, we see a growing demand for people qualified in the sciences. Even non-computer oriented companies have the need for people trained in computer sciences. I am competing with McDonald's for people I formerly had an exclusive call on because of increased computerization in business. With this present demand visible, we must also consider the future demand of adequately trained people. By the year 2000, we will be short between 500,000-750,000 scientists (mathematicians, physicists, biologists, chemists, engineers.) The results are obvious. As in any condition of a scarce commodity, we bid the value up. This is a hopeless solution. The salaries will increase, but nothing is being done to increase the supply. Another alternative would be to do without them, but this means phasing out of technology businesses.

Present efforts to make up for the shortage in my field are focused on lessening the need for these people through the building of software development tools which take the place of software engineers. But automating mental functions is much more limited than automating physical functions. Examples exist whereas tools are available to lessen the need for specialists; CAD/CAM leverages a designers' capabilities, computer assisted teaching tools alleviate teachers' more mundane activities freeing them to concentrate on more substantive activities. Related to this are statistics which show an average equipment expenditure per worker in industry is about $50,000, while in education that expenditure is about $1,000. About 93 percent of our education costs are labor.

Back to the pipeline: we can't do anything to increase the influx at the beginning, how do we increase output? The answer would be to increase the efficiency of the process; we have to get more of the people entering the pipeline to come out where we need them. One way would be to strategically look at the demographics and attract more minorities and women to these fields. The other option is to go to the K-12 level and send a

message to the youngsters. Some statistics show that by the time a child reaches the fourth grade level, he or she has already determined whether or not he/she is science oriented. We can't miss this opportunity to steer children toward science. To do that, we need to have a group of teachers who are able motivate children in that direction. Presently, of science teachers in grades K-6, only about 25 percent are qualified to do this.

There is also the possibility of setting economic incentives to reflect the market's demand; pay teachers who teach science more that those who don't. Educational incentives are also an alternative where extra incentives are provided to get students to study the sciences.

High school is where I think industry can play a role with direct support. Programs like "Young Astronauts" which President Reagan put into action brings science alive for these youngsters while they are still in more formative stages. At Lockheed, we have a local high school intern program where juniors and seniors beginning to show an interest in science are brought into the company to positions that we hope strengthen and increase that interest. For instance, we bring some students into our research lab to work on the VAX system. This exposes them to both computers and a research environment. Other activities include volunteer participation in science fairs and giving tours of our facilities to students.

Our future program successes depend on motivating youth to pursue these essential career fields. Private industry can play a key role in developing education incentives at all levels. We just need to recognize the problem and show an interest in solving it.

An example of a small but important industry effort occurred in the case of a CAD/CAM center at Cal Poly at San Luis Obispo, jointly maintained by a number of companies. Soon after the establishment of the center, we were told that the professor charged with running the center might possibly be hired away by industry. The university could not meet the salary bid, so Lockheed offered the professor a flex-time eight hours/week job, with pay to complement his university position, to run the center and continue in academia.

There is not one, big solution. Each company could take a small step and together we could achieve the desired results. We must also realize that attached to the effort are costs, but the costs are unavoidable; we will foot the bill now or later on. I urge all of you to reinforce the ideas you've heard at this conference and, as managers, participate in the effort.

4.4.2 Scientists and Engineers in the Classroom: What Both Sides are Getting

Dr. John M. Fowler, Director, The Triangle Coalition for Science and Technology Education

We are all aware of the problems in education today. They are borne out by failures in the classroom, failures in the workplace, and failures in the voting booth. While the situation is presently the least serious in higher levels of science and technology, the problem will be much more apparent in the future. We need to develop a scientifically literate citizenship.

Structural responses to this need have been the formation of a number of alliances at the state and community level. New curriculum designs are coming up, new teacher training techniques developed, new systemic changes in school governance set up, and major technologies involved. Many activities are taking place, but none have been around long enough to show true results.

A specific structural response which would not be useful by itself, effective only in conjunction with all the other efforts, is The Triangle Coalition for Science and Technology Education. Our purpose is to fill the need to help business, industry and labor meet with science, engineering and labor as equal partners. Our membership consists of 40 major industries, all specific discipline science groups, all science education groups, several large engineering groups, and education groups like the NEA and American Federation of Teachers. This strong framework and abundance of resources can affect action in many areas. This gathering of large and powerful voices, backed by a cause, has enabled us to take on an advocacy role through a number of position papers which call for federal programs and actions.

In most of your states now a promising movement is taking place. Alliances on the state level, some on the community level as well, are pushing to improve science and math education. Many organizations are forming groups, and we have a grant from the Carnegie Foundation in New York to work with existing groups to expand efforts. In effect, there is a grass roots network involving community leaders, business and industry, and the universities and school systems.

We now ask ourselves, "How can we combine the national network which The Triangle Coalition represents with the local alliances?" One of our efforts is the National School Volunteer Program whereby scientists and engineers identified on the national level go into schools and work with science and math

teachers to share knowledge and perspective with students. We have in three groups, the American Chemical Society, The American Medical Society, and the Institute of Electrical and Electronic Engineers, more than a million members to tap. Pilot programs in Dade County, Pittsburgh, Denver, Texas and Washington state are working with local alliance leadership to bring scientists into the schools. Hundreds or thousands of volunteer hours have been logged in Dade County and Pittsburgh. The logistics of the program are not simple. The schools' classes must be designed to incorporate the volunteer with the class subject, and the volunteer must be briefed as well.

Through evaluation studies, we find that students are very inspired by interacting with these professionals, and the volunteers, in turn, develop long-lasting connections with the educational community. We are ready to address the issue over the next two decades and look forward to expansion of this program and significant two-way benefits from it in the future.

4.4.3 Detroit's 1989 Venture: Teachers on the Job in Industry

Robert B. Aronson, MIISME Coordinator, Marketing and Design, Ford Motor Company

I am going to discuss a program which shows what can happen when you participate in educational improvement programs. Ford Motor Company is acutely interested in fostering educational improvements because our work requires a constant infusion of well-trained people for our survival. Anything we can do in the education effort will benefit both the nation and the company.

The Michigan Industrial Initiatives for Science and Math Education project gives high school teachers an opportunity to work for a summer in industry. This opportunity is granted with two goals in mind: 1) to improve our schools' technical instruction quality, and 2) to encourage young people to enter science, engineering and mathematics.

The program has been in existence for about one year. My presentation comes from the operations perspective so that you may consider whether such a program would be viable in your organization.

The program was started by the director of one of Ford's three research laboratories, Dr. Norman Justine. Early this year, he was approached by The Triangle Coalition who asked if he would be interested in starting a fellowship program in the Detroit area. The first meeting included representatives from schools, school districts, universities and local industry. The main component of this meeting was a presentation by the California Industrial Initiatives group who has successfully been doing fellowship programs for the past five years.

From this initial meeting, we were able to gather enough interest to form a steering committee. The steering committee, composed of representatives from nine industries, met in March 1989 to determine whether or not we should launch the program immediately. We decided that forging ahead would be better so that the enthusiasm, support and initiative sparked by the first meeting would not be lost. Ford already had a high school program and was considering a high school teacher fellowship program before the Triangle Coalition approached us with their opportunity. This made us experts by default.

Briefly, about our current fellowship program, about 200 high school students are brought into our research lab for 9 sessions. They get six mini-lectures to pique their interest and enthusiasm, and this involves about 144 volunteers from our research staff. At the end of the sessions, the students who have good attendance and who have completed a paper can compete for summer fellowship programs. We have seen some very pleasing results and hope to maintain the opportunity to hire them when the time comes.

The MIISME steering committee then decided to pay each teacher $2,850 for a six week period, to pay the teachers in the form of a stipend, and to have the schools pay worker's compensation. Our decisions were based upon many interviews with teachers and certain Michigan legal considerations regarding who is and who is not an employee.

The steering committee's next move was to go back to their respective companies and generate support. Two weeks later, six of the nine members tentatively agreed to provide 22 fellowships. Subsequently, financial difficulties forced one company to withdraw their offer and another to reduce its initial offer from six to four. The other half of the effort involved recruiting high school teachers from all of Wayne County (where Detroit is located), as well as four surrounding counties; a total of 159 schools to contact. We contacted schools by mailing a statement of purpose flyer and an application form. We had no specific names and we had also been warned that principals don't always support these sorts of programs, so we directed three packets to each school for the principal and the heads of math and science.

Considering that we mailed the packets on April 5 with a deadline of April 15, we were pleasantly surprised to receive 138 usable replies (152 applications were actually received, counting those that were late or incomplete.) The extensive application required three pages of personal

information, a resume and a personal statement of interest. This response told us the interest existed.

The initial selection process involved matching teachers' qualifications with the various industry job descriptions; their school assignments; their personal statements; and their industry related, outside activities. Forty applications remained after this process, and these were circulated to the steering committee members. Each company then conducted their own interviews and made selections by June 5.

The worker's compensation problem arose because schools had never been asked to provide this insurance for a summer program. Steering committee members worked hard to work this issue with the various districts, and we did lose one teacher because the school refused to provide the compensation. This was balanced in that the high number of qualified teachers allowed us to bring in three more to a total of 20 for last summer's program.

Each participating industry was responsible for providing a six-week job, between June 26 - August 4. The teachers were required to provide a written report of their experience.

At our most recent steering committee review session, we agreed to proceed. But to expand, we needed outside help. Michigan State University has agreed to take over the program for us. In addition, they have proposed to raise the stipend to $4,000 which would give them $1,000 per teacher for overhead, and they also proposed that the teachers get three credit for their work with MIISME.

4.4.4 Project Bridge: Intermingling Teacher and Technical

Palmer D. Swanson, Director of Public Affairs, Polaroid Corporation

We are in the midst of a significant crisis in American public education. We are seeing a dramatic growth in the shortage of well-trained math and science teachers. According to National Science Teachers Association statistics, we are losing more than 15,000 math and science teachers annually to jobs in industry that are better paying. Also every year, less than 1,500 college graduates enter the classroom to replace them.

The cumulative effect of this imbalance between supply and demand is a projected shortfall of 300,000 math and science teachers by 1995. How many young people graduating from our schools will be mathematically and scientifically illiterate, unqualified to do the jobs waiting for them? The consequences of this shortfall are difficult to measure. Jobs that this nation needs done to remain a leader in an increasingly competitive global marketplace will not be done, ultimately affecting the American economy and lifestyle.

This concern has prompted the formation of Project Bridge, a partnership between Polaroid and the education community geared to address the mounting crisis in the shortage of qualified math and science instructors. Our response to this shortage holds an additional dimension for everyone. An effective response to this problem is a matter of answering to market implications; failure to resolve this issue affects every company's bottom line.

As parents, we desire well-prepared teachers who will inspire our youngsters. As citizens, we want for our communities teachers who will teach our young people the skills needed to live rich and fulfilling lives. As businesspersons, we want teachers to understand the jobs that need to be done and prepare students to do those jobs today and in the future. Polaroid has for more than a half century sold products of its own invention. To continue that requires the best efforts of a well-educated and conscientious work force. We have a nearly insatiable appetite for creative, intelligent, well-trained workers and to satisfy us, the employee run Polaroid Foundation allocates nearly one-third of its resources to support and improve education.

Improving the quality of education only solves part of the problem. We must have in our schools a cadre of competent, committed teachers concerned about their students and knowledgeable about their subjects; teachers who understand both the theoretical implications and practical applications of their disciplines. Enter, Project Bridge, a program through which our presence could have a significant social impact. This program, generated by a Polaroid education specialist and personnel administrator over a cup of coffee, allowed us to respond to a matter of both local and national consequence. It also fit into our system of values and grew logically out our respect for and commitment to education.

The project prepares eligible Polaroid employees for second careers as certified math and science teachers, and it enables teachers to spend a sabbatical year at Polaroid to better understand industrial math and science applications. This bridge, or two-way exchange between education and business, reaps benefits for both. It also creates mutually valuable, professional relationships between educators with classroom experience and technical professionals with workplace experience.

Project Bridge offers certification through a number of educational institutions; Leslie College, Harvard Graduate School of Education, or Bridgewater State College. In researching the viability of Project Bridge

as a formal program, we found a great number of long-time employees who harbored a desire to become teachers; to return the good fortune they have enjoyed.

Project Bridge is open to permanent part- or full-time employees who have served Polaroid for at least 10 years and have a bachelors degree. Participation begins with a 5-week part-time Exploration of Teaching seminar followed by a nine to twelve month full-time certification phase. Candidates receive full base pay until certification is complete as well as all tuition and academic fees. The first group to complete the program ranged in age from the early 30s to the mid 60s, with career backgrounds that varied from chemistry to accounting.

Those who chose to participate in the program were competent and respected members of our work force. They have the skills and passion needed to be good teachers, and a wealth of professional work experience that will undoubtedly be valuable in the classroom. Secondarily, while the primary purpose of the program was unrelated to the company's subsequent downsizing efforts, it was a valuable option to offer when the company was attempting to reduce its work force; an option that serves the employee, the company and the community.

The second part of Project Bridge, the Teacher Internship Program, enables outstanding public school teachers to work a sabbatical year at Polaroid, at company expense, to better understand industrial applications of math, science and related fields. When they return to the classroom, they can help students and other teachers better understand the practical applications of their subject matter. Additionally, they will probably develop better curricula and stimulate students' career interests.

One of last year's teacher interns said of her experience: "I've taken every course available to chemistry teachers, but it's been through this on-the-job training that I've learned what it means to be a scientist. Now I can reinvest those ideas and attitudes in my students."

Polaroid, in turn, is enriched by the presence of professionals who bring new focused insight into the work place using their knowledge of teaching methods and subject matter in specific company assignments. Participants are selected through a rigorous interview process by teams of Polaroid employees, through a pool of teachers nominated by their superintendents. Area superintendents, I should note, have been critical to the design and execution of Project Bridge.

Finally, because this is an enrichment program, not a recruitment effort, the 11 teachers from eastern Massachusetts communities who are currently working with us are not eligible to be hired by the company. They are doing are real jobs of real value to the corporation, and we are more than adequately rewarded for the expense of bringing them into our work place.

In sharing how Project Bridge works, we hope it serves as a model which encourages communities large and small to take on such projects.

Panel B3 - Investing in Employees-A Capital Idea!: (from left to right) Dr. Karen K. Whitney, Rockwell Space Operations Company; Glenn D. Norfleet, Sverdrup Technology Inc.; Kirk Froggatt, Silicon Graphics Computer Systems

Panel B4 - Quality in the People Pipeline (Continued): (from left to right) Dr. Richard F. Hartung, Lockheed Missiles and Space Company, Inc.; Dr. John M. Fowler, The Triangle Coalition for Science and Technology Education; Robert B. Aronson, Ford Motor Company; Palmer D. Swanson, Polaroid Corporation; Charles P. Boyle, NASA Headquarters

5.0 Ensuring Continuous Improvement Through Partnerships and Incentives

A review of the quality and productivity partnerships established between NASA centers and their contractors and the status of the ongoing contract incentive activities.

5.1 NASA Center/Contractor Partnerships

How and why NASA centers and their contractors are forming proactive quality and productivity improvement partnerships. They will discuss their goals, objectives, missions, and how they are seeking common and/or shared opportunities for mutual benefits.

5.1.1 Introduction

Alvin L. Reeser, Executive Vice President and General Manager, USBI Company, Inc., Chairman

Most of today you've heard about NASA and contractor team work. For this panel, I'd like you to focus on an other-than-vertical team-work component. Of equal importance to the NASA/contractor relationship is the relationship between contractors, between NASA centers, between the functions in our own organizations. Each individual has customers, and we should serve those customers just as we serve NASA. This team work is important not only for our own business purposes, but for the sake of our nation's future challenge in the world market.

5.1.2 Exploring a Common Agenda to Enhance Partnership Relationships - the NASA Perspective

Dr. R. Wayne Young, Deputy Director of Administration, Johnson Space Center

I'd like to start with a bit of nostalgia. This is my sixth NASA/Contractors Conference, but I'd like to go further back to 1982 when eight of us from the NASA centers were on a team formed by NASA Administrator Jim Beggs. Mr. Beggs came to NASA with a vision; a vision that NASA, as an agency, would set in motion a model which would improve productivity in NASA and its contractor team. He also envisioned this movement permeating all of government and private industry, serving as a model for the nation.

