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19 ABSTRACT (Continue on reverse if necessary and identify by block number) The purpose of the First National Symposium on the Role of Academia in National Competitiveness and Total Quality Management was to examine academia's role in the education of future managers and engineers in TQM philosophy and to establish a national network of individuals from industry, academia and government, interested in the promotion and adoption of TQM principals. The book includes speeches by prominent leaders from industry, academia and government that provide a national perspective on the symposium topic. Significant time was spent in team discussions. The presentations and discussions focused on teaching and practice of TQM. This book of proceedings documents symposium activities. It is divided into six sections: I--Executive Summary; II--Correspondence; III--Speakers; IV--Panels; V--Team Reports; VI--Appendix. The table of contents provides details of each section. The proceedings include letters from Vice President J. Danforth Quayle and Senator Robert C. Byrd.

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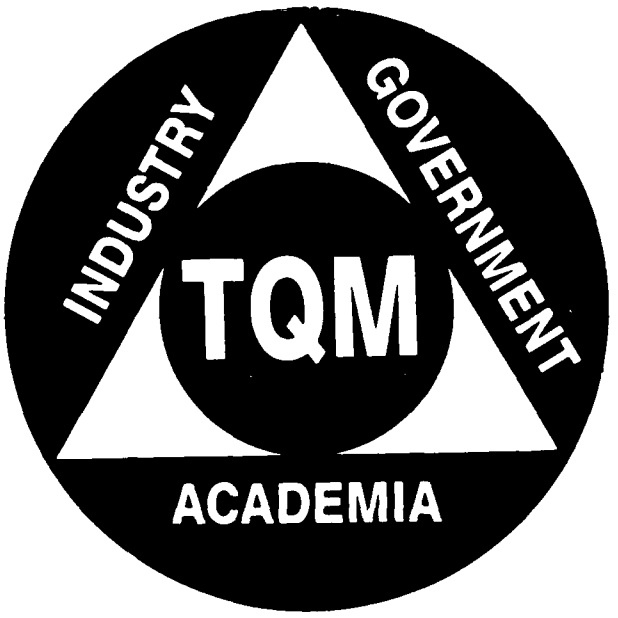
PROCEEDINGS

1st National Symposium on the Role of Academia in National Competitiveness and Total Quality Management



Lakeview Resort
West Virginia University
Morgantown, WV

July 18-20, 1990

FOREWORD

Total Quality Management (TQM) is an evolving philosophy for continuous improvement of products, processes and services to enhance quality. It involves the application of quantitative methods and human resource management techniques to control all processes of a system in order to achieve customer satisfaction. It is widely recognized that understanding and implementing TQM philosophy is critical to U.S. competitiveness.

The purpose of the First National Symposium on the Role of Academia in National Competitiveness and Total Quality Management was to examine academia's role in the education of future managers and engineers in TQM philosophy and to establish a national network of individuals from industry, academia and government, interested in the promotion and adoption of TQM principals.

Prominent leaders from industry, academia and government provided a national perspective on the symposium topic. A Significant amount of time was spent in team discussions. The presentations and discussions focused on teaching and practice of TQM.

This book of proceedings documents symposium activities. It is divided into six sections: Section I - Executive Summary; Section II - Correspondence; Section III - Speakers; Section IV - Panels; Section V - Team Reports; and Section VI - Appendix. The Table of Contents provides details of each section.

Many individuals contributed directly or indirectly to the planning of the symposium, to its execution and to the preparation of the proceedings. Institutions for special mention are: Fordham University, University of Notre Dame, National Institute of Standards and Technology, Defense Systems Management College, U.S. Department of Education, Martin Marietta Corporation, Litton Industries and Boeing. The Program Committee welcomes your reactions and suggestions as an aid to planning future Symposia.

Rashpal S. Ahluwalia
Chairman of the Program Committee
and Proceedings Editor
West Virginia University

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Section I

Executive Summary

EXECUTIVE SUMMARY

The First National Symposium on the Role of Academia in National Competitiveness and Total Quality Management (TQM) was attended by more than 200 people. It was the first time that academia, industry, and government came together on this topic. The symposium was hosted by West Virginia University and was held on July 18-20, 1990, in Morgantown, W. Va. The 2 1/2-day symposium was devoted to presentation by prominent national leaders and to discussions, by all attendees, of the critical issues in teaching and practice of TQM at the institutions of higher learning.

Deputy Secretary of Commerce Thomas J. Murrin provided the keynote address. He discussed three major academic quality roles: (1) assisting our nation's organizations in applying quality improvement techniques; (2) researching and enhancing understanding of quality principles throughout society; and (3) applying quality improvement techniques to internally upgrade the processes and products/services of our educational institutions.

Other speakers included Congressman Don Ritter of Pennsylvania; David T. Kearns, CEO Xerox Corporation; John A. White, Assistant Director of Engineering, National Science Foundation; John P. Evans, Business School Professor, University of North Carolina; Rashpal S. Ahluwalia, Engineering Professor, West Virginia University; John A. Betti, Under Secretary of Defense for Acquisition, Department of Defense; Curt W. Reiman, Director, Malcolm Baldrige National Quality Award, National Institute of Standards and Technology; Myron Tribus, Chairman, Community Quality Coalition; Robert W. Galvin, Chairman, Motorola, Inc.. In addition to speakers, the panels on Models of Cooperation, and Accreditation and Curriculum Issues provided an exciting and enriching resource base for the deliberations by the participants.

The symposium participants spent many hours in facilitated small teams working on critical issues such as: (1) What actions should be taken jointly and separately by government, industry, and academia to embed quality science and discipline into the curricula of our educational institutions? (2) What should be done to cause a quality transformation within the academic institutions themselves? and (3) What are the elements of a national plan to accomplish (1) and (2)

(i.e., who, when, where, and how)? Thus, the small teams became the central dynamic of the symposium.

The teams were facilitated in their efforts to address the aforementioned issues by individuals trained in the Seven Management and Planning tools of quality. These tools were taught to the 26 team leaders in a presymposium session led by James Naughton of Goal/QPC. The quality tools proved most useful in the team sessions, as they provided the structure necessary to quickly and effectively harness the powerful expertise and creativity of such a diverse and talented population of professionals. The results of the team activities were aggregated and organized in a marathon session (utilizing the aforementioned seven management and planning tools) in which the 26 team leaders participated. The capsule summaries of each team's products were briefed by team representatives in a plenary session held on the final day of the symposium. The aggregation of the 26 team activities produced the following key actions/recommendations:

- Promote total quality management (TQM) throughout the nation and its communities.

- Define the needs of the customers to academia, business, and government.

- Define the core competencies required to successfully practice as well as to teach TQM.

- Develop national leadership for TQM and involve national leadership in TQM promotion and development.

- Develop incentives and rewards for using TQM, for developing courses, and for teaching TQM.

- Be aware of and utilize the changing dynamics of the global marketplace to implement and promote TQM.

- Develop a structure for an academic, business, and government partnership to develop TQM as a process to improve national competitiveness.

- Investigate and develop resources to implement and develop TQM.

- Investigate and resolve TQM curriculum and accreditation issues.

- Develop measurements to assess the effectiveness of TQM in the workplace, in academia, and in government.

- Investigate and resolve issues and problems regarding the quality of education and the use of TQM in grades Kindergarten through 12th grade in the U.S. education system.

- Internalize the use of TQM in universities.

This report documents speaker presentations and team discussions in considerable detail. This seminal gathering of industry, government, and academia has surfaced and sharply defined the actions necessary to address the role of academia in national competitiveness and total quality management, much more needs to be done. Two and one half days of constructive interchange on the potential benefits and possible difficulties of practicing and teaching TQM in academia strongly influenced the outlook of many of those present, generated in some a determination to further develop plans and actions for achieving national TQM objectives.

The symposium attendees agreed that the instrumentalities of planning, politics, and institutional will need to be structured and energized so that the momentum so magnificently launched at Morgantown is not allowed to stagnate and decay. To this end, there is considerable ongoing postsymposium activity and interactive teaming among the symposium attendees. Furthermore, a follow-on symposium is planned for the summer of 1991 to be hosted by the University of Southern California. It is expected that the outcome of that event will be a proposed national plan for the quality transformation of academic institutions and curriculum that includes the motivated and sustaining participation of government, industry and academia.

It is not unduly optimistic to believe that Morgantown was "the beginning of a beginning" that can lead to a new order of understanding and cooperation among industry, academia and government in a joint effort to reshape the role of academic institutions in revitalization of competitiveness of the United States in world economy.

Section II

Correspondence

THE VICE PRESIDENT
WASHINGTON

July 18, 1990

National Total Quality Management Academia Symposium
Morgantown, West Virginia

Dear Friends:

I'm delighted to greet you as you gather in Morgantown for the National Total Quality Management Academia Symposium.