Mr. Beggs signed an action to Marshall Space Flight Center's chief engineer at the time who brought the eight center representatives together to gather information on this productivity idea. We toured Westinghouse, General Motors, various aerospace companies and many others. We came back with a number of observations and recommendations:

- Most productivity measures resulted from crisis situations.
- To create change with hopes of being a model, the direction and commitment must come from the top.
- A focal point must exist in that organization who is influential with leadership and representative of the entire organization.

Today, the concepts exist in Enhancing Partnership Relationships. At JSC, the partnership is clearly vital to achieving our objectives. The ratio of contractor personnel to JSC personnel is about 3:1, and 85 percent of our dollars are spent with a contractor which means our NASA/contractor partnership must be functional.

Productivity initiatives, in the beginning, were difficult to sell to the organization, because the term implied a present state of non-productivity. We decided that team building, in conjunction with our

previous philosophy of pursuing excellence, would be the best approach.

Our present total quality program consists of three main elements: strategic planning which directs us; team excellence which communicates our approach; and our culture survey which tells us how well we're doing.

Teams, or "partnerships" in today's context, are at the heart of all our efforts. Partnerships are broadly defined. They not only include the NASA/contractor relationship, but, depending on which project we speak of, partnerships include all elements of government, customers, international parties, the administration, the National Space Council, or Congress. Clarity of responsibility, concerted efforts, and mutual goals are important factors in partnerships, especially in a changing environment. These elements enable partnerships to together take risks to achieve objectives.

As partnerships relate to efforts in space, we need to first look at our bottom-line customer, that is the public. In this changing environment, customer requirements are different, our programs are now longer in duration, and programs are more interrelated. As partnerships of individuals or teams work together to meet mutual goals, the whole is greater and stronger than the sum of the individual parts. An important component in this scheme is also trust, or confidence. The strongest organizations are found on trust which takes a long time to develop.

Our public's expectation of us is our continuing leadership in space. We must be competent and in control in this time of increasing competition.

The JSC Contractor Team Excellence Forum conveys an example of our strategy. After the Challenger accident, JSC worked a strategic plan and began to implement it. More and more our contractors wanted to know our direction and the meaning of our strategic plan. We invited our contractors and their corporate office representatives to a briefing by our director, Aaron Cohen, and his senior staff, on the strategic plan. This half-day session resulted in our contractors deciding that we must have structured communication, thus the formation of the Team Excellence Forum. A steering committee, co-chaired by Bob Young and JSC Associate Center Director Dan Nebrig, came together for quarterly meetings on making sure everyone was jointly working on a common agenda. This committee also defined issues which needed more attention.

By early 1989, we had broadened the participation of this forum. JSC and contractor senior staff members effectively worked together, bringing in larger teams of contractor representatives. This effectiveness, I feel, is demonstrated in that four JSC contractors are among this year's NASA Excellence Award Finalists.

To build on what these four have accomplished, in recent months we have recognized them in a special way, and we have had them present their success experiences, strategies, and plans to our senior staff, government people, and their counterparts in industry.

The structure we put in place is one of mutual agreement in areas with significant opportunities for joint pursuit. Our structure's elements include:

- A group to develop a set of effective and innovative contractor incentives to encourage increased contractor productivity.
- A training group to organize a program which efficiently taps the training budget and alleviates duplication.
- Measurements. This element is very challenging, especially in an R&D environment, but we are becoming able to share this area's successes.
- A focus on employee involvement and participative management.
- The Strategies Support Group, which is a unique effort on the parts of both JSC and its contractors. Contractors who heard our strategic plans wanted to make sure their own corporate strategic plans were consistent with ours. Four or five key contractors have instigated a number of studies on their own, with non-funded resources, with this group's support, and have come up with some very interesting strategic plans for JSC. The plans are currently being reviewed and tailored.

As our joint efforts proceeded, we wanted to check progress, so we asked our contractors how they thought we were doing. The replies varied. First, they did become more informed with respect to JSC's strategies. We all also saw that TQM efforts were already in place in some contractor companies in relation with their DOD activities. The communication increased the partnership's strength because all parties were more informed.

The contractors also had recommendations. They wanted to expand the involvement to middle managers and sub-system level people. They also wanted assurance that these efforts were not a short-term fad; that they were institutionalized, continuous, long term, and action oriented.

We're going to expand in workshop areas, our contractors have even offered their own weekend time to work on these efforts. Working groups will be expanded with third party facilitators. When

contractors benefit, NASA benefits as well. Our support to NASA can increase.

The future as I see it, is portrayed in a past experience of mine.

During our tours of the many facilities when the NASA team first got together, I was able to tour Japan. I saw what we have all heard so much about: the commitment from company leadership, dedication and commitment from the work force, orderliness, discipline and focus to their tasks. Most memorable for me is something I saw on a tour at a major automobile factory's production line. In a display, very neatly presented, was a chart which appeared to me to be product delivery numbers. I asked the interpreter what this was and the answer was most interesting. The chart I saw was the number of customer complaints the company received per one million products delivered. The number was a mere 5 complaints per million.

I was intrigued by this focus on the output here in the heart of the process, the manufacturing line. This display brought workers closer to the meaningful results of their efforts. We need this kind of focus as we examine our future partnership endeavors. As we work with others, contractors, government, or Congress, the key to our future is working together and enhancing that partnership.

5.1.3 Exploring a Common Agenda to Enhance Partnership Relationships - the Contractor Perspective

Hugh C. Goff, Staff Director, Business Development, Engineering Services Division/Houston, McDonnell Douglas Space Systems Company

I will identify some characteristics and qualities which differentiate partnerships, because the understanding of partnerships, formal or informal, are useful for application purposes.

What is a partnership? All of us here are involved in different kinds of partnerships, and we all appreciate the attributes of such relationships. Partnerships are formed in legal matters like in a real estate deal, a business contract or a marriage, or they can be more informal as when two or more partners work together toward a common goal. Each partnership has expectations of an effort's outcome. In the case of a NASA center/contractor partnership, a common set of expectations exist that we're trying to jointly achieve. The joint efforts and the commonality of goals are key and make them unique from informal partnerships.

In any partnership, the partners contribute their own unique resources, and share in the venture's risks and rewards. The maximum synergistic effects of this combination come out when each partner contributes his/her best efforts, motivation, enthusiasm, and self starting attributes. Also in every partnership, partners have responsibility, accountability, and authority. These are characteristics of partnerships:

- Sometimes partnerships are equal and sometimes they vary in degrees. In partnerships with senior partners and junior partners, senior partners are usually identified, especially in problem situations or when critical decisions need to be made.
- A contract which binds us together, whether formal or informal, must be built on earned trust and credibility.
- A success oriented, customer focused partnership has the highest chances of success. We prove to the customers with every quality effort, every day, that their best interests drive our actions. Also very importantly, from this, we receive new opportunities to satisfy their future needs.
- Free flowing and open communication among all elements of the partnership is essential. Communication enhances the trust and credibility component of the partnership.

Within our partnerships, we have certain responsibilities which are vital to its function. We must empower the people who comprise the organizations to carry out their job responsibilities. We need to provide them with the resources they need and give them the power to apply their unique abilities and skills. Empowering people to make decisions and perform requires great elements of earned trust and credibility among partners.

Regarding the degrees of authority within partnerships, during stable periods, the team members work well together and senior and junior partners are not always identified. When an emergency arises, a senior partner is identified if not already identified, and this person is called upon to exercise his/her authority. This person will have to take the lead, make decisions and resolve issues. If conflicts which arise during this process are not resolved and decisions are not made, the partnership will fail.

I'd like to elaborate on the two types of partnerships I mentioned earlier, the formal and informal. In a formal, contractual, legal partnership, formed to achieve common goals and objectives, contracts define each partner's expectations, roles to be performed,

any considerations involved, schedules to be met, products delivered, and the like. Informal partnerships, natural working groups existing and working together without a contract, exist today at NASA centers with their contractors. The NASA JSC Contractor Team Excellence Forum is a good example of an informal partnership. This Forum brings together representatives of NASA and its contractors to jointly develop programs to achieve common goals. Good examples of cooperation are the strategic planning, external relations, and technology working groups. Other examples of these working groups are Partners in Space, Space Business Roundtable, and an impressive number of scientific, technical, contract management and other professional societies.

Partners have both internal and external expectations. The following are two examples of external expectations held by our partnership:

- To ensure a highly successful civil space program. This is the paramount expectation of our partnership's primary customers, the U.S. taxpayers. We have a basic premise that America must retain leadership in space so we can ensure the freedom of this new frontier. For example, when we landed on the moon, we declared that it was open space for all and the same position is being taken on Antarctica today.
- All of us are aware of the declining interest in the study of engineering and the sciences. Our partnerships through its outreach programs, supported by the NASA Public Affairs Office and volunteer speakers bureaus, can help to inspire our nation's youth to seek careers in aerospace and related fields.

Our partnership needs to inform the public of its benefits through the civil space program's advances, especially the societal benefits of advances made in communications, weather forecasting, and medicine. Our leadership in space faces worldwide challenges. Cooperation and partnerships between foreign governments and their domestic space agencies are high competition for us. We must retain our edge in technology leadership so we can effectively compete for and win new international opportunities.

Creating environments to enhance employee commitment is a major internal expectation of our partnership, and is being realized today through conferences like this one. Each of us needs to enhance our own environments by setting and demonstrating the highest standards of quality of which we are individually capable. We must look for total quality in all tasks, whether the tasks are technical, contractual, or managerial; and strive to continuously improve our own performance. Working together in our highly cooperative NASA center/contractor partnerships, we can be confident that we will meet these expectations.

Some characteristics, unique in government and contractor partnerships, must be considered. Who has the authority to commit financial and human resources? Who is responsible to perform the work or expend these resources? Who is accountable to the customer for the partnership's actions? In equal or informal partnerships, partners share responsibility, accountability and authority, while in government/contractor or formal partnerships, the challenge is that while responsibility and accountability can be delegated, one cannot delegate authority. The ultimate authority resides in the government even though the contractor is responsible and accountable for the work performed. The government partner is the taxpayers' legal and fiduciary representative.

Because the government is also the customer in this relationship, it has a dual partnership role; customer, and senior partner since it has the authority of final decision. We need to recognize and accept this unique difference between our government/contractor informal and formal partnership relationships. We both share the common goals of customer satisfaction and project success.

Recognizing and accepting these unique differences in our formal partnerships avoids conflicts within the partnership. We can build in mechanisms to avoid barriers. One example of a built-in mechanism is mutual complete trust in the other partner(s). This trust is earned through a demonstration of commitment, technological competence, and fulfillment of our respective responsibilities. The trust is reflected in a mutual respect and recognition of the value in each partner's contributions. Such actions should result in the sharing of all resources, risks, and rewards resulting in win-win situations.

Here are some examples of good NASA center/contractor relationships:

- In Houston, we have a very proactive relationship with JSC and the contractor community. NASA/JSC Contractor Team Excellence Forum works to integrate improvement efforts in strategic planning. The other activities include strategic planning, external relations and technology training.
- The National Contract Management Association sponsors training seminars to certify professional contract managers.
- Southwestern Aerospace Professional Representatives Association (SWAPRA) is an

informal partnership among industry bringing together personnel in aerospace firms together to meet objectives in our mutual best interests.

NASA center/contractor JSC partnerships have successfully accomplished a number of projects. Five key JSC contractors, Boeing, Lockheed, Rockwell, Martin Marietta, and McDonnell Douglas, working in an informal partnership with the New Initiatives Office at JSC, planned, researched and published studies on the next manned space transportation system. These studies were generated primarily on the corporations' funds. The Space Center Houston facility, supported by private funds, will be built to showcase our nation's space programs.

In summary, for us to enhance these relationships, we need to:

- have an overall plan with common goals to meet the partnership's objectives;
- create milestone schedules for achieving interim and time oriented goals, and implement ways to measure the effectiveness of our actions; appreciate and formally recognize partnership members for their contributions to the partnership and their organizations;
- realize the interdependency among all partners' actions;
- develop trust and confidence through high quality, on-time, results oriented, and customer focused performance;
- recognize that TQM implementation is a fluid process, but reaps many benefits; and
- maximize TQM benefits for individuals as well as organizations.

5.1.4 Shared Experiences in the Contractor/Government Partnership for Quality and Productivity

Gene Porter Bridwell, Manager, Shuttle Projects Office, George C. Marshall Space Flight Center

Partnerships require certain "real world" characteristics, processes, and environments to achieve productivity enhancements and, ultimately, a product's quality enhancements. I will share with you the experience I had in watching a partnership work.

That partnership was a government project manager and a contractor project manager working on the External Tank Project. These partners took a certain approach to achieve their objectives and customer satisfaction. Four major contributors lead to project completion, and having their product successfully used in meeting mission goals and satisfying the customer:

- They recognized the management process.
- They understood the project environment and the commitments that project was making.
- They established project characteristics and drivers from that understanding.
- They assessed their accomplishment.

These four steps were continuous throughout the project.

The External Tank Project manager utilized a certain management process. This process had an assurance role which ensured that each partnership element adhered to its contractual obligations.

The manager was also responsible for providing the government facilities, if required to do so, to support that project. He and his partner also needed to develop back-up for the project to ensure its proper design, development and flight.

The partnership made a very difficult up-front commitment to a $66 million investment to improve their productivity and processes. Concurrent to the improvement efforts to ensue, they committed to fabricate and deliver a number of external tanks per a schedule requirement. They finally had the responsibility, in that environment of change and improvement, to deliver a certified product which was ready to fly.

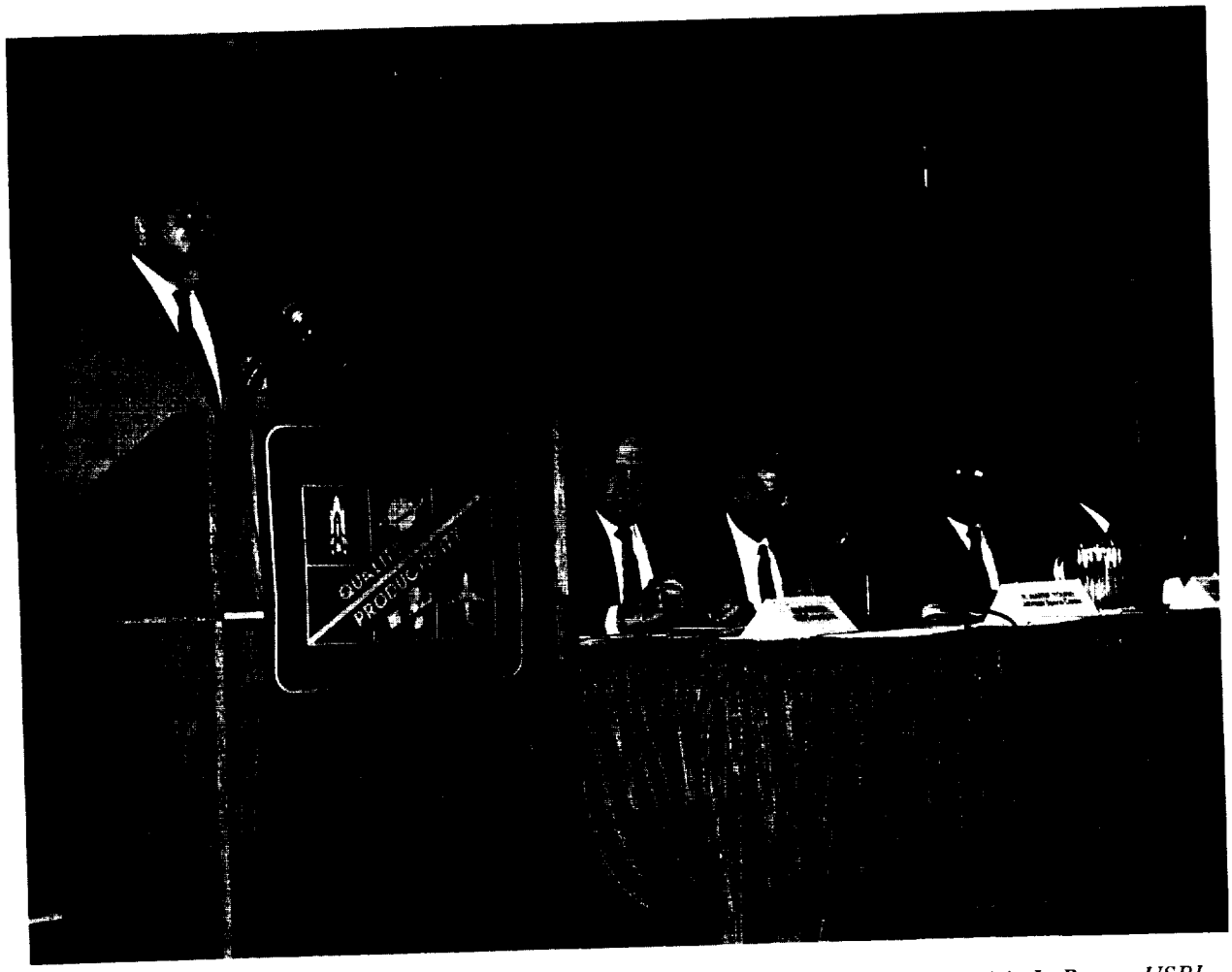
The partnership had to recognize the environment, from a project standpoint, in which they were to achieve their goals. Considerations of time frames, schedules, budgets, production readiness, and facilities are all important, especially in a project of long duration. For example, can the facilities be justified five years in the future, and are these schedules reasonable?

In retrospect, the following points seemed to be the project's drivers:

- Common Goal -- The relationship's number one priority was mission success.
- Commitment -- They understood the commitment they had made to the productivity goal.
- Production Readiness Program -- allowed them to build the hardware on a recurring basis.

- Proximity -- The partners were within 1.5 hours of each other by plane allowing them to meet when necessary.
- Successful Transition -- They were able to manage change and transition to the light-weight tank.

Their end result, up until Challenger, was the ability to produce almost one tank each month. Other performance measures also showed that the partnership was successful in satisfying the customer. The keys to their success were understanding the processes; recognizing the commitments, environments, drivers and their characteristics.



Panel C1 - NASA Center/Contractor Partnerships: (from left to right) Walter E. Hall and Alvin L. Reeser, USBI Company, Inc.; Dr. R. Wayne Young, Johnson Space Center; Hugh C. Goff, Engineering Services Division/Houston, McDonnell Douglas Space Systems Company; Gene Porter Bridwell, Marshall Space Flight Center

5.2 Contract Q/PI Initiatives for Incentivized Procurement

This panel will provide a status report on current agency activities to reward and encourage contract quality and productivity improvement. Topics will include NASA implementation of Value Engineering; the new NASA FAR supplement on Q/PI and related training material; and application of Q/PI to award fee and fixed fee contracts.

5.2.1 Introduction

Leroy E. Hopkins, Deputy Assistant Administrator for Procurement, NASA Headquarters, Chairman

I'd like to share with you some of NASA's general postures relating to providing incentives on quality and productivity. NASA has taken two basic approaches to providing incentives. One is through the value engineering incentives and the other is through the award fee. Value engineering, briefly defined, is an analysis of product or service to be provided with a view towards reducing cost.

One of the key features of a value engineering proposal is that it must yield quantifiable results. It requires a modification of the clause, and if the modification is acceptable, the value engineering proposals cannot in any way degrade the performance of the service or product being produced in terms of quality, productivity, reliability, or maintainability.

There are two approaches to the use of value engineering. One approach is the program clause. The program clause is a separate clause in the contract, and requires the contractor to apply value engineering analysis and the submission of value engineering proposals to the government as part of the on-going effort. It requires periodic reports on the status of the program.

The more commonly referred to value engineering proposal is the incentive program. Unlike the program clause, the contractor is in effect on his own in the development of value engineering change proposals. His money and resources are invested in developing such proposals.

The NASA value engineering program is progressing. We have issued the appropriate changes to the NASA FAR supplement that require the use of the value engineering clauses in our solicitations and contracts under appropriate conditions. We currently have a handbook that is being developed that will be sent to our centers to be used to facilitate the processing of any value engineering proposals received. We have also issued a NASA management instruction on the subject of value engineering, which in its short version really requires that the center identify a single point of contact for the processing of the value engineering exchange proposals, and instructs them further to conduct the appropriate training as necessary to educate NASA personnel in that process.

We are also working on an approach for rewarding productivity and quality improvements in our contracts through the use of the award fee. We use the award fee on a substantial number of our contracts. One of the problems is the subjective and qualitative subject matter. We do, however, want to create an environment that encourages our contractors to adopt reliable and effective programs in terms of good quality, productivity, and qualitative incentives. However, it does require some sort of base line in order to measure some sort of improvements.

We currently have draft award fee guidelines on how we might approach this particular subject. We are certainly going to have our contractors, once solicited, submit to us a Quality and Productivity Improvement Plan in the initial proposal submission. We will identify criteria to outline what would be rewarded, and we evaluate it with other factors under an award fee contract.

There has been test in the use of the award fee to reward outstanding quality and productivity incentives at both the Lewis Research Center and the Goddard Space Flight Center. We have a draft of a change to the NASA Federal Acquisition Regulation (FAR) supplement which will make this capability available to all of our centers in the procurement process.

NASA earnestly and seriously desires to stimulate quality and productivity incentives in our contracts. We are currently using an approach of both value engineering and award fee. There are other variations that may be better, and we are willing to look at them and experiment with them.

5.2.2 Update on Contract Mechanisms for Q/PI

David J. Steigman, Productivity Program Manager, Lewis Research Center

A team of representatives from centers, Headquarters, and contractor organizations has been meeting for the past two years to develop a set of recommendations for quality and productivity improvement contract incentives based on an initiative

that began at the Fourth Annual NASA/Contractors Conference in 1987. This activity is now nearly complete, and we have sent a draft Federal Acquisition Regulation Supplement on the subject out for review. Rather than legislate evaluation criteria, we provide a checklist of items which may be considered pertinent or appropriate for any given offerer. The criteria are very similar to those used in the NASA Excellence Award Evaluation and are geared to developing communication between the government and a contractor. They include:

- Top Management Commitment
- Training and Development Efforts
- Work Force Involvement, Reward and Recognition
- Effective Use of Goals, Plans, and Objectives
- Demonstrable and Verifiable Benefits
- Involvement in Quality and Productivity Improvement of Subcontractors
- Applicability to Specific Contract Effort

Since some productivity initiatives are fairly nebulous, we use open-end questions such as, "What are you doing to develop a culture focused on excellence?" and, "What would you consider to be good award fee criteria?"

We want to make the results of our study fully available to those involved in contract specifications. Summary information will be available soon, and we intend to produce a training video covering the key recommendations.

5.2.3 Performance Incentive Experiments: Fee Set-Asides and Contractor Report Cards

Glenn C. Fuller, Chief, Engineering and Space Technology Resources Management Office, Goddard Space Flight Center

At the Goddard Space Flight Center, we are experimenting with two performance incentive procedures with our contractors: quality and productivity improvement set-asides in award fee contracts and Contractor Report Cards in cost plus fixed fee contracts.

The objectives of the set-aside program, which consists of setting aside a portion of the contractor's award fee to reward quality and productivity improvements, are to heighten contractor awareness of our interest in a continued focus on quality and productivity improvement on our engineering directorate contracts and to encourage contractor initiation of quality and productivity improvement programs in support of engineering directorate contracts.

The steps a contractor must perform to receive the quality and productivity set-aside money are:

- contractors must submit an event in quality and productivity improvement to be eligible for funds;
- contractors must identify specific and verifiable accomplishments during evaluation period; and
- the quality and productivity improvements must be above and beyond the call of duty, not just meeting contract direction and requirements.

The criteria used to evaluate the Q/PI events include: cost savings, improved procedures, eliminate duplication of effort, increased quality or quantity of output, health and safety, and instituting quality and productivity improvement programs. The results have shown substantial contractor accomplishments and savings.

Another experiment we are working at Goddard to encourage quality and productivity improvement is the Contractor Report Card. The objectives of this experiment are to develop a means to provide our major contractors with performance feedback in cost plus fixed fee contracts and to devise a mechanism by which our contractors can provide us with recommendations on how to streamline operations and improve our working relationships.

The benefits include:

- improved GSFC/contractor dialogue on cost plus fixed fee contracts;
- early warning system, timely trouble shooting;
- opportunity for contractors to recommend improvements to GSFC; and a
- streamlined method for tailoring the best aspects of the cost plus award fee process to the larger cost plus fixed fee universe.

Both of these experiments have had a positive impact on improving quality and productivity, both at the Goddard Space Flight Center and throughout our contractor community.

5.2.4 Contractor Experience with Q/PI Incentives

David H. Orbock, Quality and Productivity Improvement Program Manager, NSI Technology Services Corporation

Major elements of the NSI quality/productivity improvement effort are program development, employee involvement, implementation of suggestions, and program evaluation. Based on established improvement goals, we have solicited and documented a number of problem-solving suggestions through a Quality Boosters activity. Every suggestion is acknowledged with a letter, and accepted ideas are recognized by a variety of awards, including savings bonds. Quality/productivity improvement is evaluated on the basis of potential savings in time, money, or material; improved procedures or equipment; increased quality and/or quantity of output; and reduced safety hazards.

Participation has steadily increased in the NSI Quality Boosters since its inception. The program has had a positive effect on the NSI award fee and improved the quality of the organization's work life. We will continue to involve a broad spectrum of the work force in this effort as we review and revise our goals to assure customer satisfaction.

(Pictured Below: Panel C2 - Contract Q/PI Initiatives for Incentivized Procurement: (from left to right) Leroy E. Hopkins, NASA Headquarters; David J. Steigman, Lewis Research Center; Glenn C. Fuller, Goddard Space Flight Center; David H. Orbock, NSI Technology Services Corporation; Philomena G. Grodzka, Lockheed Missiles and Space Company, Inc.)

5.3 Investing in Partnership

How the investment in a partnership is viewed by the participants in terms of benefits. The topic will be approached from commercial, NASA, and NASA Contracts perspectives.

Charles E. Henke, Director of Procurement, George C. Marshall Space Flight Center, Chairman

5.3.1 Government-Support Service Contractor Team: Partnership for Technological Advance

Dr. J. Stuart Fordyce, Director of Aerospace Technology, Lewis Research Center

We have a vertical integration matrix management role that involves aeropropulsion, space propulsion, space power, and space science and applications. We have achieved higher levels of organizational effectiveness through cultural change and introduced participative management practices that have worked to flatten the organization. Our program is based on (1) widespread participation, (2) individuals empowered to take responsibility, (3) some reductions in organizations that were solely dedicated to administrative functions, and (4) expanded professional and scientific expertise.

Our management beliefs are that:

- people are capable and desire to do well
- we need to foster willingness to share ideas and solicit help and ideas from others
- we need to provide meaningful work to stimulate employee potential for growth
- we must encourage involvement, teamwork, and shared responsibility at all levels.

Team building comes from the top down. We provide upfront recognition of achievements and make an effort to handle barriers in a timely manner. We want to establish a clear understanding of the technical work to be accomplished and establish a feeling of equivalence between civil service and support service contractors. Our policy is to award the technical lead on a project to the person who is most qualified, regardless of civil servant or contractor status. As a corollary, authorship on research papers and articles is given to the person who actually did the work and is the expert, regardless of civil service or contractor status.

Success is dependent upon effective leadership of management, a pervasive commitment to quality performance, and a highly professional environment.

5.3.2 Partnership in Support Services

Dr. Stuart L. Petrie, Vice President and General Manager, Lewis Research Center Group, Sverdrup Technology Inc.

We are involved in research in all phases of engineering and science at the Lewis Research Center and must gear our performance to meet a great diversity of customer needs. This is a challenging effort that demands teamwork. Our overall philosophy is that each employee plays a critical role. Top-down management commitment to excellence is apparent, but we recognize that the working supervisors carry out key interfaces and assure quality performance.

A constant infusion of technical talent is required to meet the needs of our customer, so recruitment is an ongoing process for us. We carry on a nation-wide search for the right people to work on our tasks, and when U.S. citizens are not available, we will hire foreign nationals. Personnel retention measures are needed because of the large investments we make in highly skilled technical personnel. Therefore, we provide competitive benefits, as well as career development programs and diverse educational opportunities.

There is now a strong synergism in developing a capable work force. In the early stages of one of our scientific research programs, there was a perception of owner-slave attitude and a doubt about our commitment to NASA's commitment. We worked through these problems and teamwork has grown. We now have a codependent, cotrusting relationship with the customer. It is a cooperative effort in that it is essential to meeting customer requirements, and sometimes we can supply a proven performer to the government. In the future we will be challenged to continue to grow without eroding our core capabilities, to foster teamwork, and to solve basic common problems of working together.

5.3.3 Boeing Supply Quality Improvement

Robert A. Bogash, Director, Materiel Quality and Surveillance, Boeing Commercial Airplane Company

Continuous improvement actually translates to continuous change in terms of one's comfort zones. Today's changing environment has brought a number of realizations at Boeing. Airlines are now more economy driven than technology driven. Total quality results from improved productivity. Strong competition occurs at every stage of the operation.

Boeing's quality objectives are directed toward production improvements, reductions in total cost, and reductions in lead time. The goals are to deliver defect-free products and services, to redefine quality, and to incorporate the principles of continuous improvement with our suppliers as well as internally. They will be achieved through communication, education, and an institutionalized focus on continuous improvement. Through advance planning for quality we have improved our processes and products. We have come to recognize the value of investing time and attention in initial, low visibility stages of a process so as to attain success in later high visibility phases.

(Pictured Below: Panel C3 - Investing in Partnership: (from left to right) Charles (Ed) E. Henke, Marshall Space Flight Center; Stuart L. Petrie, Sverdrup Technology Inc.; Dr. J. Stuart Fordyce, Lewis Research Center; Robert A. Bogash, Boeing Commercial Airplane Company; Charles D. Purple, Boeing Aerospace and Electronics Company)

Our quality standards have been communicated to Boeing suppliers. The main elements of our supplier improvement activities include:

- Development of improvement strategies
- Data distribution
- Supplier improvement conferences
- Dollarizing the cost of nonquality
- Communication
- Education and training
- Measurements

Our suppliers have participated in seminars that include a two-way dialogue regarding impediments to quality. Boeing assessed and prioritized the 3300 comments on impediments to quality that were uncovered at our Supplier Symposium. We discovered that we sometimes create problems for our suppliers and established quality improvement teams to work on these problems. This teamwork with our suppliers has resulted in a number of benefits:

- Improved production quality
- Improved Boeing and supplier productivity
- Reduction in total costs
- Reduction of total leadtimes
- Improved relationship with suppliers
- Enhanced marketability for both Boeing and supplier products

6.0 Achieving Total Customer Satisfaction

This panel will focus on how to determine customer expectations, ways to measure performance against those expectations, and finally, how to continue meeting those expectations.

6.1 Defining Customer Expectations

This panel will stress the importance of defining customer expectations and provide participants with ideas and tools which can be utilized in achieving total customer satisfaction.

6.1.1 Customer Expectations: A View from Both Sides

Robert E. Lindstrom, Senior Vice President, Thiokol Corporation, Chairman

Based on experience of what the shuttle program looked for the contractor to do, I would say that teamwork is basic to success of the working relationship. However, the best of contractors knows that it is necessary to go beyond that. The customer is looking for a contractor to be aggressive and to take an ownership and leadership role in the program.

A contractor to NASA cannot afford to be a follower these days; this is borne out by observing the best contractors, those who receive the highest award fees. These are organizations in which nothing is left to chance and a tremendous amount of attention is invested in small details. A contractor must be self critical in that performance is closely observed and a procedure for check and balance be in place. These are long standing principles of operation; they involve nothing new and yet they continue to be sought by customers and are not always operative.