As Chairman of the President's Council on Competitiveness, I have a special interest in the issues you'll be discussing, and I'd like to share with you a few words about our competitiveness as a nation.

Over the past several months, I've had a series of roundtable discussions on competitiveness with local businessmen and research scientists. We've discussed many of the hurdles to a more competitive America, and how we can leap those hurdles.

Some proponents of protectionism say the only way to make America more competitive is by attacking the trade policies of other countries. At the same time, they say that we need to tax the most productive sectors of our society, and that we need more regulation in our industries.

I disagree with these anti-competitive approaches. Rather than protecting Americans from competition at home or abroad, we need to make fundamental changes in our system to support a free market and become more competitive. In addition, we need to strengthen the basic infrastructure -- including our human capital. To do this we will have to start by making some fundamental changes in our education system.

This is particularly true in the fields of math, science, and engineering. The "pipeline" of young people that feeds the science and engineering workforce may not be adequate in either numbers or quality to provide the workers that will be needed during the next decade and beyond. This situation is compounded by an even more serious factor. The performance of U.S.

precollege students in math and science is far below that of students other major industrialized nations. The quality of education, particularly science, mathematics, and engineering education, must be improved.

The Bush Administration is moving aggressively on a number of fronts to address the shortcoming in the nation's science and technology education enterprise. The 1991 budget proposed a total of $1 billion in direct spending in four agencies for science, mathematics, and engineering education -- an increase of 26 percent above 1990.

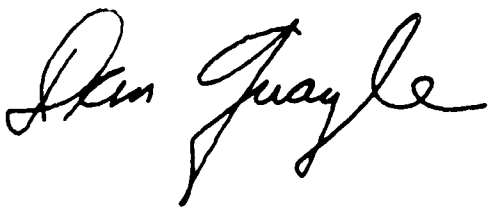
But increased spending alone cannot solve the problem. That is why this gathering today is so important. With help from education and business leaders such as yourselves, we can make the necessary changes to our education structure and curriculum to regain America's leading position in math and science.

I will be working closely with Secretary Mosbacher and the other members of the Council on Competitiveness on other ways to bolster America's free-market structure. These include, first of all, cutting the capital-gains tax, which will not only create thousands of new jobs, it will generate the level of capital investment we'll need to compete through the nineties and beyond.

We'll also need to fight against more regulations. The only way to end this terrible waste is to cut through the hopeless mire of regulations now on the books, not add to it. And we'll need to counter the excessive litigation that deters our companies from creating new products. Astonishingly, American companies spend 15 times what their Japanese counterparts do on product liability costs.

Every American can contribute to the task of strengthening America's competitiveness. I trust that your discussions on education and national competitiveness will be an important contribution to this effort.

Sincerely,



United States Senate
COMMITTEE ON APPROPRIATIONS
WASHINGTON, DC 20510-6025

July 10, 1990

The Total Quality Management Symposium
West Virginia University
Department of Industrial Engineering
Post Office Box 6101
Morgantown, West Virginia 26506-6101

Dear Friends:

I send you my best wishes as you meet at Lakeview for the First National Total Quality Management Symposium. I have long believed that cooperation between the private sector academia and government is a crucial keystone toward much of America's future technological, economic, and industrial progress. Particularly in this era of rapid world-wide political change and furious international trade competition, challenging young Americans of talent and promise to enter careers and professions vital to America's future economic and technological positions is imperative. As training grounds for tomorrow's inventive geniuses and technological leaders, our colleges and universities can be especially helped to fulfill their paramount responsibilities through continuing conversations with the private and governmental sectors.

I congratulate you on the foresight that you are showing in your meeting together, and I hope for you a fruitful, exciting, and informative exchange of ideas and visions.

With warm regards, I am

Sincerely yours,

Robert C. Byrd

RCB:jrt

Section III

Speakers

Keynote Address
Government Perspective

Thomas J. Murrin
Deputy Secretary
U.S. Department of Commerce

It is a privilege and pleasure to take part in this landmark session with you. This conference, and your enthusiasm and participation, is an encouraging sign -- a significant signal that our country is waking up to the tremendous challenges and opportunities for combining our quality-oriented and our education-oriented goals and talents.

I wanted to speak with you, and be part of this conference, because I am firmly convinced that quality improvement -- properly defined and effectively implemented in a total quality management approach -- is perhaps the most significant key to our nation's future success. And properly defining and effectively implementing quality improvement depends heavily upon our ability to better educate ourselves——workers, managers and students alike.

This conference is about quality and education. But there's a natural source of confusion whenever those terms are linked. So let me define my terms and "playing field," if you will, right up front.

I am going to address the role of the education community in three major respects:

- Helping our nation's institutions to apply quality improvement techniques.

- Researching and better understanding quality improvement principles, and how their use affects the well-being of companies, and

- Applying quality improvement techniques to upgrade our education enterprise.

These are three separate, though closely related, aspects of quality and education that tend to get blurred, depending on the special

interests of the speaker. So I'll tell that each is my special interest. I suppose that's why I gained the reputation among many of my business colleagues for being something of a zealot on quality.

I don't want to take for granted that we all appreciate fully the importance of quality improvement, so let me spend a few minutes explaining why I believe this matter is so important to our nation's future.

Out of all the things a business manager can do -- out of all the priorities that we set -- quality improvement can and should be given top priority. Virtually everything our companies need to achieve will benefit greatly from our constant attention to quality improvement.

There are many reasons for companies to sharpen their focus on quality. I can think of at least five. It is perhaps the only process that simultaneously:

- Satisfies customers
- Motivates employees
- Stimulates suppliers
- Comforts investors
- Wins public approval and media praise

I can give you one other very good reason. The quality of a nation's goods and services may be the single most important factor in determining that country's economic health and industrial competitiveness. Other countries have recognized the advantage offered by total quality management. Mention quality to any American, and Japanese goods likely will come to mind first. But it's not just the Japanese. Other Pacific Rim nations are taking the quality challenge seriously. The Germans long have had an international reputation for quality and workmanship, and they are increasingly being joined by their European Community partners when it comes to quality improvement. The Europeans agreed recently to band together to establish a foundation for quality improvement, with plans to inaugurate a European quality award by 1991.

Fortunately, more and more U.S. firms are embarking on extensive efforts to improve the quality of their operations from the ground up -- not by banners and slogans, but by thoughtful, self-critical assessment and hard work.

That's where the Malcolm Baldrige National Quality Award comes in. This program aims to recognize quality achievement in individual companies, to promote quality awareness among our nation's businesses, and to share successful strategies. The award program has demonstrated how the public and private sectors in this country can effectively join forces and work productively toward a common goal.

In less than 3 years, the National Quality Award has begun to capture the imagination of many of our country's organizations. It has been the catalyst for what is becoming a quality "evolution" in the way our companies conduct their business. Just look at the evidence: about 12,000 application guidelines were distributed in 1988. About 65,000 were requested last year, and approximately 130,000 have been distributed so far this year.

Unless you know what the application is all about, that's not a very significant statistic. But it becomes truly important once you understand that the application is a guidebook for total quality management, and once you know that thousands of organizations now are using the guidelines to assess and upgrade their own quality capabilities and performance. I've used the term organizations -- rather than companies -- because groups in health care, in the legal profession, and, obviously, in education are getting involved.

Dr. Curt Reimann, who manages the program from our Commerce Department's National Institute of Standards and Technology (NIST), is going to share with you today some of the details and strategies behind the award effort -- especially the criteria that help to determine and define top quality organizations.

While we are encouraged by the greatly increased interest in the program; 97 companies applied for the award this year and now are being evaluated by teams of private sector examiners under NIST's guidance -- we have only scratched the surface in our national quest for excellence in quality. We need even greater involvement by individual companies, and by trade and business associations,

professional societies, and by labor unions. And we especially need greater involvement by many of you, leaders in our education community. That includes individuals and organizations in business, government, and other sectors of society who are involved with our vast education system.

For those of us who have approached quality improvement and education primarily from the perspective of business managers, it is obvious that there is a crying national need for a more highly trained work force that will be more capable of developing and carrying out quality improvement strategies.

We know that national student test results -- and our worrisome performance compared with our industrial competitors, especially in math and science -- carries ominous implications for our future economic competitiveness. We know that a university system that isn't turning out nearly enough U.S. scientists and engineers to meet future demands likewise has major negative consequences for our economy. So when people talk about the need to improve the quality of our education system, the implications are far more than"academic" -- they are crucial to the health and welfare of this nation and our citizens.

Company after company has discovered how difficult it is to find the talent needed in order to provide the quality goods and services the competitive marketplace demands. It's not unusual for firms to have to interview 10 or 15 applicants to find one qualified applicant for jobs requiring basic skills. And once they're hired, the need for basic training continues. Motorola, for instance, estimates that about half of its production workers in the United States require some kind of reeducation and basic skills training at the fifth- through seventh-grade level.