Certainly we need teamwork, communication, and measurement. But successful contractors will be aware of the imperative to take the initiative and assume an active role in the success of the program.

6.1.2 Defining Customer Expectations Through Teamwork

Alexander A. McCool, Director, Safety, Reliability, Maintainability and Quality Assurance, George C. Marshall Space Flight Center

Customer expectations are best met through the kind of teamwork that entails a commitment from everyone involved in a project. This includes the prime contractors and also the subcontractors. Communication is a key because a great deal of detailed information must be provided; clarification of major items such as cost and schedule must not preclude addressing other, seemingly minor aspects such as how orders will be written and what constitutes management of personnel.

Our goal must be to surpass customer expectations, to anticipate needs and be creative in providing solutions to problems. Once the service is in progress, we need to go back to the customer and find out what his experience is. Is value being delivered? What are the areas of concern at this point? This process presupposes that the customer is defined in terms of our priorities. Every employee has a number of customers, some of whom are external and others who are internal. Key customers, the "vital few," naturally receive priority consideration, but effective communication is essential to meet the needs of anyone who is a customer.

Teamwork, communication, and constant customer/contractor interfaces are keys to successfully defining and achieving customer expectations. When we redesigned the solid rocket motor on the Shuttle, Thiokol and NASA worked together with one-on-one contact in identifying, assigning, and completing the tasks necessary. Although we can't always match, man for man, a customer and contractor, the principle is applicable. Teamwork is the key.

Teamwork is built through good leadership and effective communication, and the customer must become part of the team. Each person can contribute to the process and, as a team, expectations of the most demanding customers can be met. At Marshall we have an understanding, an unwritten contract with one of our most vital customers, the astronaut crew, that we will provide safe, reliable products to ensure successful flights. We are proud to meet these expectations and will continue to work together and communicate so that the shuttle program will move forward as a key part of the NASA space effort.

6.1.3 Total Customer Satisfaction: Gaining Team Commitment

Charles L. Gibbons, Deputy General Manager, EG&G Florida, Inc.

Quality is in the eye of the customer, and customers are made up of a very broad spectrum of individuals. Our task is to involve the customer in establishing expectations; in effect what we have to do is create a team atmosphere.

At EG&G we perform services for many groups and we are highly customer oriented. The first step is to make sure that you're communicating in a common language which has to do first with being thoroughly acquainted with the customer and, second, with clearly specifying requirements.

You have to measure how you're performing and you have to remain flexible because everyone's needs change. Part of the cause of changing needs derives from the reality that the customer has a customer has a customer. The chain reaction is inevitable. At EG&G we are regularly questioning the customer about what is being provided. Are you getting what you need and want? The planning process is vital to successful customer relationships when a variety of elements is involved. Interface agreements establish who owns what and how it will be used.

The effect of TQM will be to make role definitions disappear. It will no longer be important to call attention to who's the manager because everyone will be fully committed and involved and share in the responsibility for meeting customer expectations. We must be senstive to commitment and keep to schedule while maintaining quality at all costs. We must also measure the effectiveness of what we do because if you can't measure it, you can't manage it.

But in spite of an enormous volume of demanding requirements, we've been able to meet our customer's needs, and in the process of team building even the hard core union group has become enthusiastic and dedicated to reaching our goals. In this kind of team environment, the supervisor acts as a coach to see that people get what they need to do the job. In fact, the supervisor of one of our groups was out for two days and no one missed him. We train people to use the system and, when provided with this kind of support, they realize how vital they are and a strong team emerges. The result is a win for everyone and a realization that team wins are more satisfying than individual wins.

Panel D1 - Defining Customer Expectations: (from left to right) Robert E. Lindstrom, Thiokol Corporation; Alexander A. McCool, Marshall Space Flight Center; Charles L. Gibbons, EG&G Florida, Inc.; WIllis E. Chapman, NASA Jet Propulsion Laboratory

6.2 Measuring Customer Satisfaction

Satisfied customers are the ultimate measure of quality. This panel will address measurable and verifiable customer satisfaction (NASA or a prime contractor in the case of subcontracted work) for overall performance. They will discuss who is responsible and how their customer satisfaction is measured.

David L. Van Der Griend, Vice President, Unitech Composites, Inc., Chairman

6.2.1 The Many Parameters of Customer Satisfaction

Joseph P. Zimonis, Vice President, Space Propulsion, Pratt & Whitney Group, United Technologies Corporation

At United Technologies we work with our customer to define acceptable standards for customer satisfaction and to track both absolute levels and trends in our service. Measurement is continuous, and in the process of defining quality we use many items, including:

- technology development
- product improvement
- safety
- previous contract performance
- utilization of small business
- conformity with affirmative action programs
- cost reduction
- delivery timeliness
- quality assurance
- property management

We have 30 parameters that are continuously monitored and reported to our CEO. With feedback from our customers, we set goals to improve performance. For example, recurrent engineering changes that were identified as taking too long became the focus of improvement activities. We set out to reduce the process time and successfully reached our goal.

At United Technologies TQM is very visible. We are increasing employee involvement and experiencing continual improvement in meeting customer needs. Total involvement by all employees is critical. Improvements don't just happen because the guy at the top says to do it. They happen because the people who actually do the work in the shop believe in the importance of the improvement process. This also carries into the supplier community. In the course of practicing TQM for five years, we've had excellent compliance with a number of key customer contract requirements in diverse areas such as Affirmative Action and Product Performance. We have reduced the number of engine-caused incidents nearly to zero. This has been a mutual customer/contractor effort.

Another way we measure customer satisfaction is by reporting the number of promises made versus the number of promises kept. This is an area which we negotiate prior to project start-up to establish an acceptable level of compliance. We track schedule, cost, and product performance in order to see improvements and identify areas that need attention. The success of our record is a result both of employee and supplier involvement. Customer satisfaction influences our ability to recover our R&D investment. Upper management has a role in the customer relationship in that it is possible to use them to gain real-time feedback from the customer. We view the customer's feedback as a grade card and we are always aware that customer satisfaction is our key to the ability to win future contracts.

6.2.2 Suppliers and Subcontractors as Partners

Donald C. Wilhelm, Vice President, Contracts and Procurement Aeronutronic Division, Ford Aerospace Corporation

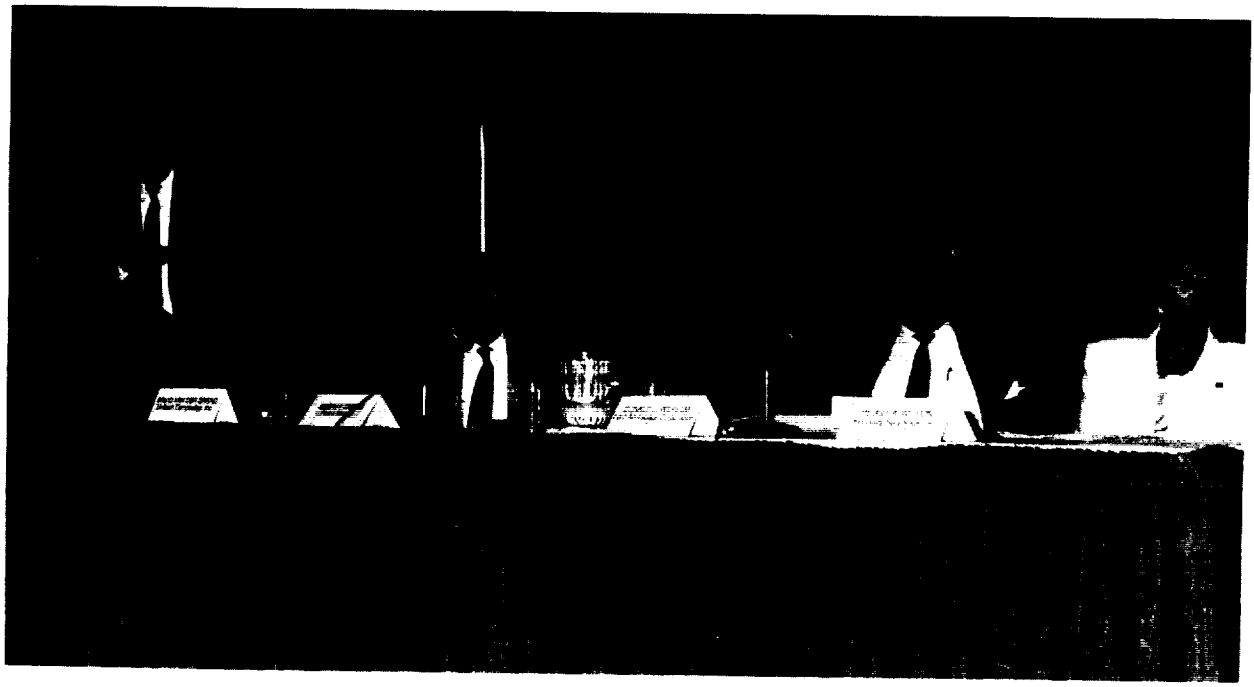
The fundamental Ford precept is that quality is defined by the customer. At one time Aeronutronics had an unstable supply process that affected overall performance and resulted in some unhappy customers. A detailed analysis of the situation suggested that improvements needed to be made through increasing supplier involvement in our goals and reducing the overall supply base. We realized that we had a great many suppliers for the same item; for example, we had a pool of 350 machine shop suppliers, many of whom were not providing acceptable service. The great number of small value deliveries for non-inspected material was bogging our system down

We notified many of these suppliers that we would no longer be using them because of poor service. The response in a number of cases was interesting in that these companies came back to us saying, "If only we

had known that what you wanted was an on-time delivery of a quality part, we would have provided it." Clearly our communication with suppliers had some deficiencies.

In the course of reducing our supply base we went from 5,100 suppliers to 2,500 and continued to seek ways to bring the number down even further. A revised commodity code serves as a guide for supplier selection in the future. This effort, which occurred at the same time that a number of changes were being made within the company and our overall work force was reduced, had an immediate effect. We experienced substantial improvements in our ability to meet cost and schedule requirements, and customer satisfaction was increased.

We want suppliers to know that we expect a lot and that they are vital to our achieving customer satisfaction. This is a process that requires continual fine tuning. Our experience is that problems that have evolved over decades don't take decades to correct. The transformation depends upon a commitment to continuous improvement and a dedication to customer satisfaction.



Panel D2 - Measuring Customer Satisfaction: (from left to right) Joseph P. Zimonis, Pratt & Whitney Group, United Technologies Corporation; David L. Van Der Griend, Unitech Composites, Inc.; Donald C. Wilhelm, Ford Aerospace Corporation; Peggy A. Wilson, Kennedy Space Center

6.3 Vision of Customer Satisfaction as a Continuous Process

Presenters will explain customer satisfaction as a process of continuous improvement requiring leadership that creates an environment in which employees can accept and execute their responsibilities with confidence and finesse.

6.3.1 Top Management Leadership in Customer Satisfaction

Richard M. Davis, President, Martin Marietta Manned Space Systems, Chairman

Maintaining customer satisfaction is a continuous process. The first requirement is your conviction that customer satisfaction is important. There is a discipline in the Total Quality Management (TQM) drive that we can all benefit from, and that is the broad definition of the term "customer."

Management has to lead the way, and customer satisfaction has to be articulated as part of your basic corporate culture. We have to take the lead in resolving any inconsistencies between the existing corporate culture, constraints, and the item of customer satisfaction. When customer satisfaction starts meaning some reduced profit, that's when conflicts emerge. Management needs to take the challenge to resolve those conflicts for their people, so that indeed they can keep customer satisfaction in the forefront. Also, management is challenged to demonstrate customer satisfaction personally in daily operations. Talking the issue is not sufficient. If in your daily actions you do not demonstrate you believe in the importance of customer satisfaction, it is not going to happen. Finally, you have to continually measure, react to, and reinforce customer satisfaction, both internally and externally.

The emphasis is usually placed on the program manager and his superiors. Many of us don't realize that there is another customer probably equally as important. They are the chief engineers, the technical engineering personnel, the contracting officer, the business personnel, and the quality, safety, production facility. You have to satisfy them all. One of the best ways to do this to encourage the interaction between your people in those skills and their corresponding level of customers, and make sure that your people view them as customers. Satisfaction of commitments is one aspect of customer satisfaction that is sometimes overlooked. Not necessarily contractual commitments, but the personal commitments that you make in your everyday interaction with your customer. It can be a simple as "Gee Joe, I'll look into that problem and give you a call tomorrow." Make sure you do look into that problem, and make sure that you do call Joe tommorrow, or even today if possible.

How do you get a widely disparate group coordinated in a production effort? You must have some common, program-oriented goals. In manned space flight that one singular goal is mission success. We also have schedule and cross goals that are not unimportant, but obviously subservient to mission success; 51L has shown us the cost of not achieving mission success, and it is just not acceptable.

To understand a customer's problems and expectations, you must sometimes adopt his perspective. The customer has problems too; resource problems, dollars problems, regulations problems, management to answer to, time constraints, etc.

Remember that the customer is just like you and me; dedicated to mission success and wanting personal satisfaction out of a job. Help your customer with any problems that arise and don't hide behind the contract. Satisfying only the contract language is not enough. Contracts are only a written definition of obligations and agreements. Put the program first and work toward those common goals. Get the contract changed if it prevents you from meeting program goals.

Continuous assessment by top-level management is necessary. Most of the programs today have an award fee structured to them. There are written evaluations. Read them. Find out what the customer didn't like. Don't argue. If the customer didn't feel that way, it would not be in the evaluation. Go fix it. Even if you think it doesn't take fixing, go fix it. Also take a look at your ratings. Satisfaction will be reflected in that. There are other ways of gauging your customer's satisfaction. In program reviews, focus on the customer's tone and attitude. See if the customer is frustrated with what is going on, and ask yourself if this problem was discussed three months ago and never fixed. Go test the reality of the information you're getting at the program review. Examine the contract performance track record from your customer's side. If your program has had a history of continued schedule slips and continued schedule cost increases, just because you're on track in cost and schedule today does not erase the fact that deep down your customer is wondering if this will continue.

Be responsive to your customer, be responsible, and always keep your common goals in mind as you

perform. Once you and the customer share those common goals, it's a "win-win" situation.

6.3.2 Customer Satisfaction as a Driver for Continuous Management Action

Dr. Hiten N. Ghosh, Vice President, Customer Satisfaction and Quality, Unisys Corporation

Unisys believes in a customer-driven culture that expresses the following values:

- The customer comes first
- We work as a team
- We back the innovator
- We honor high ethical standards
- Quality is in everything we do

Quality is defined as meeting customer expectations. We realize that these expectations will increase as time goes by, so we have programs that act as building blocks from which to phase quality improvement. Since there is a degree of compatibility in all manufacturing activities, in many cases level of quality is the only distinguishing factor.

The Unisys Quality Policy is two-fold:

- We are committed to quality and excellence in all endeavors
- We have set our goals to achieve total customer satisfaction, to deliver error-free, competitive products and customer solutions on time, with service second to none

The goal is to exceed customer expectations, thereby gaining the status of preferred supplier for the market.

This goal was incorporated in the strategic planning process of the company. With this in mind, Unisys evaluated its current product and found that it would not meet all the customers' needs. We came out with the open system strategy, our objective was to let them buy other competitive hardware and we would provide the connectivity. That put quality into the survival issue. If our strategy succeeds, only the quality of products and services will let them stand out above the rest. By examining the design quality, we found that we take too long to test and qualify our products. Because of quality design efforts, this process will take considerably less time in the future. We also feel that customer feedback, on all aspects of the company, is very important and this is measured by customer surveys.

These surveys are not just recorded and read, they are acted on. If a customer indicates dissatisfaction in an area of the Unisys product, business process, or associated services, a manager must go out to the site and discover the reason for the dissatisfaction. Top ten areas for improvement are derived through statistical analysis from the surveys, and these are acted on by top management, who is kept abreast of the problems and the actions taken to correct the action.

To be the preferred supplier of customer solutions in the information processing industry, we must provide competitive products and services and competitive quality to provide total customer satisfaction.

Panel D3 - Vision of Customer Satisfaction as a Continuous Process: (from left to right) Robert P. Hessler, McDonnell Douglas Space Systems Company; Richard M. Davis, Martin Marietta Manned Space Systems; Dr. Hiten N. Ghosh, Unisys Corporation

7.0 Improving Technology Management/Partnership

This panel will discuss: 1) technology as a key factor in achieving excellence in high technology organizations, and 2) developing effective technology management processes for the benefit of management, line organizations, and individuals.

7.1 The Challenge of Technology Management

William A. Huffstetler, Jr., Manager, New Initiatives Office, Lyndon B. Johnson Space Center, Chairman

Coping with change requires an ability to manage chaos. The dynamic management of technological change is essential to our survival. A major difference between the technology of the 1960s and 1980s is that aerospace R&D now draws upon many sources, not just the government. Universities are a major asset to the civil space program. The challenge is to identify the program requirements and then match them with what already exists. We must not reinvent technology; we know where the sources are, and the technological maturity exists. No good single system exists which unites all mature technology; rather, many individual systems operate. We are using the following management principles to define our technology needs for the future

- Use of existing information systems when appropriate
- Preparing requirements definitions and establishing technology needs and drivers
- Comparing available technology
- Narrowing down the implementation of new technology to small elements that are manageable.

Long range planning is essential. It is mandatory that we establish needs for the future as soon as possible to determine where our investments should be. The field centers are working aggressively with NASA Headquarters in long term strategic planning. This planning must take politics into account, because we will always have to deal with politics if we are to be successful.

The solution is to assure face-to-face communication between technology users and developers. All this complexity boils down to use of good common sense, a process that is dependent upon people and leadership. We need to be sure that employees are placed in areas that will best suit their professional and personal needs and that they realize the need and importance of their jobs. We need to provide maximum possible freedom for those in technological areas. Effective communication is essential. At the extremes, we will find ourselves needing to communicate with those who know everything and those who know nothing. There is a time to hold the line, and there is a time for change, but at all times quality must be a prime consideration in technological decisions.

7.2 Contractor Perspectives on Technology Planning

John G. Ferguson, Manager, Houston Office, Allied-Signal Aerospace Company

The contractor technology team formed by NASA initially had 22 members and was a voluntary effort. Two tasks were undertaken: (1) to define the technical management process, and (2) evaluate special emphasis technologies. The latter task involved consideration of 19 technologies with 55 subsets, all of which were to be clarified and prioritized. Advertising technology problems through the Commerce Business Daily (CBD) is one vehicle in the search for technology solutions.

At a strategic planning meeting at JSC, the team asked for assessments for the JSC Special Emphasis Technologies that were identified and how the center can work to encourage the development of these

technologies. The following comments were the most prevelant.

- List of Special Emphasis Technologies was too general, application requirements were needed to further define the technologies
- Technology areas need to specifiy goals and objectives relative to programs
- Incentives must be provided for contractors to develop and apply critical technologies
- NASA should create an advocate for each critical technology, a focal point for information and unsolicited proposals
- List of technologies should be prioritized based on need date, deficiency and commonality across programs.

The team set out to act on recommendations to make special technologies usable to the NASA/contractor team. In the prioritization, five technologies surfaced as top priorities in manned space flight technologies: mission automation, human performance, regenerative live support, flight system automation, and EVA systems.

The result was to establish a database of technologies. The benefits of participating on this team included direct contact with NASA, access to the leading edge of technology, an enhanced corporate image, and an increased focus on IRAD programs.

7.3 Developing a Technology Focus in Engineering Organizations

Norman H. Chaffee, III, Deputy Chief, Propulsion and Power Division, Lyndon B. Johnson Space Center

At Johnson Space Center we have developed a division-level action plan that translates program requirements into technical targets. This effort, which is very time intensive, involves a number of people. Strategic planning extends to programs, technology, and project management. There are two phases of technology management: (1) identify and prioritize technological efforts, and (2) define and manage specific technical projects.

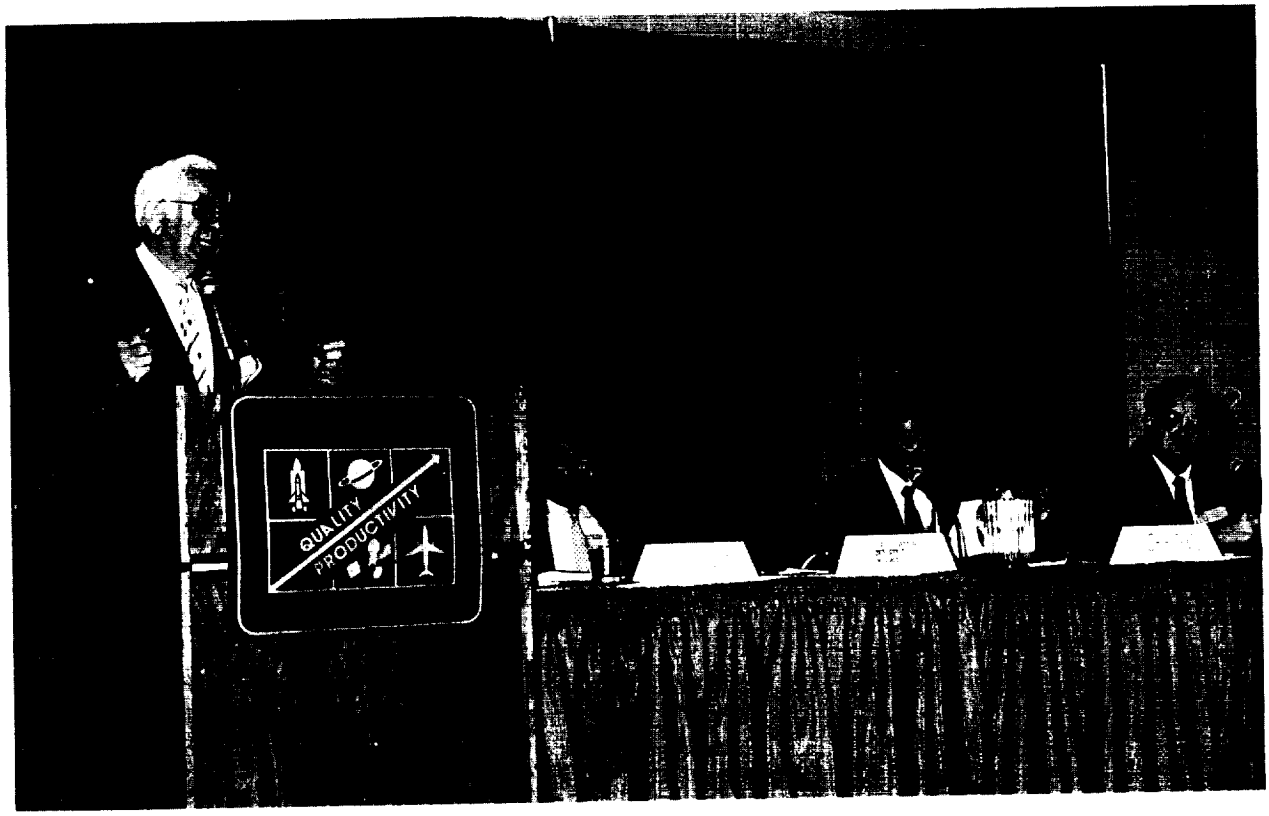
The three main steps in the technology planning area are:

- Identify and prioritize technology fronts/areas that are important to your organization.
- Determine your technology position (where you are relative to others) for each area.
- Decide where you need to be in each technology area and set goals for each area.

With this broad direction, you can narrow the process of technology acquisition down to the project management phase. The two important steps in the project management phase are:

- Define the specific technological projects that you want to work on
- Manage and control technology projects

There is frequent feedback in what you are doing in the project management area and what you want your long-term goals to accomplish.



Panel E - Improving Technology Management: (from left to right) Leslie J. Sullivan and William A. Huffstetler, Jr., Johnson Space Center; John G. Ferguson, Allied-Signal Aerospace Company; Norman H. Chaffee, III, Johnson Space Center

The 1988-89 NASA Excellence Award Finalists: (from left to right) Bill F. Barry, Computer Sciences Corporation; Wiley E. Williams, Grumman Technical Services Division; Robert B. Young, Jr., Lockheed Engineering and Sciences Company; Emyre' B. Robinson, Barrios Technology, Inc.; C. Michael Riddell, Boeing Computer Support Services; Robert G. Minor, Space Transportation Systems Division, Rockwell International Corporation; James R. Dubay, EG&G Florida, Inc.; H. Joseph Engle, Bendix Field Engineering Corporation

8.0 NASA Excellence Award Banquet

This session recognizes the 1988-89 NASA Excellence Award finalists and announces the recipient of the 1988-89 NASA Excellence Award for Quality and Productivity.

8.1 Presentation

Robert A. Parker, Ph.D., NASA Astronaut, Johnson Space Center

Tonight, I represent a group of folks who quite literally puts their lives on the line on each space shuttle flight. A visible symbol of the importance of excellence and quality, and quality workmanship as it relates to safety. Our lives depend upon it.

But there is another side to the story of excellence...mission success. Just like safety, mission success depends on excellence, and the space program, in turn, depends upon the success of each of our missions. I don't mean the success of the Mission to Mars, or Mission to Planet Earth or STS-30. I mean the missions that are a part of our daily endeavors; whether it's a part of the Space Station program, the Space Shuttle program, the Hubble Space Telescope, or the operation of a wind tunnel or calibration lab. In each program, success is vital in each phase of those programs; the design, the procurement, production, or servicing. All the phases of all the programs are individual missions, and their individual successes are of the utmost importance to our space program.

During quality conferences, we often hear horror stories. What we should do instead of remembering horror stories of quality failures is remember the horror stories that were prevented. More positively, we should remember the success stories. Stories of things that were done well the first time: new programs, new approaches that increase employee involvement, reduce manufacturing non-conformities, which means saving money and saving time and improving product quality. These things are often taken for granted in day-to-day life.

Excellence in workmanship is simply defined as caring; not settling for something that is "in spec," adequate, or, described with the phrase we hear so often in derision or in jest, "good enough for government work."

The Voyager team, recently publicized, kept two probes going year after year after year, planet after planet. I have to suspect that "adequate" and "good enough for government work" were not terms in their vocabulary. Pride in workmanship is really what it's all about -- putting the name on the product and standing behind it. Excellence depends, ultimately, on the individual, individuals at all levels. We in Houston give out an award, called the "Snoopies," to individuals at all levels for outstanding work and outstanding dedication.

But as you all know, beyond those individuals whom we recognize, there are the managers, the corporations, the bosses who support and encourage those individuals. People who make sure that work environments are such that employees in onerous jobs do not burnout too quickly, that they can derive some satisfaction from their jobs; people who increase operator responsibility, who see to increased communications between managers and employees, all these things.

I salute and extend my thanks and NASA's thanks to the eight finalists and those of you from the other 212 organizations here today who, by your participation, show that you care about commitment, teamwork, and excellence.

8.2 Introduction

George A. Rodney, Associate Administrator for Safety, Reliability, Maintainability and Quality Assurance, NASA Headquarters

Since its inception, we have been gratified by the response of companies and individuals who supply NASA and America's space program with the hardware and services necessary to successfully accomplish our programs.

The astronauts very deservedly get much of the publicity, but they know, as do we, that the success of their missions and their lives depend on the conscientious job performance of each person who contributes to this effort. The same is true for our unmanned scientific programs and research operations. I know from personal experience that you can never relax, and you must always strive for continuous improvement.

I would like to extend my personal thanks and congratulations to the eight finalists here for their continuous improvement efforts. In this multi-billion dollar array of both large corporations, small companies, and individuals, there are those whose outstanding efforts bring them to the top. We have already mentioned the eight companies who achieved the distinction of Finalist status this year, and indeed, we honored them with a special reception last month. This evening we shall acknowledge those who have been judged to have the highest achievements even within this elite group; to have become the best of the best, the distinction among their peers and an inspiration to all of us.

8.3 Announcement of the 1988-89 NASA Excellence Award Recipient

James R. Thompson, Jr., Deputy Administrator, NASA Headquarters

I certainly know that if Admiral Dick Truly were here tonight, he would take immense pride to be able to honor the award finalists, and to announce what George has termed, "The Best of the Best," and I certainly can state tonight that I am proud to be here in his place.

But before I go further, I want to emphasize that the key words are, "Award Recipient." To call them an "Award Winner," I believe, would be inaccurate and unfair, for there are no losers in this process for the NASA Excellence Award for Quality and Productivity. We Americans, as you know, are highly competitive by nature. In our culture, we feel compelled to distinguish between winners and losers. We read our sports pages, and we can tell you who won the World Series and last Saturday night's football game. But a few weeks later, many of us are hard pressed to recall who finished second. But as we honor our Award Recipient tonight, I think we would indeed be remiss not to salute, as well, those who competed, because by participating, we all win. But I think the big winners tonight are the American people and the space program all of us are so proud of. There is no such thing as second place. Every company that entered this year's award process, I believe, benefited in an immeasurable way. The standards are tough. Our applicant companies were repeatedly challenged and each found the wherewithal to achieve new levels of excellence.

Our recipient and each of the other finalists, I believe, exemplifies the very highest standards of performance in the aerospace industry. They have achieved high marks after months of review of their efforts in productivity improvement, quality enhancement, quality and productivity achievements, and last, but perhaps most importantly, customer satisfaction. The companies that entered this award process imposed upon themselves the most rigorous standards possible and, in turn, their suppliers and subcontractors had to reach back and themselves go the extra mile achieving new mileposts of excellence for themselves in order to satisfy their customers. Throughout this process, NASA continuously challenged the applicants, and the applicants, in turn, challenged their suppliers.

The challenges were many. They had to find many answers to some very tough questions. What are your measures of productivity improvement and performance enhancement? How have you performed in terms of schedule, in terms of cost, and quality assurance? Can you indeed demonstrate evidence of top management commitment and involvement? What innovations have you used to bring about these productivity and quality enhancements?

All eight finalists have reached varying degrees of excellence, and believe me, the competition was stiff. The quality and productivity improvement claims made in the application reports were verified not only by NASA, but also by the American Society for Quality Control during numerous on-site award validation visits. On these visits, we had the opportunity to see, first hand, the processes that were employed.

I think it was a tremendous experience for NASA this year. We at NASA benefited from your programs, from learning of your incentives and in seeing your accomplishments. You have shown NASA the means to reach new levels of excellence in our aerospace programs. I think it is very clear that there are many winners in this program; the applicants who have learned by preparing, competing and improving; NASA itself by virtue of improved quality in the goods and services received; American business by sharing of lessons learned and techniques for improving; and finally, the American public through an improved and cost-effective space program and a continuing dominant position in aerospace and international economics. This impressive teamwork and a lot of hard work led to this proud occasion tonight. It gives me great pleasure to announce this year's recipient of the NASA Excellence Award for Quality and Productivity.

It's a company which has supported many major NASA programs now for nearly a quarter of a century. Both Dick Truly and I will present the actual award at the company site where the employees can participate, as soon as it can be scheduled. This is the fourth time that this company has applied for this

award and it is proof that continuous improvement really leads to excellence.

Tonight we all congratulate the Lockheed Engineering and Sciences Company of Houston, Texas.