No quality improvement movement in this country can succeed without the active involvement of an educated and trained work force. My old friend, Joji Arai, long associated with Japanese productivity and quality improvement efforts, offers some sobering facts to remind us of the reality of Japanese employees' extensive involvement in quality:

"In most major manufacturing companies in Japan, approximately 85 percent of the workers are active in the corporate-wide quality control program, resulting in a drastic reduction of defects and

elimination of waster. Similar participatory efforts to improve quality and reduce the cost of production can also be observed in the Japanese suggestion system.... The average number of suggestions per employee per year in Japanese corporations is 22."

We cannot expect anything approaching this level of employee involvement unless our workers -- including our managers -- are better educated and equipped. A survey by the Institute of Industrial Engineers, recently led by Dean Tompkins, quantifies and reinforces this fact of life. Fully 97 percent of the industrial engineers responding said that employee training, education, and motivation are essential to increasing productivity and quality.

I discovered long ago that being the opening and keynote speaker offers some distinct advantages. It gives you the opportunity to set the tome for the conference. Usually of greater importance, you have the luxury of raising issues and problems without having to offer solutions. Well, I'm going to pass up that opportunity, because it is way past time for action when it comes to improving our education and our quality improvement systems. The competition isn't waiting for us to wake up. So let me offer some recommendations about what we can and must do.

Some of our most aggressive and forward-looking companies have decided that they have no choice when it comes to improving the capabilities of our work force. Unless they take action, these companies know they cannot compete. So they either get heavily involved with our local educational institutions or, even more directly, self-train these employees. David Kearns, one of your speakers this morning, puts it best. He says: "Business, which is spending more than 25 billion dollars each year on remedial training for new employees, is doing the 'product recall' work of our schools."

This is a sad reality. Those of us involved in quality improvement know that it is far better to do the right things right the first time. Similarly, it is far better to educate our students and workers right the first time.

But, I congratulate corporations like Xerox -- which invests $300 million each year to satisfy its internal education needs -- including 150,000 days of training employees just on quality-related matters -- and Motorola -- which devotes $55 million annually to educate and train its employees through its own Motorola University. I believe

these companies are prudent and foresighted in undertaking their own initiatives. By doing so, at the same time that they also support other educational institutions, these firms increase the odds that they will have the talented work force needed in the years ahead.

There are those who say we cannot afford to spend the resources required to improve our educational system and to do quality-related training. Like those corporate managers who have taken the leadership in thi :rea, I say we cannot afford not to improve our overall educational system and, specifically, to undertake quality-related training! Unless and until we get more of our educators, business people, government officials, and the general publi^ to understand this, we will not be able to make quality improvement progress on a guard, national scale.

So, first and foremost, we must do a better job at raising national awareness of the importance of both higher quality education and better educaiion about quality improvement techniques.

Because of President Bush's commitment to improving our education system, the active involvement of our 50-plus governors and thousands of local leaders and educators, with the concern of key industrial leaders, and the attention given to the subject by the news media of late, we are beginning to see progress in improving our education system.

Specific, measurable goals are being set. Parents and companies are taking a more active interest -- and sometimes playing a formal role -- in the administration of our precollege schools, and in what is going on inside our classrooms. Our teaching professionals are reevaluating both curriculum and techniques, and re-examining their own training needs. New programs are being launched to encourage our students to pursue studies and then careers in science and engineering. That's especially true for women and minorities who will make up a growing part of the work force in the 21st century, and who are so underrepresented now in these professions. Both the business and professional communities are playing a key role here, and they deserve greater national recognition for their initiatives.

Having made some progress, now we need to expand and intensify these efforts. We cannot let our education crisis be just a passing fancy that fades from the national spotlight as soon as our S.A.T. scores start to creep up by a few points, or as soon as we start

graduating a few more engineers and scientists, or as soon as editors tire of running stories about how Johnny can't read, write, or do math. This is a long-term problem that requires a long-term commitment.

While there is some good news to report in regard to our overall education enterprise, when it comes to better educating our students and our work force regarding quality improvement techniques and strategies -- with the notable exception of several outstanding organizations -- we have made little progress. In particular, we need our schools and colleges to teach that quality improvement makes business sense. That includes business and engineering schools, vocational and trade schools, and community colleges.

Not long ago I lectured to a business school class at a prominent university. I asked how many of the several dozen students could deliver a 5-minute lecture on quality improvement and how companies could implement quality improvement strategies. Not a single hand went up. These business school graduates obviously will be ill-prepared to help our companies plan and take much-needed quality improvement steps in the years ahead.

I was disappointed but not surprised. That's because I had discovered in my own experience that quality and quality management -- just like manufacturing and manufacturing management -- are receiving relatively little attention in business schools, either in the curriculum or as an area for research. Too often corporate quality improvement simply hasn't been on the faculty's list of business-related matters worthy of their attention.

In fact, the subject of quality too often has been considered to be the domain of just our universities' statistical experts. Certainly, people like Dr. Deming and Dr. Juran have demonstrated that statisticians can play a key role in developing and carrying out quality improvement strategies, and that statistical considerations and techniques are key to quality improvement. But just as certainly, corporate quality improvement and total quality management requires a much broader view to be effective -- and our universities and business schools must expand their own faculties' horizons accordingly.

That includes more than simply offering up traditional quality improvement information to students. It means that our universities

and educators must be involved directly in generating new information about the link between quality improvement techniques and business performance.

There is much to be learned here, but there is remarkably little effort being made. For instance, Japanese studies have concluded that winners of that nation's Deming Prize are notable more profitable than other Japanese firms. It seems likely that companies which endorse and implement quality improvement principles in the United States can earn similar benefits -- by enhancing productivity, reducing waste, gaining market share, improving products and processes, and boosting employee morale. But the ties between specific quality practices and economic benefits need to be placed upon a firmer foundation than now exists. That information will be invaluable to corporate planners as well as to the financial investment community.

Our engineering educators have their own share of work to do, especially in linking manufacturing and quality principles and practices. For instance, tremendous improvements in quality can be gained through the application of concurrent engineering principles to manufacturing. By better integrating research, development design, manufacturing, maintenance, and marketing functions, companies can radically reduce costs, speed products to market, and improve quality.

These are areas that merit far greater attention from our university researchers and educators. But I'm an optimist. The very fact that key educational, business, and government organizations have joined together in planning and sponsoring this conference -- and that you all are here -- is a very hopeful sign for the future.

The last area I want to address involves opportunities for the education community to put quality improvement techniques to use in the education enterprise -- to self-apply, if you will, proven quality improvement strategies. Earlier I cited five reasons why the business community should endorse and apply quality improvement approaches. I said that quality improvement was the only process that simultaneously:

- Satisfies customers,
- Motivates employees,

- Stimulates suppliers,
- Comforts investors, and
- Wins public approval and media praise.

These are just as valid for the education community as they are for businesses. Those of you in our education sector know well that you also have customers, employees, suppliers, and investors -- and it's a safe bet that you, too, would like to win public approval and media praise!

Curt Reimann tells me that educational institutions, including those involved in accreditation, are showing growing interest in the Malcolm Baldrige National Quality award process and the application of quality improvement techniques. I urge you to listen carefully when Curt describes the seven major criteria for quality improvement, and to think creatively about how you can effectively apply these guidelines.

In fact, I believe that the Malcolm Baldrige National Quality Award program can serve as a framework -- a standard of excellence, if you will, that we all can rally around to accomplish our several quality and education goals.

We are giving this careful consideration at the Commerce Department as we begin to develop a report to the Congress on the wisdom of establishing a formal national quality education and outreach mechanism. The award program already is serving as a focal point for transferring information -- for educating others -- about the ways and means of total quality management. Rather than devoting our precious quality-related efforts and resources to brick and mortar institution building, we have been network building.

We are witnessing the beginnings of a new approach to quality-related education by existing organizations. The needs, self-interests, and capabilities of business and professional organizations are yielding solid advances in the development and use of quality improvement techniques.

For instance, each of the five past Malcolm Baldrige National Quality Award winners has undertaken outstanding information outreach

efforts. The winners have given literally thousands of presentations, and hosted hundreds of corporate visitors interested in learning more about how these companies achieved quality management success. These audiences are taking those lessons home, and beginning to apply them to their own organizations.

That includes suppliers, which are feeling the pressure of customers' demands for more reliable, higher quality products and services. I've always found survival to be one heck of a motivator, and suppliers are feeling the pressure of customers who are narrowing their supplier base.