8.4 Lockheed Engineering and Sciences Company -- the 1988-89 NASA Excellence Award Recipient

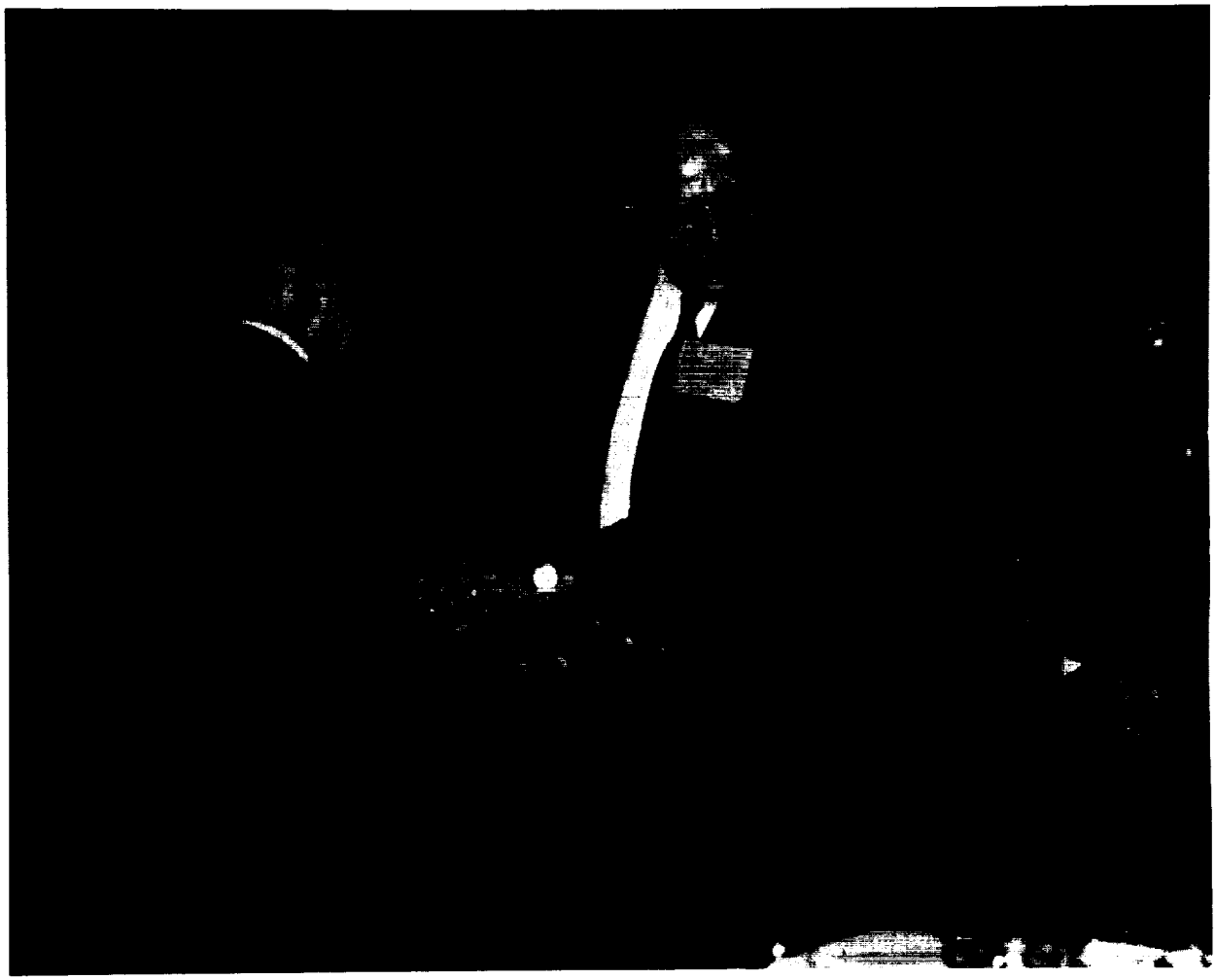
Robert B. Young, Jr., President, Lockheed Engineering and Sciences Company

I am tremendously excited for the people of Lockheed Engineering and Sciences, for the people of Lockheed that were selected for this award. Thank you very much. I am especially excited for Sherry Prud'homme and Moe Miller who have worked extremely hard on this. I am very proud of the whole team of people, the hundreds of people, who have worked to get us into this position.

I also very much appreciate the support we've had from Aaron Cohen and his people at the Johnson Space Center who have given us the environment, the climate, the umbrella in which we could work to be successful in this program.

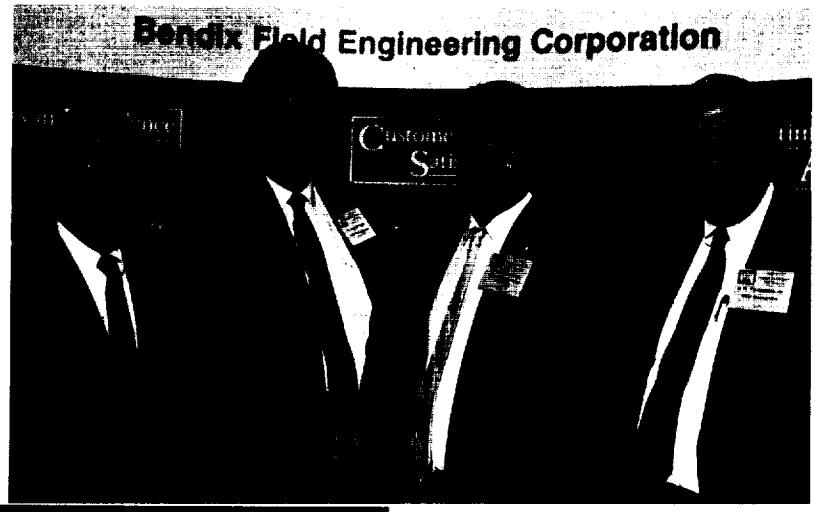
We have participated in the award process over some time, until we could get it right. We have had tremendous help in developing a continuous improvement program. Joyce Jarrett and the many people on the validation teams who have come in have given us the feedback that allowed us to gain and improve year after year. The support at JSC, our principal worksite, and from Headquarters has been a tremendous asset to us. So, on behalf of the people at the Lockheed Engineering and Sciences Company and the people of Lockheed, it's my real privilege to say, "Thank you," for this award.

NASA Deputy Administrator J.R. Thompson (right) congratulates Robert B. Young, Jr., President, Lockheed Engineering and Sciences Company.

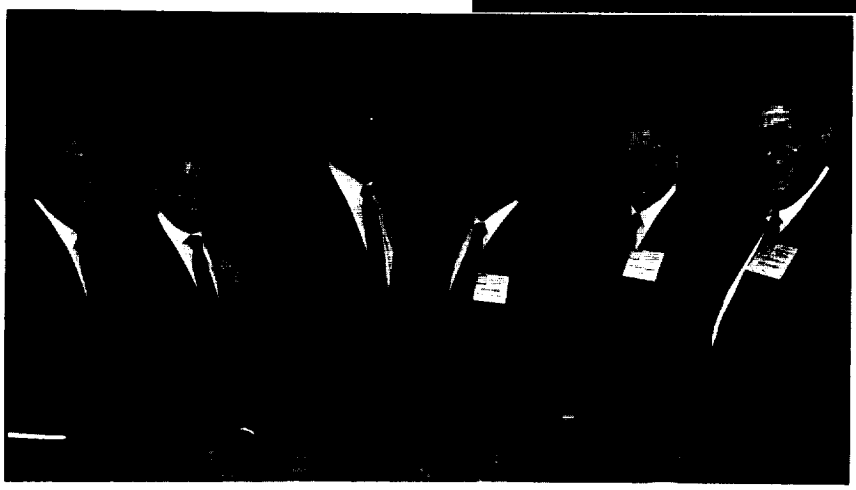


Excellence Award Finalists Teams

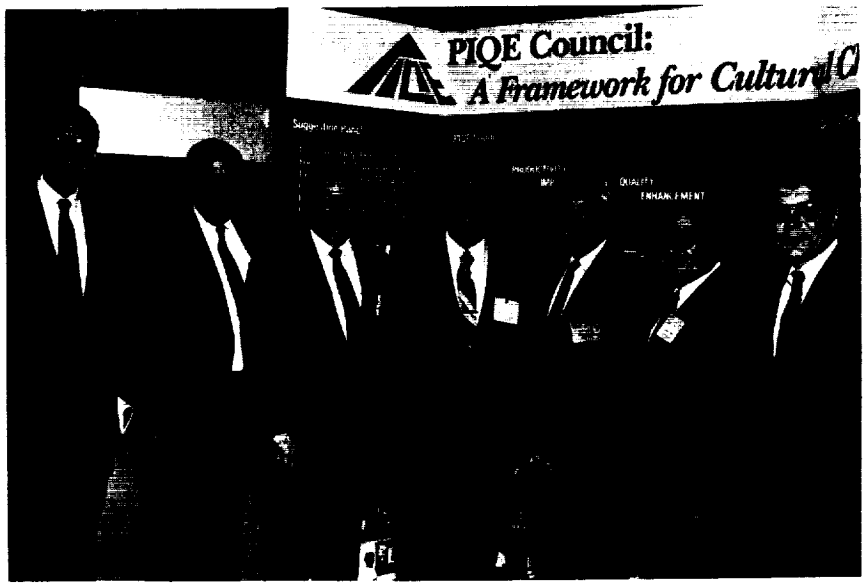
From left to right: J.R. Thompson, Jr., NASA Deputy Administrator; Emyre' B. Robinson, President and Chief Executive Officer, Barrios Technology, Inc.; Robert A. R. Parker, NASA Astronaut



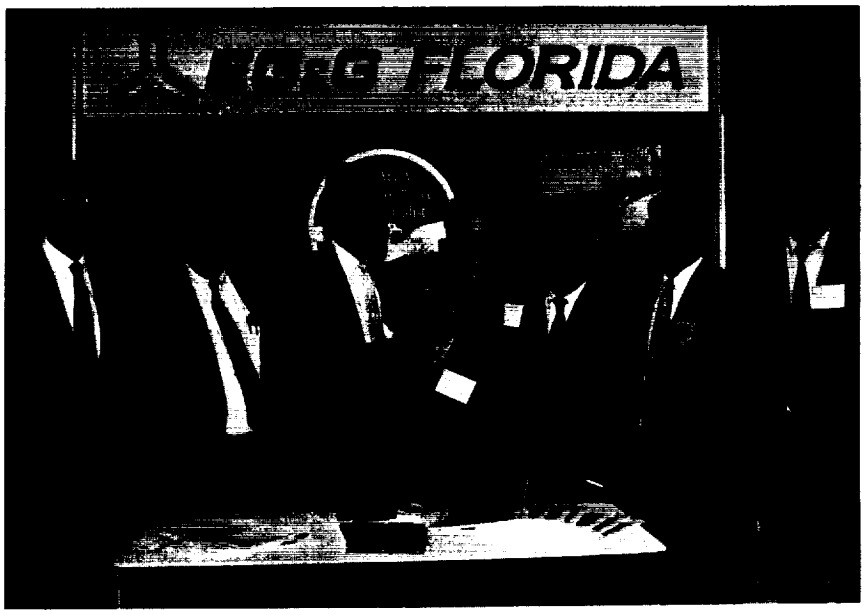
Bendix Field Engineering Corporation: H. Joseph Engle, President and Chairman of the Board; Philip H. Johnson, Vice President, Space Operations; flanked by Robert Parker (left) and J.R. Thompson (right)



The Boeing Computer Services Team with Robert Parker (far left) and J.R. Thompson (far right)



Computer Sciences Corporation is represented in this picture by Kenneth Nickerson, Ted Pykosz, Bill Barry, and Leonard Jaffe. George A. Rodney, Associate Administrator for Safety, Reliability, Maintainability and Quality Assurance, and J.R. Thompson stand on the left and Robert Parker on the far right.



EG&G Florida, Inc. stands in front of their booth with George Rodney, J.R. Thompson, and Robert Parker.

The Grumman Team shows their colors with J. R. Thompson, George Rodney, and Robert Parker.

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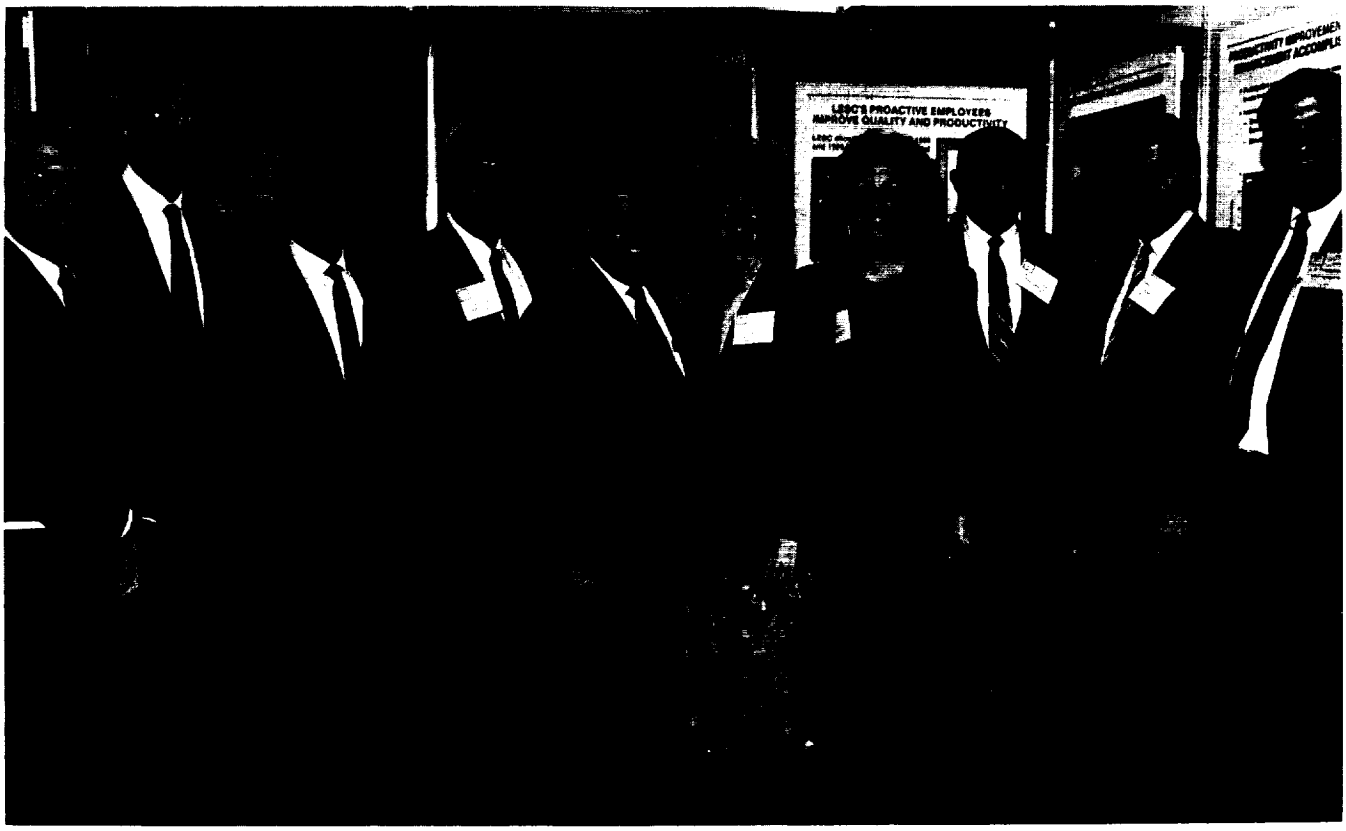
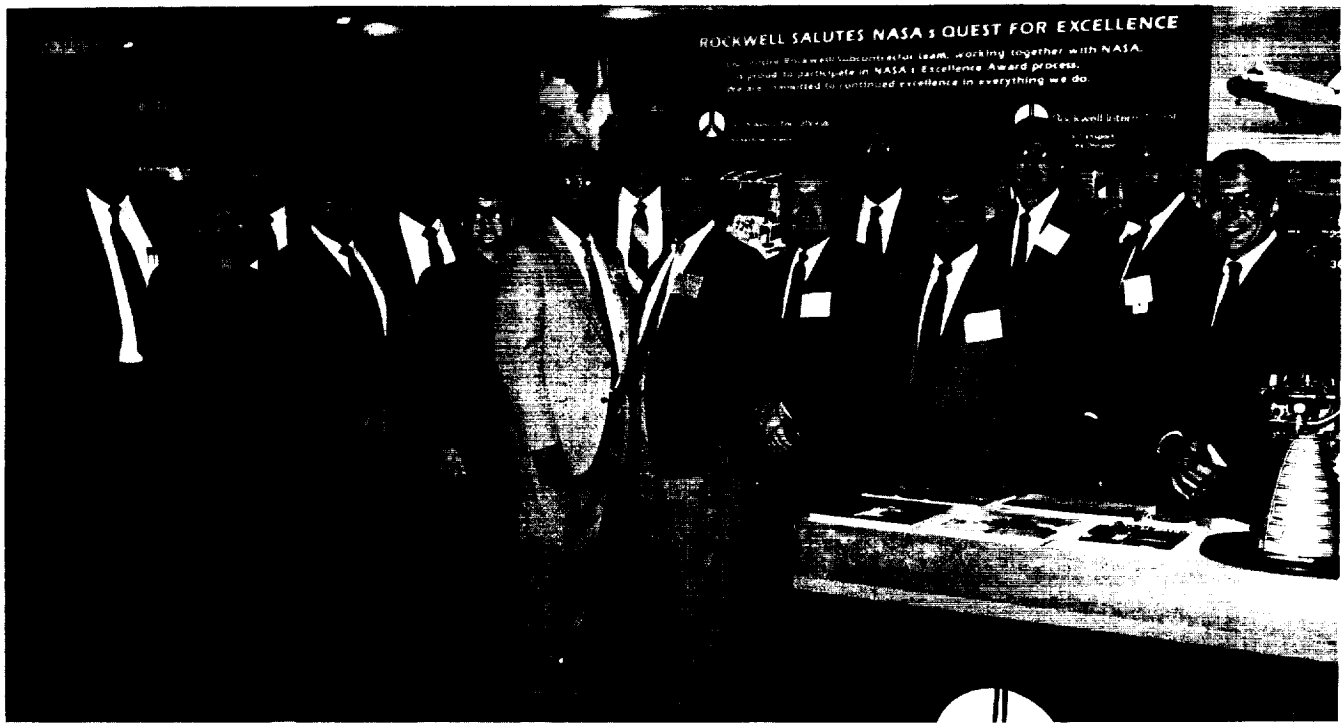


An enthusiastic Lockheed Engineering and Sciences Company Team poses here with Robert Parker and George Rodney (left) and J.R. Thompson (far right).