Numerous professional and trade associations have become actively involved in their own quality improvement-oriented education efforts, targeting their members' special interests but usually building upon the Baldrige award criteria. This includes special issues of magazines, exhibits, and conferences devoted solely to quality improvement potential and methods. Ours is a nation full of societies, and we can use this vast network to improve our quality-related capabilities.

State and local economic development organizations are beginning to help companies to apply the principles embodied by the quality award. Some states even have chosen to establish their own quality award competitions, recognizing the value of quality improvement asa tool to strengthen local corporations, thereby retaining and generating jobs and tax revenues. They also are recognizing that a better-trained work force -- one that will be more capable of turning out quality products and services -- is an increasingly important inducement to companies seeking to expand or relocate. In a particularly encouraging development that complements state and local initiatives, our community colleges -- which traditionally have served as key resources for local education efforts -- are beginning to show real interest in incorporating the award criteria and principles in new curricula.

As I'm confident that Under Secretary John Betti will tell you after lunch, the Department of Defense -- a major educational institution in its own right -- has begun to evaluate the importance of quality improvement in its training programs for employees and contractors. And having spoken recently to the Defense Systems Management College (DSMC) about the wisdom of that organization getting involved more directly in TQM, I was pleased to note that DSMC is a

cosponsor of this session.

Education accreditation organizations and the U.S. Department of Education are showing an interest in the quality award effort and the possible application of similar quality criteria and assessment tools to educational institutions.

The federal government is using the quality award criteria and process to improve the work done by its agencies and employees. For example, the Federal Quality Institute, which provides advice and hands-on training to promote quality management practices for federal managers and employees, is promoting the award's approach. The President's Award for Quality and Productivity Improvement -- which recognizes the accomplishments of federal agencies -- and our own new Commerce Secretary's award, do likewise. Moreover, the federal government is encouraging its suppliers to employ the award's concepts and criteria.

The thousands of organizations that are using the award application guidelines as a handbook and self-assessment tool are a key part of this grass roots national quality education effort. So too are the several hundred experts who have served as award program examiners, along with the program's top corporate advisors. In fact, this entire effort is unprecedented for its scope, its involvement of multiple organizations, and its self-initiative. It's an approach to education that matches America's diversity and strengths.

I don't want to overlook the emerging "growth market" for quality-related training. With the increased awareness of quality as a business improvement tool has come a new service sector devoted to quality training. And several of the country's top corporate quality-achievers are recognizing that their own education and training related expertise -- developed with their internal work force in mind -- is a valuable commodity in the expanding quality training market.

These all are positive developments, efforts that we can and must reinforce. There are tremendous challenges when it comes to education and quality. But we have tremendous resources, too. Our advanced education capabilities, in particular, are among the best in the world.

But it is important that we recognize and raise our national awareness about these challenges, and that we make better use of

our nation's human resources. We can and we must do that by better teaming our educational and quality improvement efforts and institutions.

This conference is a call to action. I urge you to work together, through your schools and colleges, your companies, associations, and agencies. Take advantage of the growing national quality improvement network that many of you already are a part of. Share your experiences with others, exhort them to use proven quality-improvement criteria within their own organizations. Urge them to study and provide new information about the linkages between quality improvement and organizational effectiveness. We have exciting opportunities ahead. Let's turn them to our nation's benefit. Thank you! Good luck! God bless!

Congressional Perspective

Don Ritter
U.S. Representive
15th Congressional District, PA

Introduction

Thank you, it's a real pleasure to be here this morning, I am honored to be given the opportunity to address this forum.

My goal today is to give you a brief congressional perspective on competitiveness, quality, education, and the ties that exist between all three. This is one of my favorite subjects, because for years I have been doing all that I can to share this message with my congressional colleagues.

Quality and education are the *sine qua non* of competitiveness.

America and the Changing World Market

Competitiveness has become an important word on Capitol Hill, and with good reason. The world economy is evolving, and new centers of economic power are emerging. With apparently reduced military tensions derived from the economic implosion of communism, economic power is more and more replacing military power as the real global power.

Television coverage associated with Emperor Hirohito's funeral brought home the story of Japan's incredible economic success. Many people were shocked by the blase way the Japanese and the newscasters referred to Japan, not only as a superpower, but as "Number One, the number one industrial power," having a higher per capita income than the U.S.," etc.

A recent New York Times/CBS News/Tokyo Broadcasting System poll, published in last weeks N.Y. Times, reported that 50 percent of Americans believe that Japan will be the number one economic power in the world in the next century, against 32 percent of

Americans who picked the United States.

And American's competitors are not just in the Far East. European-owned companies like Thompson and Philips now play an important role in our economy, especially in consumer electronics, and, if all goes according to plan, in 1992 the European Economic Community will become a single integrated market -- larger than the U.S. and Canada. If European products already compete in markets that America once dominated, one can only imagine what may happen after 1992.

In waking up to the Japanese and European challenge, Americans have realized that much of our electronics industry -- to cite just one example -- s either gone or under foreign ownership. This is true even though semiconductors, digital computers, consumer electronics, commercial TV and broadcasting plus near-universal home TV set ownership were American inventions. From a dominant position in the world market and clear technological leadership, we have gone to near insignificance in consumer electronics and in major parts of the semiconductor industry and now even our computer industry may be threatened.

We can say similar things about machine tools, automobiles, and heavy equipment. We don't dominate these markets anymore. In some of these we're lucky to be alive! And yet, a "fortress America" approach could beggar us and others.

No, to succeed in today's world, we are going to have to be able to compete globally. Our competitors in Europe and Japan have been able to win our markets with new products across the whole spectrum of high-value added, high-technology manufactured products. Without American made mass market products, in the information age we could become a second-rate power.

Where Do We Go From Here?

After more than three decades of near-abandonment by industry leaders, government and the professions, our society is returning to an appreciation of the importance of "making things." The current economic activity, which has lasted for an unprecedented length of time in a peacetime America, is being driven by a new vitality in manufacturing.

Just last week, a Wall Street Journal article reported that we posted a trade surplus with Western Europe for the first 4 months of this year. Many attribute this to the decline in the dollar, a rebound in European growth and the recent upheavals in Eastern Europe. This trend will be watched closely.

Still there is some cause for concern. Earlier this year the *New York Times* published a broad sketch of where the economy is going. In a section entitled "High Tech Payoff" the editors listed six critical sectors of our economy by the ration of exports to imports in the U.S., Japan, and West Germany. We have a ration greater than 1.00 in only aircraft, computers, and pharmaceuticals, (where we still hold technological leads).

And that may be because our foreign competitors haven't targeted those areas yet.

Earlier this year, Dr. Kent Bowen of Massachusetts Institute of Technology (MIT) testified to the House, Science, Space, and Technology Committee about five ways to continue the American manufacturing recovery. I'd like to share them with you, since they reflect policies and programs which I have worked to achieve in my years in the Congress. Incidentally, these ideas come from the outstanding book Made In America, a report of the MIT Commission on Industrial Productivity.

First, we must focus on the new fundamentals of manufacturing. American companies need to elevate their regard for products and manufacturing processes above finances and quarterly results. They need to establish new indicators of how well they are developing, producing, and marketing their products. Firms also need to focus on the effective use of technology in manufacturing.

Next, we must cultivate a new economic citizenship in the work force. For new technology to be used effectively, those working with working with it must be able to plan, make good judgments, work together, and analyze complex systems to better organize the production process. Education and training must be overhauled so people can obtain good basic schooling and learn for work.

Third, we must blend cooperation and individualism in the work force.

Fourth, we must learn to live in the world economy, or as I call it, the "global competitive challenge." We must improve our product distribution and servicing capabilities, and develop more internationally conscious trade policies.

Finally, and perhaps most importantly, we must provide for the future. The United States must invest substantially in achieving long-term benefits, such as improved basic education -- reading, writing, and mathematics -- and universal scientific literacy.

Our businesses need to develop longer-term strategies such as retaining and enhancing expertise in existing areas, rather than moving into new areas that appear more profitable in the short term. Our government, for its part, should establish economic policies that stimulate productive investment.

A New Competitive Strategy

These and other clarion calls have given us an unqualified mandate for action. We must promote the growth of the technology base in America by taking our basic knowledge of science and turning it into products which people want to buy. We must do more efficiently, less expensively, faster, and better than our competitors.

We must have a national commitment and some specific actions by the federal government to remove the barriers to innovation and add some incentives to get our companies back in critical marketplaces.

Simple protectionism isn't the answer. This will only prop up inefficient American industries while the rest of the world passes us by. The American consumers and our standard of living would be the big losers. Instead of keeping others out, we must build world-class industries which are at the cutting edge of science and technology and which can hold their own with any foreign competitors, here or overseas.

Innovation Without Quality Isn't Enough

But R&D, innovation and invention, important as they are, by themselves are not enough. Our recent problems in competitiveness have never been associated with the level or quality of our basic science and technology research. Instead, we have had trouble turning our basic science and our technological innovations, which

should give us a leg up on the competition, into competitive products.

Our competitors in Japan and to some extent in Europe have been able to integrate their R&D into an accelerated product cycle that brings to market new technology in new machines and products across the whole spectrum of high value-added manufactures.

And when we have brought products to the market ahead of the competition, we have later often lost part or all of those markets as our competitors used Quality principles -- particularly continuous improvement -- to overtake and pass us.

As NEC Corporation's research director Michiyuki Uenohara said in a *Business Week* story, "For the Japanese, innovation is 'the result of tiny improvements in a thousand places.'" That's a textbook description of managing for quality.

To secure America's position in this competitive world, we in the Congress must do at least as much to promote quality as we do to promote R&D.

The Quality Revolution

There is a third industrial revolution going on in this country -- the Quality Revolution. Not enough Americans understand that the main driving force behind Japan's success is its almost 40-year commitment to continuous improvement and Quality. The VCR's, compact discs, Toyotas, and now HDTV didn't happen by luck in Japan. Quality principles originating in America and refined in Japan had a lot to do with it.

"Quality" refers to a whole new management and work philosophy, based ultimately on common sense and a belief in the value of individual workers fulfilling their potential as members of a larger team.

It emphasizes people are more important than machines, and gives people power to use technology to its fullest, so worker involvement, training, education, teamwork, and reward can lead to unprecedented mastery over the job to be done and satisfaction from doing it well. Workers become more their own managers, and automation or technology simply expands their power. That is a revolutionary idea.

Quality puts less emphasis on direct cost-cutting to increase profits. Instead, it focuses on improving the whole process by which a product is manufactured or a service is delivered. Perfecting the process perfects the product -- a simple but stunning conclusion.

Constant improvement by taking small steps forward over the long term is build into the process, which delivers products or services that more and more meet customers' needs and expectations. That old adage that, "If it ain't broke, don't fix it," is going to become obsolete.

Experts estimate that from 25 percent to 40 percent of the average company's resources are wasted in "production" or on correcting mistakes! That means that vast billions of dollars down the drain. Companies that focus on quality gain the advantage because, through improvements in the way they work together to produce or service, they waste fewer resources. They do things right the first time.

Quality and Education

The linkage between quality and education is extremely important. Speaking at a Defense Department meeting, former Secretary of Labor Ray Marshall said it well. "The key factors in competitiveness are learning and information sharing. Modern technology provides you with lots of information. You need workers that are capable of taking advantage of that information. The biggest challenge facing the United States is to develop a work force that can develop and use leading edge technology."

A past *Business Week* article about CalComp (the plotter company) really brings this home.

Since 1985 CalComp has raised its productivity by 50 percent and its revenues by 62 percent by turning to quality. And one of the things they did was to eliminate quality control as a separate function. Each CalComp employee is responsible for checking the work received. According to *Business Week*, "Whenever anyone spots a major defect, work stops until the cause is found and fixed." That's quality in action. But it takes a work force that's educated, trained and motivated to do it.

The American education system is proving to be obsolete in

preparing us for global competitiveness. Not only is there an acknowledged scientific illiteracy (and indeed far too much English language illiteracy) to cope with, we must begin to prepare an entire new generation of scientists, engineers, technicians, and workers for the factors of the future.

Where will they come from? Not from our current pool of high school students; only 7 percent of them are ready to take a college-level science course of any kind! Engineering and physical science enrollments in colleges and universities seem to have plummeted to record lows. That's why I believe that the first step in effective public understanding and involvement in science and technology is effective education in our schools.

Toward this end I have introduced a resolution in this Congress calling for universal scientific literacy -- understanding a core of scientific concepts -- in this country by the year 2000. This a major, long-term project of the American Association for the Advancement of Science (AAAS), and deserves the support of all technical professional societies, and professors of science and engineering across the country.

Then there's the challenge of recruiting and retaining the best teachers. Teachers must be regarded and rewarded at least as well as other professionals. The key is the flexibility to reward teachers' excellence and critical skills without having to reward everybody regardless of "merit" or "market" signals. Merit and Market (M&M), like the candy is very American. The key is to pay more attention to merit and market along the length and breadth of our public school system. Such flexible rewards are just starting up in a few school districts nationwide.

David Kearns, the next speaker, has written a book titled *The Brain Race*. I recommend that you read it and bring it to the attention of your representatives (state as well as federal). It talks of a major freeing up of the public school system and professionalizing teaching, about the length of school days and years, and about rewards.

At the very least, a spirited debate is long overdue as our students are regularly out-scored in math, science, and languages by our competitors.

We need education for quality, and we must bring quality principles

to education.

We must do all that we can to prepare our future engineers and managers to meet the challenges of the global marketplace. To do this effectively we need your help. You have a vital and important role to play in this movement.

There is a need to integrate the concept of Total Quality Management into the curricula of our business schools, MBA Programs, and economics. David Kearns is leading a charge to make this happen. This is the theme of a quality forum that he will be hosting at the end of this month in Leesburg, Virginia.

We also must train our engineers to design with quality in mind. They must understand that they are part of an entire process, and their responsibility goes well beyond the initial design.

Our managers must be aware of the benefits derived from rotating people through the process. Most will tend to resist placing their designers in a manufacturing or marketing assignment -- but how else will these people understand the problems faced by these sectors of the business.

Last, but not least, managers must be made aware of the contributions that people at all levels who run the process can make. These people understand every aspect of the system, and management must see to it that the bearer of bad news will not be shot. Their inputs are needed to achieve continued improvement.

Building Communities of Excellence

If our nation is to compete effectively, we'll need dynamic local and regional movements to accelerate broad acceptance of quality improvement. This focus on the region is based on the contention that competition requires American business to learn about Quality quickly, and that work with educational institutions, local governments and private groups can help not only the business enterprise, but the educational and public ones as well.

Business cannot offer all the educational support or marshal the community's diverse leadership to promote a culture of quality by itself. That's what we need -- a "culture of quality."

To compete effectively in the world market we must find more ways to work together as a community toward common goals with common means. Groups like this audience can play a role in encouraging and facilitating such movements.

I know from my own personal experience with the "Quality Valley, USA" group how vital a community organization for quality can be. I am working with other congressmen to encourage them to start communities of excellence like Quality Valley, USA, in their districts or to get involved in such an effort if it's already underway.

It's a non-political effort for political leaders that will help us all. And as local leaders in education, you can help.

I am also working with leaders in industry, the Congress, and the administration to together accelerate the revolution. I believe that political leaders who lead America to Quality will lead America.

Conclusion

As I said at the beginning of this talk, "competition" and competitiveness" are important words inside and outside the Beltway these days. For example, the cover story in a recent past issue of *Forture* was about competition and titled "Where Japan Will Strike Next."

Let me quote a sentence from that story. "Many U.S. and European suppliers of goods and services could be vulnerable to the Japanese -- particularly if Western companies fail to press on with leading-edge research or invest lavishly in world-class manufacturing plants to keep customer satisfaction high."

Keep customer satisfaction high -- that's kind of the bottom line of the Quality revolution. All must participate if we are to play a dominant role in this global economy.

Let's do it!

Industry Perspective*

David T. Kearns
Chairman and CEO Xerox Corp.

Curt, thank you very much. Let's see if I can get myself organized here. I am pleased to be here and I appreciate the invitation. Going third when you know your audience is a little anxious to begin work on the subject and develop some interaction is somewhat intimidating. Further intimidating, I'm sitting here with Myron Trybus who was one of my teachers in quality and was involved in this subject long before me, and Tom Murrin from Westinghouse who was one of our early corporate teachers. The Westinghouse Quality Institute was one of our first benchmarks when we started this whole process. In any event I'm going to try to whack away at this for the next 20 minutes or so and try to get you to think about a couple of things that I hope might be helpful as you go forward.

First, I'd like to say, Curt, I think it would be important as we are having our second forum in Leesburg at the end of this month with the business schools as well as a discussion and interaction of how the business schools can begin integrating quality within their curriculum. And I think we made quite a lot of progress last year which information we'll share with you. If we could get the information from this session that could possibly be a collaborative effort in the future because I agree with the point Don Ritter made: the cross-discipline approach to this is important. Let me just make a few comments about the overall situation in education. In fact I'm really going to try to focus most of my remarks on quality this morning, but we have a national catastrophe in the education of our youth starting from the time they are born until they graduate from high school. In fact we are educating half of our people adequately while our competitors are educating 90 percent of their people. If we don't fix that, all this other stuff we're talking about will be immaterial because we will be a third-rate nation as we move into the next century. It is a matter of national survival. In the July 23,

* This text was transcribed from a video recording.