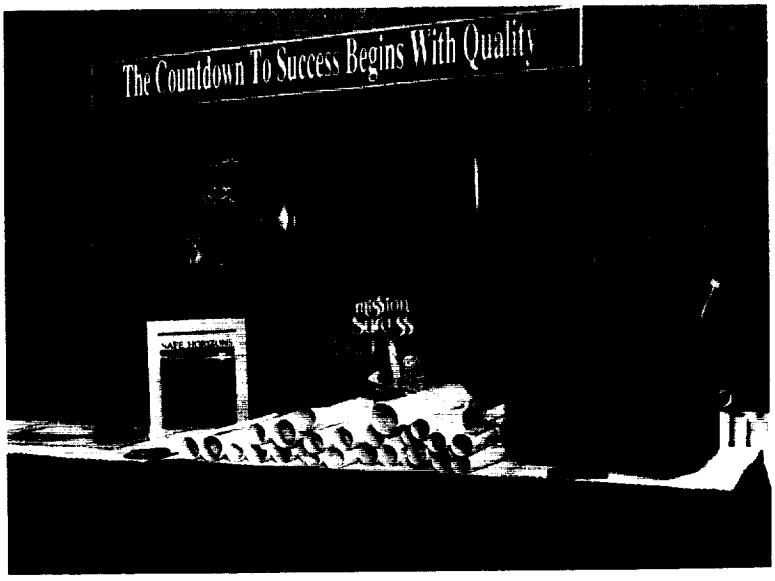


Rockwell International's Space Transportation Systems Division and Rocketdyne Division representatives stand with J.R. Thompson, George Rodney, and Robert Parker.

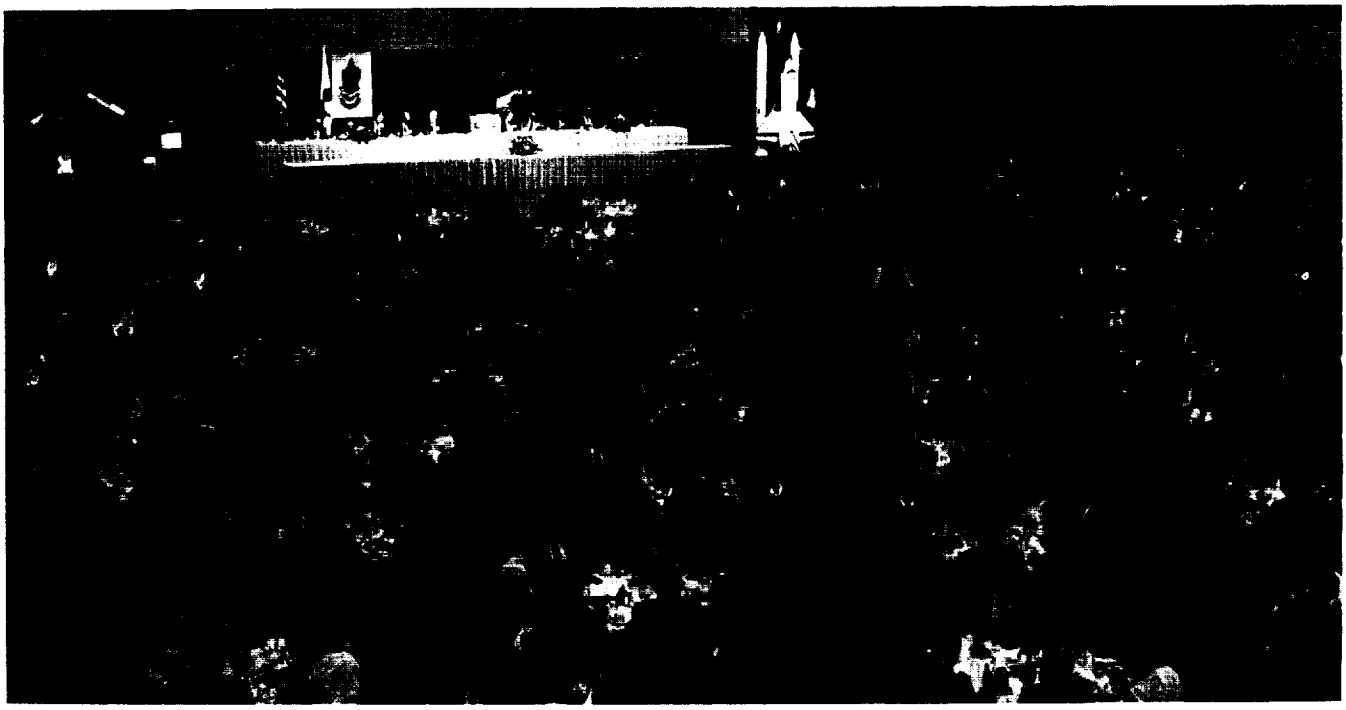
The Honorable Steve Hettinger, Mayor of the City of Huntsville, welcomes the Sixth Annual NASA/Contractors Conference delegation to his city and the Von Braun Civic Center.

The NASA Excellence Award Reception provides an opportunity to exchange improvement ideas. From left to right are: Robert Parker, NASA Astronaut; Arnold Aldrich, Associate Administrator for Aeronautics and Space Technology; George A. Rodney, Associate Administrator for Safety, Reliability, Maintainability and Quality Assurance; and Kenneth Leach, Vice President, Administration, Globe Metallurgical, Inc.

Manned Flight Awareness was heightened with an attractive booth which attracted numerous visitors over the two days.



The Sixth Annual NASA/Contractors Conference Planning Committee



More than 800 representatives from government, industry, and education demonstrated their commitment to the Partnership for Continuous Improvement, while also setting an attendance record.

APPENDIX A - CONFERENCE AGENDA

Sixth Annual NASA/Contractors Conference On Quality and Productivity

Hosted by the
George C. Marshall Space Flight Center
Von Braun Civic Center
Huntsville, Alabama
October 31-November 1, 1989

(In Cooperation with the NASA Headquarters Exchange)

"Partnership for Continuous Improvement"

Monday, October 30

5:00 - 8:30 p.m.	Pre-registration at the Huntsville Hilton

Tuesday, October 31

7:00 - 8:00 a.m.	Buffet Breakfast and Registration at Von Braun Civic Center
8:00 - 8:10	*Welcome* - **Thomas J. Lee**, Director, Marshall Space Flight Center
8:10 - 8:15	*Greetings* - The Honorable **Steve Hettinger**, Mayor of the City of Huntsville, Alabama
8:15 - 8:20	*Welcome and introduction of Keynote Speaker*, **George A. Rodney**, Associate Administrator for Safety, Reliability, Maintainability and Quality Assurance
8:20 - 8:40	*Keynote* - **James R. Thompson, Jr.**, NASA Deputy Administrator
8:40 - 8:50	*Conference Overview* - **Joyce R. Jarrett**, Conference General Chairperson
8:50 - 9:10	Break
9:10 - 10:30	*NASA PANEL* - An overview of the NASA focus and thrust under the new Administrator and Administration. Discussion of planning as a result of the President's view of future NASA missions as well as comments on NASA's organizational structure for manned space flight activities, NASA's continuous improvement activities, and Lewis Research Center, recipient of the 1989 OMB Quality Improvement Prototype Award. **James R. Thompson, Jr.**, Deputy Administrator, NASA Headquarters, **Chairman** **Aaron Cohen**, Director, Lyndon B. Johnson Space Center **Arnold D. Aldrich**, Associate Administrator for Aeronautics and Space Technology, NASA Headquarters **Dr. John M. Klineberg**, Director, Lewis Research Center Moderator: **Joyce R. Jarrett**, NASA Headquarters

10:30-10:50 *Profile of a Quality Organization* (1987/88 NASA Excellence Award Recipient) **Robert D. Paster**, President, Rocketdyne Division, Rockwell International Corporation. Introduction by **George A. Rodney**, Associate Administrator for Safety, Reliability, Maintainability and Quality Assurance.

10:50 - 11:00 Break

11:00 - 12:00 Three Concurrent Panel Presentations

NASA EXCELLENCE AWARD SESSION - PARTNERS IN EXCELLENCE - Highlighting the NASA Excellence Award criteria, these panels of award finalists will discuss significant methods and accomplishments used in achieving performance excellence.

Panel Director: **Arthur V. Palmer**, NASA Headquarters

Panel 1 - Sustaining Customer Satisfaction - An overview and specific examples of key service industry techniques, measures, and approaches to sustaining customer satisfaction. The discussion will range the gamut of defining customer requirements; measuring quality in the service industry; customer/contractor teams; quality achieved through effective problem resolution processes and effective communications; and work force involvement to achieve excellence.

Dr. Robert Rosen, Deputy Administrator for Aeronautics and Space Technology, NASA Headquarters, **Chairman**

Philip H. Johnson, Vice President, Space Operations, Bendix Field Engineering Corporation. "Partnership -- Transitioning Continuous Excellence"

Emyre' B. Robinson, President and Chief Executive Officer, Barrios Technology, Inc. "Measuring Productivity and Quality for the NASA/JSC Instrument Calibration and Repair Laboratory"

Jarvis L. (Skip) Olson, Vice President and SPC Project Director, Grumman Technical Services Division. "Golden Handshake and Teamwork for Excellence"

Moderator: **Imants (Monte) Krauze**, Director, BFEC PIQE Program, Bendix Field Engineering Corporation

Panel 2 - Involving Everyone in Continuous Improvement - Effective continuous improvement processes require a quality of emphasis from both top management and an involved work force. Both are critical to developing and maintaining the entire organization's commitment to continuously improve products and services. This panel will address implementation methodologies from each of these two perspectives.

Robert D. Paster, President, Rocketdyne Division, Rockwell International Corporation, **Chairman**

Robert G. Minor, President, Space Transportation Systems Division, Rockwell International Corporation. "Commitment and Teamwork for Sustained Improvement"

Michael R. Hallman, President, Boeing Computer Services. "Quality Leadership Starts at the Top"

Moderator: **Leroy A. Mendenhall**, Manager, CMS Quality and Productivity, Boeing Computer Support Services

Panel 3 - Impact of Organizational Culture on Productivity Improvement and Quality Enhancement (PIQE) Activities - Organizational culture is an integrated pattern of knowledge and beliefs which provides a context for organizational activities. Three award winning companies will describe how their unique organizational cultures facilitate the development of productivity and quality improvement activities. Elements of organizational culture which will be addressed include top management commitment and involvement; goals, plans, measures, and dissemination; open communications; training; work force involvement; rewards and recognition; and involvement of subcontractors.

Roy S. Estess, Director, John C. Stennis Space Center, **Chairman**

Bill F. Barry, Vice President, Central Region, Computer Sciences Corporation. "PIQE Council: A Framework for Cultural Change"

James R. Dubay, President and General Manager, EG&G Florida, Inc. "Mutual Trust Enhances PIQE Activity"

Robert B. Young, Jr., President, Lockheed Engineering and Sciences Company. "Proactive Paradigms: Key to Successful PIQE Cultures"

Moderator: **Sherry H. Prud'homme**, Project Manager, Lockheed Engineering and Sciences Company

12:00 - 1:30 p.m. Lunch/Luncheon Keynote Speaker: **A. Thomas Young**, Executive Vice President, Martin Marietta Corporation. "Quality First"

1:30 - 5:30 **PANEL PRESENTATIONS** (Concurrent Panels). Generic panels will be presented vertically, one after the other, to permit participants to follow a series or attend other panels, if so desired.

PANEL A - PROCESSES FOR CONTINUOUS IMPROVEMENT - This panel will examine the concept of continuous improvement from several perspectives: the government's initiatives, the planning necessary to implement continuous improvement, examples of successful processes, and the importance of commitment and participation at all levels of an organization.

Panel Directors: Jessica R. Breul, Assistant to the Director, Corporate Productivity, Grumman Corporation, and **Sammy A. Nabors**, Technical Manager, Productivity Improvement Office, Marshall Space Flight Center

PANEL B - HUMAN RESOURCES: A CAPITAL INVESTMENT - The United States will not remain a competitively productive nation unless it continues to prepare, with dependable regularity, a future work force of the right size, with the right skills, and of the right quality. This panel focuses on current actions taken by industry and educators to develop math, sciences, and engineering students for the future; select, enculturate, and develop employees; manage work force diversity; and to approach human resources as an asset critical to the success of any business.

Panel Directors: Linda A. Marvin, Manager, Administrative Operations, Lockheed Engineering and Sciences Company, and **William L. Williams**, Senior Staff Scientist, George Washington University

PANEL C - ENSURING CONTINUOUS IMPROVEMENT THROUGH PARTNERSHIPS AND INCENTIVES - A review of the quality and productivity partnerships established between the NASA centers and their contractors and the status of the ongoing contract incentive activities.

Panel Directors: Allen L. Cassity, Manager of Productivity, Martin Marietta Manned Space Systems, and **Leslie J. Sullivan,** Chief, Management Analysis Office, Johnson Space Center

1:30 - 2:40

Panel A1 - Government Initiatives: NASA's Quality/Productivity Improvement Program (Q/PIP) and DOD's Total Quality Management (TQM) - Executive Order 12637 directs all government agencies to implement continuous process improvement initiatives. This panel will discuss the status of this order from the Administration's perspective and examine the efforts of NASA and the DOD in carrying out this order.

Dr. Carolyn M. Burstein, Chief, Quality Management Branch, Office of Management and Budget, **Chairman.** "Governmentwide Quality and Productivity Improvement Efforts"

Colonel Ronald A. Fullerton, USAF, Assistant to the Commander for TQM, Wright-Patterson Air Force Base. "Total Quality in Action"

Frederick P. Povinelli, Director, Administration and Computer Services, Lewis Research Center. "Continuous Improvement at NASA Lewis Research Center"

Moderator: **Dr. Dean R. Lee,** Director, Quality/Productivity, System Development Group, Unisys Corporation

Panel B1 - Quality in the People Pipeline - Industry employs two-thirds of our scientists and engineers. Your productivity will be affected by students now preparing for such careers. Aerospace and other leaders describe their innovative involvement with education, helping to 1) inspire interest in math/science/engineering careers and, 2) ensure sufficient quality and quantity of candidates for the future work force.