1990 issue of *Time* Magazine, there is about a one-and-a-half page interview with Bill Brock, the former Labor Secretary, about his commission on skills and the American work force. You ought to carry it around in your pocket because it is absolutely frightening, and it just brings home the kind of things we have. Now you can turn that around and we have an anomaly. With all the frailities, problems and issues we have in higher education in the United States, our system is the best in the world. And not by a little, but by a lot. The great research universities of this country are, in fact, a huge national asset and a competitive advantage. Therefore, the reason a session like this is so important is that we now have to leverage that asset in a much more practical way and I believe you are in the forefront of the kind of things we're talking about. If we can do that, and I believe we can, then I think our college and university system will be one of the key leverage points to help us regain a huge competitive advantage we should have in this world. Although I am an optimist on almost everything I must admit it's easy to get down about kindergarten through 12th-grade education because that is the most entrenched bureaucracy I have ever dealt with in my entire life. I thought corporate America and Xerox were difficult to move, but I will tell you the education bureaucracy is unparallelled. So we're going to have to keep whacking at it, and I think, as you all know, historically no institution has ever changed itself without outside pressure. It cannot be done. The changes required are so onerous that if you are not pressed to make those changes you will not do them. We would not have done this at Xerox had we not been forced to do it by our competition. We just would not have done it. Now let me talk a little bit about quality -- quality at Xerox and what quality is as we see it. We have used the quality process as the competitive tool to turn around the business. We did go after the Baldridge Award last year. We said that 10 percent of the process of going after it was because we wanted to win it and 90 percent was because we wanted to do an assessment of where we stood. The application itself and going for it was part of the quality process, and quality improvement. Some others have said the reason we felt that winning it was only 10 percent is because we did not think we were going to win. One, we were convinced that Milliken would be a winner since they had come very close the year before, and one of the major benchmark companies with whom we shared information. We knew they were good. But having said that, we drove for the Baldrige Award as part of the quality process. Now I'd like to go back a little bit historically for Xerox because we always thought we were a customer-oriented company. And in fact in 1964,

well before I came to the company, and I think, Myron, even before you came to the company, Mr. Wilson of Xerox said something I use from time to time. I'm not sure I've ever met a wise man, but I think Joe Wilson might have been one. I've read a lot of the things that he has said, and I have used this quote over and over again. But this was 1964. Xerox was not a very large company at that time, but was beginning to make great progress. And in a talk he gave to Xerox people, he said, in the long run our customers are going to determine whether we have a job or not and their attitude will determine our success. So this was embedded historically in the company. Somewhere along the line in the '70s we lost track of that. We had patent protection, we had extraordinarily high profit margins, and we were running fat and happy or whatever you want to call it. But we lost it. And as we roll out of the '70s and go into the '80s, I'd like to just give you two facts. The Japanese were selling products in the United States for what it cost us to manufacture the product. Not manufacture and distribute, but what it cost us to manufacture it. Initially, of course, we used dumping and all that kind of thing as excuses except after we started to study and understand it, they were doing it and were making money, so the problem was ours. The second point was that it took us twice as long to bring a product through the development cycle, manufacturing and into the marketplace. If you put those two things together, it's clear we were on our way out of business. This was a survival necessity. The way competition was going we had to make product improvements at the rate of 17-18 percent per year to catch up, and it was clear to us that we needed a new process. I was giving a talk like this several years ago and a Controller of Levi Strauss, after listening all day to the 9-step quality process and the 6-step problem -solving process and the time it takes, said to me at the end of the day, why do you do this? I said, I may not be the best speaker in the world, but I'm not the worst and I've been going around the world for the last few years exhorting people with banners and slogans and things to do better, and it didn't work. You cannot change culture and you cannot change the way a corporation runs and get the kinds of outcomes you need in this world without different processes than we had. I'd been visiting Japan a great deal, I'd done a lot of things, had read what other people had done, I'd gone off to Phil Crosby's school and read his book; we had Deming and Juran and Taguchi in at Xerox and I'd been spending a great deal of time at our Fuji Xerox joint venture in Japan. Fuji Xerox in the early '80s won the Deming Award. We not only had competition from Cannon and Sharp, IBM and Eastman Kodak, but had

competition from our own joint venture that had a quality improvement process substantially better than ours. I made a trip in the early 80's to Japan and on the way over I was reading *Fortune* magazine. There was an article in it about an $8 billion investment by the General Motors Corporation to improve the quality, reliability and costs of their product. On this trip I visited the Toyota Company as part of my benchmarking process in Japan. At Toyota they had those articles all over the place. They had already started the process of changing all of their cost, quality and reliability targets because they assumed that their competition would be successful. It was already underway. On the way home on the airplane I started doodling and as usual I was both scared to death and invigorated after having spent 8 days in Japan. I started to wonder what it is that is different. Why are the Japanese moving at such a faster rate than we are in the United States. First, I wrote down all of the rationalizations that we all have, monolithic cultures, a controlled society. But, I finally wrote down high expectation levels which came out of my visit to Toyota. I concluded that the Japanese businessmen had higher levels of expectations for success than we did. Not a complicated thought process. It really banged home at me. Out of that began a thought process in my mind that we were shooting at the wrong targets; we had set the hurdle too low and we were on the wrong track. We needed something completely different and that's really how we got into the quality process. We pulled together the 25 top executives of Xerox and basically pounded out a quality strategy. We said it was a quality process for the 80's. Process was important. Everything at Xerox had been program oriented -- a start and a finish. I had opportunities to speak. In fact, John Evans, who's on the program here, had invited me to come down to Chapel Hill and talk to the business school students. And Paul Rizzo, the Dean and a former associate of mine at IBM, had been the vice chairman of the company, and after talking for about 30 minutes, answered the student's questions for about 1-1 1/4 hours, Paul Rizzo made a comment to me. Here's someone who had worked at IBM, clearly a quality company, and who has been in the academic world for four years or so in an administrative role, who said, he understands now for really the first time, that when Kearns talks about quality at Xerox he's talking about the management process and the way they are running the business. That's what the quality process is. It is not something on the side. The quality process is the tools you give your employees to run your business for continuous improvement. Now I will say one thing that is very important and is from the training aspect. I'm not going to take a lot of time to talk

about the quality process at Xerox. By the way, we describe quality in what I think now is the acceptable way, and that's meeting our customer's requirements. It's a very important part of the quality process, because it forces you to understand what your customers want. We train from the top down at Xerox. We started with 28 hours of training. Six of us started with the senior group and I am the only person who did not do it twice. Everyone else then had to train their group, yes, they had a facilitator and an educator to go with them. We took that down and it took us more than three years to process 100,000 employees. Of course, by the time we were through, we were modifying the process -- the way we taught and some of the things we had to learn. We were so used to managing outcomes at Xerox that inspecting the process, which is part of a quality process, we had to redo and go back and teach our management, including ourselves, about what inspecting the process meant. Now benchmarking has been a very important aspect of the Xerox quality process. Just a couple of statements about it. We've been benchmarking our competitors for years, tearing products apart. We really got started in that area. But we benchmarked everything. There are about 300 metrics that we measure. We measure the best in the world as part of our planning process and I'd like to give you a couple of examples. I'm going to use the administrative process and billing to give you a feeling for this. About three years ago I was making a customer call on the director of the Social Security Administration. He said, "David, I'd like you to know, and this is the good news, that we now have put Xerox products back on our procurement list for value, reliability and quality." They had taken them off in the early 80's. "But, now I want to tell you that if you do not fix your administrative process or interface with us we are going to stop doing business with you." The quality process is every single function and piece of what you do. Our benchmark for billing errors had been IBM because they were doing substantially better than we were. Until we started to look outside of our industry, at companies like American Express who do consumer billing, and their benchmark for error rates was three times lower. Well, our people had all the reasons we can't do that; the millions of bills they do, statistically you can't do that. Last year we met the American Express billing error rate because our expectation levels had continued to grow during this period of time. One more story on expectation levels. Some of you have heard me tell the story about the Phillips Company in Holland. They make bulbs, small bulbs for the automobile industry, all over the world, and they are a major supplier to the Japanese automobile industry.

They were selling bulbs to Nissan or Toyota, and their error rate or defect rate was about 500 per million which is pretty good, but not good enough from the standpoint of the Japanese. They told them they had to do it and get it down to 100 defects per million. They grumbled a little bit, but after a while they got there and, of course, you can't get there by inspecting at the end of the line because that costs a lot of money and is very inefficient. Nissan told them that they had to continue to provide not only more of a high quality product, but they had to continue to reduce the price as well. When they got to 100, Nissan said you must go to 10 per million; when they got to 10 per million, Nissan said you must go to 1 per million and when they got to one defect per million, Nissan said you have to go to 1 per 10 million, which is where they are today. When they asked Nissan, why didn't you tell us to do that in the first place, Nissan said we didn't have the slightest idea whether you could do that or not, we could not tell you how to do it, and you were the best bulb supplier that we had. There is a great deal to learn and we benchmark across the board. Florida Power and Light, IBM, Westinghouse, Machusta, they are the best consumer electronic manufacturers in the world today. They make all the video tape recording heads in the world and are just plain better. They have totally integrated from research, to development, to manufacturing, the type of thing Tom was talking about. One of the things you'll find at Machusta is the very best engineers do manufacturing as well as development and research and there's across, and back and forth. By the way, they don't fake it by calling it operations, they call it manufacturing. It's o.k. in Japan to tell your mother, or your grandmother that you're in manufacturing engineering or process engineering, not just in development. I'd like to just talk a little bit about what we've accomplished -- not to brag, but to point out what we still have to do. We reduced our supplier base from 4,500 in manufacturing to 400. The importance of that is your suppliers must be part of the entire quality process from development through manufacturing and into marketing. You cannot do that with thousands and thousands and thousands. They must become part of the team and they must be part of telling you how you can use their products in your process as well. The idea of throwing procurement requirements over the wall and having ten people come in and bid on them guarantees that you will end up getting something which is not the most efficient or the best. We have reduced our manufacturing employment from 12,000 to 6,000 direct employees during this period of time and doubled production. Our indirect to direct ratio in manufacturing when we started down this line was 1.6

indirects in manufacturing to directs. It is now .7 indirects to directs, which is still not at the benchmark, it is not particularly good. But it is a lot better than we were. So you can see that it is in the indirect area where we took out much of the resources during this period of time. We've reduced our unit manufacturing cost in real terms 45 percent, our development time by 40 percent, and improved our machine performance in the first month of installation by 40 percent. We didn't measure first month performance in the old days, we had learning curves indicating that after 12 months in a customer's office, it would work the way we wanted it to and by that time the customers were ready to rip or throw the machines out. The machines must be ready to perform when they arrive. It is in the first month your product is used that an opinion of whether you are a good supplier or a bad supplier is formed. Dataquest, who measures our industry, rates Xerox products in five of their six categories, the best in the world in quality, reliability and value. I believe at the end of this year it will be 6 out of 6. Now, best in the world is really important. I am absolutely offended by an advertisement in the United States by a company that says I make the best automobile in America. The buyers do not care. The buyers only want the best that they can get. Last year 94 percent of our employees in a survey said they really believed now that our top priority was customer satisfaction. We have gained market share during this period of time and we have improved our return on assets from 7- 1/2 percent to 12-1/2 percent. We did win the Baldridge Award. Now that's the positive side of it. Let me tell you where we are in our assessment. We put 17 people together to go after the National Quality Award. People say: I can't imagine you'd spend that much money on it. But you have to remember, this was part of our continuous improvement process. That team stayed in place for 6 months after the award process was over. They put together two documents. One was our application to the Award Committee in the Commerce Department. They also prepared us for the site examination and did a good job. We won the award. They also prepared a document that was our worldwide assessment of where we stand today and identified 537 points of improvement that were required. They then took that and with the senior executive team, over a 3 month period of time, culled that down into 50 categories and then six key points and have now transferred that to the group executives, and that is our next 5 year plan for improvement. By the way as a check, that quality award team will come back together at the end of this summer and take 2 weeks for an inspection of how the group executives are moving toward

implementation. Now out of that came six principles. And I'd like to go through them quickly as I'm running out of time and have a meeting in downtown Manhattan at 12:30. Six principles: One, the customer defines our business and you must have a clear identification of market segments. We basically came out of it as we were focusing on the customer but not in specific enough terms to really drive us.

Second, success depends upon an involved, empowered and trained work force. Now I'd like to just pause on this for a minute, because I am not saying we have the ability to pull this piece off. Every industrial psychologist I have ever talked to will tell you that change tends to be a demotivator. We have to figure out how to make change a motivator for our employees. If you think about what's going to happen, the application of technology down at the level of every employee has yet to happen. If you talk about work stations with artificial intelligence and expert systems, there's a whole segment of businesses running with segments of managers and analysts who tell people what to do and figure out what they are doing. By the end of this decade that will all go away because you will not need all of that when you empower the employees and you apply the system so that the knowledge is there. This means huge changes for American corporations and I believe some invention is necessary. These are also the kinds of things in which I believe the universities can help. There is not a lot of real research to date, just more stories like I am telling you today. Therefore this is something in which we need a lot of help. I'm convinced it is really important that competitive companies in the next century will be the ones to figure this out.

Third, quality is on the line, by the line. Quality's an integrated part of the management process. Over the next 3-4 years I want the quality specialist gone at Xerox. Someone asked me why you didn't do it this time? I didn't quite have it, we're not there yet, we're using them as catalysts for change, change agents, but we've got to do away with quality specialists. This is a process that has to do with managing the business and the line people that have the responsibility.

Fourth, management develops, articulates and deploys clear directions and objectives and then empowers the people and lets them run with it. You have a process that you have confidence in that they can do.

Fifth, the strategic quality challenges. This is important particularly for Xerox. We have a tendency over the years to spread ourselves too thin with too many things. And what we've done with these 500 problem areas and so forth now is really prioritize them to get the high leveraged items early in the process. We did not do that in '82 and '83 and therefore took longer, I believe 2 years longer than was necessary had we done a better prioritization early on the key leveraged items. We were internally focused when we started, and our first quality projects were internal and not external for the real customer.

Sixth, the business is to be managed by facts using the quality tools. That may be more of a problem for us about not using facts, I think it really is for a lot of other people too, but I think it really is important that you have to make sure you are collecting data and using it which forces you to run the business on a disciplined basis.

Now let me give you just a feeling and, I'm going to take the manufacturing and development area of hard targets we have for '93-'94 from where we are today. A four-fold improvement in new product reliability from where we are today by the end of '93. That's going to be tough to make, but we at least now have some processes in place which give us some confidence that we have the ability to do that. Second, to reduce development time by another 12 months. Difficult to do, but absolutely necessary. Third, another 50 percent reduction in unit manufacturing costs in real terms during this period of time. And fourth, the most difficult one of all, which is we are now looking to have 100 percent customer satisfaction. Now you ask why is that difficult? The reason is because that's a moving target. The other ones I can put a mark in and I can run at. But customer expectations are going up at an extraordinary rate. It reminds me of my 7th-grade arithmetic or whatever it is, when I first learned that when you keep cutting a line in half you never get to the end. And that's what we are doing. We are getting continuous improvement but our customers are continuing to run ahead of us. Now let me just end by saying, the customer is king; he will drive our expectation levels higher and higher, and we must meet those expectations with a quality process and product. Shareholders want value. Now, the takeover time may be gone because of some changing financial markets and I think that's probably good. The shareholders now will take another approach. They are going to throw out the management that does not do these things and give

them the things they want. Now there are two acts of faith that you need when you're dealing with a quality process. One is that real quality in a quality process will drive costs down, not the other way, and when you start, there is not a lot of quantitative data that proves that. It's getting better, but I can tell you where we are today. I know someone talked about 20 percent of your revenues in a manufacturing company, I think the number's probably higher than that. In other words, the cost of quality or in fact, it's the reciprocal of that, the lack of quality or non-conformance which costs, not counting lost opportunity. You've got 10 billion dollars in revenue and that's 2 billion dollars saved in costs. That makes it worthwhile. So it's an act of faith when you get going. The second act of faith is this. It's another mistake that Xerox made. When we started, we had three priorities. Customer satisfaction, market share and improved return on assets. All were important. I said they were all equal. In fact, I said anybody could manage with a bag of gold, it's mixing the priorities from time to time. That was an error. In late '87 going into '88, we changed it and said customer satisfaction is number one; that drives market share and the combination of those two things will give you over the longer term, the results that you need financially to drive the company. I'm convinced that the quality process works, it's worthwhile. I believe without question that it can be taught. No question about it. I think that's for the academic world to figure out if there should be special quality courses? Maybe to start with, yes. But I think over the longer term they need to be integrated, just like our businesses into almost all of the things that you teach. All of you who are involved in this, I think when you look back on this and we all do, 7-8 years from now, you'll find that these endeavors are worthwhile. It is not just manufacturing. This is for any kind of a process where you have objectives and you are trying to accomplish something. Thank you all very much and have a good conference.

Academia Perspective
TQM: IT'S TIME, ACADEMIA![1]

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Introduction

The quality of America's educational system is receiving widespread attention, with much of the focus directed toward precollege programs. The President's educational summit and consequent commitment for America's high school graduates to be "first" in math and science by the end of the century (3,452 days from now!) are representative of the emphasis being given to improving the quality of education. While some may believe that essentially all of the Nation's resources should be directed toward the precollege educational "crisis," I favor a portfolio approach with a greater emphasis on the undergraduate programs in engineering, math, and science.