Lynford Kautz, Director, Fairfax County Public Education Foundation, Inc., **Chairman**

Dr. Robert W. Brown, Director of Educational Affairs, National Aeronautics and Space Administration. "Educational Activities of NASA"

Joel R. Stone, Vice President, Human Resources and Communications, Rockwell International Corporation. "Close Encounters in the Academic Trenches"

Roberta L. Keiser, Lead Teacher, American Bankers Insurance Group, A Satellite School of the Dade County Public Schools, Dade County, Florida. "Beyond Child Care: An Elementary School on Company Property? Who's Doing It? Why? How?"

Moderator: **Charles P. Boyle,** Educational Programs Officer, NASA Headquarters

Panel C1 - NASA Center/Contractor Partnerships - How and why NASA centers and their contractors are forming proactive quality and productivity improvement partnerships. They will discuss their goals, objectives, missions, and how they are seeking common and/or shared opportunities for mutual benefits.

Alvin L. Reeser, Executive Vice President and General Manager, USBI Company, Inc., **Chairman**

Dr. R. Wayne Young, Deputy Director of Administration, Lyndon B. Johnson Space Center. "Exploring a Common Agenda to Enhance Partnership Relationships - the NASA Perspective"

Hugh C. Goff, Staff Director, Business Development, Engineering Services Division/Houston, McDonnell Douglas Space Systems Company. "Exploring a Common Agenda to Enhance Partnership Relationships - the Contractor Perspective"

Gene Porter Bridwell, Manager, Shuttle Projects Office, George C. Marshall Space Flight Center. "Shared Experiences in the Contractor/Government Partnership for Quality and Productivity"

Moderator: **Walter E. Hall**, Manager of Productivity, USBI Company, Inc.

2:40 - 2:55 Break

2:55 - 4:05 *Panel A2 - Planning for Continuous Improvement - Space Station Freedom* - Planning for continuous improvement includes developing an appropriate strategy and technique, and keeping the user's requirements in mind. Quality and productivity improvement requires a vision, a focus, a method, and a measure. This panel examines how these concepts are being applied to the Space Station Freedom Project.

Owen K. Garriott, Vice President, Space Programs, Teledyne Brown Engineering, **Chairman**

P. W. (Gus) Ludwig, Director, Manufacturing and Test, Space Station Division, McDonnell Douglas Space Systems Company. "A Total Quality Management Approach for Space Station"

Richard L. Grant, Vice President, Space Station Program, Boeing Aerospace and Electronics Company. "Challenges in Implementing Continuous Improvement"

Dr. Phillip J. Cressy, Jr., Chief, Space Station Utilization, Office of Space Science and Applications, NASA Headquarters. "A User's Point of View"

Moderator: **Donald H. Hutchinson**, Productivity Coordinator, Space Station Program, McDonnell Douglas Space Systems Company

Panel B2 - Building a Partnership With Employees - In a highly competitive environment for quality employees, it is important for new employees to feel that they are a valued part of the organization. This panel explores programs that are being used to help employees adapt to the work environment and to build loyalty between the employees and the organization.

Gerald Sandler, Senior Vice President, Information Systems, Grumman Data Systems, **Chairman**

Charles Zimmerman, Manager, Education, Training and Development, Westinghouse Defense and Electronics Center. "The Manager's New Role in the Partnership"

Robert L. Pike, Chief, Human Resources Division, Ames Research Center. "Start the Partnership Early"

Amy M. Schumann, Manager of Organizational Development, Fel-Pro, Inc. "Employee Programs that Build Long-Term Commitment"

Moderator: **John L. Reiss**, Staff Assistant, Administration, Ames Research Center

Panel C2 - Contract Q/PI Initiatives for Incentivized Procurement - The panel will provide a status report on current agency activities to reward and encourage contract quality and productivity improvement. Topics will include NASA implementation of Value Engineering; the new NASA FAR supplement on Q/PI and related training material; and application of Q/PI to award fee and fixed fee contracts.

Leroy E. Hopkins, Deputy Assistant Administrator for Procurement, NASA Headquarters, **Chairman**

David J. Steigman, Productivity Program Manager, Lewis Research Center. "Update on Contract Mechanisms for Q/PI"

Glenn C. Fuller, Chief, Engineering and Space Technology Resources Management Office, Goddard Space Flight Center. "Performance Incentive Experiments: Fee Set-Asides and Contractor Report Cards"

David H. Orbock, Quality and Productivity Improvement Program Manager, NSI Technology Services Corporation. "Contractor Experience with Q/PI Incentives"

Moderator: **Dr. Philomena G. Grodzka**, Staff Scientist, Lockheed Missiles and Space Company, Inc.

4:05 - 4:20 Break

4:20 - 5:30 *Panel A3 - Improving Excellence: Implementation of Continuous Improvement* - Continued quality and productivity improvements require continuous process modification. Organizations which have been recognized for their quality and productivity achievements present their methods.

Anthony J. Macina, Manager, Onboard Space Systems, IBM Systems Integration Division, **Chairman**. "IBM Software: Continuing Excellence"

Ralph Ponce de Leon, Vice President and Director, Group Operations, Government Electronics Group, Motorola, Inc. "After Malcolm Baldrige, What?"

Commander Robert Malcolm Fortson, USN, TQM Advocate, Norfolk Naval Shipyard. "Quality Service to the Fleet"

Moderator: **Barbara G. Kolkhorst**, Quality Coordinator, IBM Systems Integration Division

Panel B3 - Investing in Employees - A Capital Idea! - Companies planning to remain competitive and in business in the twenty-first century are viewing their employees as assets, not simply expense items to be minimized on a profit and loss statement. These presenters will demonstrate how their organizations have made the investment in human capital a long-term business strategy, and will describe some innovative processes and adjustments their companies have made to enhance the performance and potential value of their employees.

Glenn D. Norfleet, Senior Vice President, Sverdrup Technology, Inc. "Triple Parallel Progression"

Kirk L. Froggatt, Manager, Corporate Training and Development, Silicon Graphics Computer Systems. "Human Resource Planning: A Total Quality Approach to Managing Human Resources"

Moderator: **Dr. Karen K. Whitney**, Manager of Productivity, Rockwell Space Operations Company

Panel C3 - Investing in Partnership - How the investment in a partnership is viewed by the participants in terms of benefits. The topic will be approached from commercial, NASA, and NASA Contracts perspectives.

Charles E. Henke, Director of Procurement, George C. Marshall Space Flight Center, **Chairman**

Dr. J. Stuart Fordyce, Director of Aerospace Technology, Lewis Research Center. "The Government-Support Service Contractor Team: Partnership for Technological Advance"

Dr. Stuart L. Petrie, Vice President and General Manager, Lewis Group, Sverdrup Technology, Inc. "Partnership in Support Services"

Robert A. Bogash, Director, Materiel Quality and Surveillance, Boeing Commercial Airplane Company. "Boeing Supply Quality Improvement"

Moderator: **Charles D. Purple**, Manager of Productivity, SSFP, Boeing Aerospace and Electronics Company

5:30 - 6:30 — Free Time

6:30 - 7:15 — Reception at the Von Braun Civic Center featuring Excellence Award Finalists.

7:30 - 9:30 — Excellence Award Banquet (Von Braun Civic Center) - **James R. Thompson, Jr.**, NASA Deputy Administrator, Announcement of Excellence Award Recipient(s). Message from **Vice President J. Danforth Quayle** (Videotape). Keynote Speaker: **Kenneth E. Leach**, Vice President, Administration, Globe Metallurgical Inc., winner of the 1988 Malcolm Baldrige National Quality Award for Small Business and the 1988 Shingo Prize for Quality. "The Evolution of Quality at Globe Metallurgical"

Wednesday, November 1

6:45 - 8:00 a.m. — Breakfast at the Von Braun Civic Center/Keynote Speaker, **Jaime Oaxaca**, Corporate Vice President of Northrop Corporation and Co-Chairperson, Congressional Task Force on Women, Minorities, and the Handicapped in Science and Technology. "The New Faces of America in the Science and Engineering Pipeline: Actions for Industry." Introduction: **Dr. Harriett G. Jenkins**, Assistant Administrator, NASA Office of Equal Opportunity Programs, NASA Headquarters

8:00 - 8:30	Overview of Marshall Productivity Enhancement Complex, **Robert J. Schwinghamer**, Deputy Director for Space Transportation Systems, George C. Marshall Space Flight Center
8:30 - 12:00	**TOUR OF MARSHALL PRODUCTIVITY ENHANCEMENT COMPLEX OR PANEL PRESENTATIONS**
	TOUR OF MARSHALL PRODUCTIVITY ENHANCEMENT COMPLEX HOSTED BY THOMAS J. LEE, DIRECTOR, GEORGE C. MARSHALL SPACE FLIGHT ENTER
8:30 - 9:00	Travel by bus to Marshall Space Flight Center
9:00 - 11:00	Tour of Marshall Space Flight Center Productivity Enhancement Complex
11:00 - 11:30	Travel by bus to Von Braun Civic Center
	CONCLUSION OF PANEL A AND B PRESENTATIONS AND BEGIN PANEL D PRESENTATIONS
8:30 - 9:40	*Panel A4 - Commitment and Participation: People in the Process* - This panel will focus on the aspects of obtaining commitment and ownership from all the people in an organization starting with the CEO, flowing down to the mid-level manager, and integrating all employees and subcontractors to form a unified partnership.
	Fred C. Sheffey, Director of Productivity, LTV Missiles Division, **Chairman**
	John F. Adams, Manager, Pasadena Operations, Deep Space Network Maintenance and Operations Support Contract, Bendix Field Engineering Corporation. "Effective Performance Objectives Matrix and The People Process"
	Dr. Pat Reynolds Odom, Program Manager, NASA Marshall Space Flight Center, SRM&QA Contract, Advanced Technology, Inc. "Quality Initiatives in Start-up of a Major Program with Subcontractors"
	Wayne Shelton, President and Chief Executive Officer, Planning Research Corporation. "PRC's Quality Commitment in the 80s and into the 90s"
	Moderator: **Dondie A. Stephenson**, Manager, Program Development, Space Systems Technology, Planning Research Corporation
	Panel B4 - Quality in the People Pipeline (Continued) - The quality of the technical people you hire depends upon the caliber of those who teach them. The number of recruits available to you depends upon teachers who inspire technical careers. Teachers make your hiring pipeline possible. Industry has a huge stake in helping to create, develop, support, and retain high quality math/science teachers. Leaders discuss proven and experimental involvement by industry.
	Dr. Richard F. Hartung, Vice President, Information Services, Lockheed Missiles and Space Company, Inc., **Chairman**
	Dr. John M. Fowler, The Triangle Coalition for Science and Technology Education. "Scientists and Engineers in the Classroom: What Both Sides Are Getting"

Robert B. Aronson, MIISME Coordinator, Marketing and Design, Ford Motor Company. "Detroit's 1989 Venture: Teachers on the Job in Industry"

Palmer D. Swanson, Director of Public Affairs, Polaroid Corporation. "Project Bridge: Intermingling Teacher and Technical."

Moderator: **Charles P. Boyle**, Educational Programs Officer, NASA Headquarters

PANEL D - ACHIEVING TOTAL CUSTOMER SATISFACTION - This panel will focus on how to determine customer expectations, ways to measure performance against those expectations, and finally, how to continue meeting those expectations.

Panel Directors: **Warren L. Camp**, Director, Productivity Applications Staff, John F. Kennedy Space Center, and **Robert D. Tolle**, Director of Quality and Productivity Improvement, Space Operations, Thiokol Corporation

Panel D1 - Defining Customer Expectations - The subpanel will stress the importance of defining customer expectations and provide participants with ideas and tools which can be utilized in achieving total customer satisfaction.

Robert E. Lindstrom, Senior Vice President, Space Operations, Thiokol Corporation, **Chairman**. "Customer Expectations: A View From Both Sides"

Alexander A. McCool, Director, Safety, Reliability, Maintainability and Quality Assurance, George C. Marshall Space Flight Center. "Defining Customer Expectations through Teamwork"

Charles L. Gibbons, Deputy General Manager, EG&G Florida, Inc. "Total Customer Satisfaction: Gaining Team Commitment"

Moderator: **Willis E. Chapman**, Manager, Division Support Office, Jet Propulsion Laboratory

9:40 - 9:55 Break

PANEL D AND PANEL E PRESENTATIONS

9:55 - 10:55 *Panel D2 - Measuring Customer Satisfaction* - Satisfied customers are the ultimate measure of quality. This panel will address measurable and verifiable customer satisfaction (NASA or a prime contractor in the case of the subcontracted work) for overall performance. They will discuss who is responsible and how their customer satisfaction is measured.

David L. Van Der Griend, Vice President, Unitech Composites, Inc., **Chairman**

Joseph P. Zimonis, Vice President, Space Propulsion, Pratt & Whitney Group, United Technologies Corporation. "The Many Parameters of Customer Satisfaction"

Donald C. Wilhelm, Vice President, Contracts and Procurement Aeronutronic Division, Ford Aerospace Corporation, "Suppliers and Subcontractors as Partners"

Moderator: **Peggy A. Wilson**, Productivity Program Specialist, John F. Kennedy Space Center

PANEL E - IMPROVING TECHNOLOGY MANAGEMENT/PARTNERSHIP - This panel will discuss: 1) technology as a key factor in achieving excellence in high technology organizations, and 2) developing effective technology management processes for the benefit of management, line organizations, and individuals.

William A. Huffstetler, Jr., Manager, New Initiatives Office, Lyndon B. Johnson Space Center, **Chairman**. "The Challenge of Technology Management"

John G. Ferguson, Manager, Houston Office, Allied-Signal Aerospace Company. "Contractor Perspectives on Technology Planning"

Norman H. Chaffee, III, Deputy Chief, Propulsion and Power Division, Lyndon B. Johnson Space Center. "Developing a Technology Focus in Engineering Organizations"

Moderator: **Leslie J. Sullivan**, Chief, Management Analysis Office, Lyndon B. Johnson Space Center

10:55 - 11:00 **Break**

11:00 - 12:00 *Panel D3 - Vision of Customer Satisfaction as a Continuous Process* - Presenters will explain customer satisfaction as a process of continuous improvement requiring leadership that creates an environment in which employees can accept and execute their responsibilities with confidence and finesse.

Richard M. Davis, President, Martin Marietta Manned Space Systems, **Chairman**

Dr. Hiten N. Ghosh, Vice President, Customer Satisfaction and Quality, Unisys Corporation. "Customer Satisfaction as a Driver for Continuous Management Action"

Moderator: **Robert P. Hessler**, Manager of Productivity and Communications, McDonnell Douglas Space Systems Company

12:15 - 1:35 p.m. Lunch/Luncheon Keynote Speaker: **Philip B. Crosby**, Chairman and Creative Director, Philip Crosby Associates, Inc., Author of Quality is Free (1.5 million copies), Quality Without Tears, Let's Talk Quality, The Art of Getting Your Own Sweet Way, and many others

1:35 - 2:00 Adjourn - **George A. Rodney**, Associate Administrator for Safety, Reliability, Maintainability and Quality Assurance, and **Joyce R. Jarrett**, Director, NASA Quality and Productivity Improvement Programs, Conference General Chairperson

2:00 - 5:00 Tour of Marshall Productivity Enhancement Facility

Dining Music
Courtesy of
Chamber Ensembles from the Metropolitan Youth Orchestra of Huntsville
Under the Directon of Mr. Oscar Newman

Mr. Gary Parks
Director

Excellence Award Banquet Entertainment
Virgil I. Grissom Swing Choir
Under the Direction of Ms. Annette Shingler

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For Cosponsoring this Event

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Appendix C - Acknowledgments

The papers, graphics, audio presentations, and panel notes from the conference were used as the basis for writing this report.

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