The Nation's colleges and universities are facing a three-fold challenge that must be addressed -- soon! First, the decline in the size of the college-age population between now and the end of the millennium will reduce significantly the production of engineers and scientists during a time in which science and technology are emerging as the "formidable competitive weapons" in international competitiveness. Second, the attractiveness of engineering and science is declining among today's students; engineering and science are not necessarily the majors of choice among the Nation's "best and

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[1] This paper is based on a presentation given July 18, 1990 at the First National Symposium on the Role of Academia in National Competitiveness and Total Quality Management, hosted by West Virginia University. Dr. White was invited to provided a perspective from academia on the impact of TQM on academic institutions; although his remarks are directed toward colleges and universities, some apply to all educational institutions. The remarks made at the conference, as well as those in this paper, represent Dr. White's personal views and do not necessarily represent official policy of the National Science Foundation. Reproduction or other use of this paper is not allowed without the express permission of Dr. White.

brightest" young people. Third, the demographic shifts that are underway will yield a population that has not historically opted for engineering and science; specifically, engineering and science continue to be less appealing to women, underrepresented minorities, and persons with disabilities than to the remaining segment of the population -- which is diminishing in relative size!

Given the challenge facing America's colleges of engineering and science, it is especially important for today's educators to increase the appeal of engineering and science to all segments of society; at the same time, degrees in engineering and science must be competitive with the best in the world. In this paper, I focus on one of the systemic changes that must occur if America's engineers and scientists are to maintain and improve their relative position in international competition -- total quality management (TQM).

The paper is organized into two major sections -- teaching TQM and practicing TQM -- with the latter receiving the greatest attention. In treating the practice of TQM, I address the teaching, research, and service roles of the university.

Teaching TQM

In addressing the pedagogical aspects of TQM at academic institutions, three fundamental questions must be answered. Who should be taught TQM? What should be taught? Who should do the teaching? Although I will forego consideration of the content of course material, I do feel it is useful to consider the human aspects of the question, the "who" questions -- who should be taught and who should teach.

First, all faculty and staff should be taught (at varying degrees) the concept and fundamentals of total quality management. Next, all students should be exposed to the subject, for all will ultimately be called upon to practice it regardless of what they undertake for their life's work.

As to who should teach courses in TQM, I believe each departmental faculty should decide the issue for their students. For, it will be the case that some majors will require in-depth exposure to TQM, while others will require only a brief exposure. Having said this, I must hasten to add that I believe all engineering students should receive an in-depth exposure to TQM. A failed telescope in space, a

catastrophic shuttle mission, oil spills in rivers and oceans, a failure at a nuclear power plant, a collapse of a bridge or building, a rupture of a dam or chemical vessel, an explosion of a munitions plant, and a wrist watch that no longer works -- all have in common the fact that something went wrong, something failed! Engineers must design safe and sound products and systems; they must practice total quality management regardless of their specialty.

Drucker[2] has emphasized the difference in efficiency and effectiveness by noting that efficiency means doing things right and effectiveness means doing the right things. In teaching TQM, it is critically important that the right things be taught right. The subject is too important to be taught by someone who is incapable of conveying both the spirit and the content of TQM.

Having considered the teaching of TQM, it is obvious that academia also must practice what it teaches! Specifically, it should practice TQM in the teaching, research, and service missions of the university. The next section explores the opportunities for practicing TQM in academia and treats a number of the challenges to be faced.

Practicing TQM

Practicing TQM in the Teaching Mission of the University

Before treating the practice of TQM in academia, it is useful to consider the following questions:

- How long would a firm be in business if it rejected parts, materials, and subassemblies at an overall rate of 35 percent and rejected a critical component at a rate of 65 percent?

- How long would a firm be in business if it consistently failed to meet its advertised delivery dates by 25 percent?

- How long would a firm be in business if its products failed to satisfy more than half of its customers?

- How long would a firm be in business if it paid little attention to its cost of production, but instead raised prices at a rate

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2 Peter F. Drucker, *The Effective Executive*, Harper & Row, Publishers, New York, 1967

considerably above the cost of living while competitors were entering the market with lower prices?

What do these questions, obviously based on an industrial model, have to do with TQM in academia? Consider the first question, which uses rejection rates as an analog for student attrition in the university. The attrition rate of students who enroll in engineering, in my view, is unacceptable; it hearkens to an age when it was common to hear freshmen "motivated" using a boot camp style by admonishing them to "look to the left, look to the right, they won't be here in four years!" While I never used or favored such an approach, it persisted in the face of demand for engineering degrees exceeding perceived supply-side requirements. Today, such an approach borders on the suicidal for the Nation.

Overall, roughly half of those who enroll in the university as freshmen with a stated interest in majoring in either natural science or engineering (NS&E) will ultimately receive an NS&E degree. Since many universities do not "count" students as engineering students until some time later in the process, roughly 65 percent of those who actually enroll in engineering receive an engineering degree. However, among underrepresented minorities, the comparable figure is 35 percent. While women students have a lower attrition rate than underrepresented minorities, it is greater than that for men. Further, a declining reason for the attrition of women is academic difficulty.

The time required to receive an engineering degree is the subject of the second question. Very few students complete the engineering degree in 4 academic years. Those who finish in 4 calendar years generally attend summer school. Instead of engineering being a 4-year program, it is more nearly a 5-year program.

As the third question implies, less than half of those who declare an initial interest in engineering are ultimately satisfied with the experience, including many who "tough it out" and graduate!

The last question focuses on the cost of higher education, which has risen far faster than the cost of living. While this is true for all institutions, it is especially true for a select number of private, liberal arts schools; they have learned that the business of higher education can be a very good business indeed, since the higher the tuition the greater is their enrollment demand! However, considering the years

of schooling required and the "psychological cost" of majoring in engineering, it probably has grown at an even faster rate. As a result, students are seriously questioning the "total cost" of majoring in engineering.

Having considered the relationship between industry producing products and academia producing graduates, it is worthwhile to consider the questions: who is academia's customer and what is academia's product? Some argue that the consumers of academia's graduates are its customers; others argue that the students are the customers, since they can choose to "buy" or "reject" the academic programs offered by academia. Which argument is correct?

In many ways, academia functions as an agent for the student; the university is a broker not unlike a real estate broker. Who is the real estate agent's customer, the buyer or the seller of the house? Contractually, the agent represents the seller, since any commission is paid by the seller; however, the seller pays the agent from receipts provided by the buyer. Thus, for a real estate agent to be successful in the long run, both the buyer and the seller of the house must be satisfied with the experience. I believe both its students and the consumers of its graduates are academia's customers. *Of the two, the* most important is the student. For, ultimately, the success of the graduate will determine the level of demand for future graduates. Finally, academia's product is not its graduates, but the education it provided.

If the student is the most important customer of the university, whose failure is it if a student fails a course? In applying TQM in business, the customer is "king"; the customer is always right! In business, every attempt is made to satisfy the customer. Interestingly, in academia the emphasis is on the customer (student) satisfying the producer (academia).

Although I have assumed the reader is familiar with total quality management, I do want to clarify the definition of quality I use in the paper. Case[3] defined quality as "what the customer says it is." This brings us to the crux of the matter! For TQM to be applied in academia in a similar fashion to its application in industry, academia

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3 Kenneth E. Case, "Quality Control and Assurance," Chapter 3.6, Production Handbook, John A. White (editor), John Wiley & Sons, Inc., New York, NY, 1987, p. 3-96.

must turn its world upside down; many of the "givens", many of the paradigms of the past must be discarded.

As I noted in another setting[4], "Today, there is too much dependence on selection processes and not enough dependence on development processes. We have refined to an ultimate degree the selection process. Dr. James Duderstadt, President of the University of Michigan and a member of the National Science Board, pointed out this aspect of higher education. He noted that universities have depended on selection processes in the recruitment of students and faculty. Unfortunately, little or no attention is given to developing human potential. The true 'value added' by the educational system must be questioned.

"We ensure that only the best students are admitted as undergraduates, only the very best of those are allowed to go to graduate school, only the very best of those will graduate, only the very best of those will be hired as assistant professors, and only the very best of those will become tenured. That process might have worked with the input stream of the past, but it is not likely to be effective in dealing with future input streams.

"We must pay more attention to those who might be at the margin -- those who, with a little development effort, can be transformed into superstars. We must find a way to effect the transformation. I'm reminded of the young fellow who was hiking on a mountain trail he had never hiked before. At one point on the trail he noticed a sign that read, `Pick up some pebbles from the pile at the base of this sign. Put them in your pocket. At the end of the day, you will be both glad and sad.' He looked at the pile of rocks, chose two of the smallest pebbles, and put them in his pocket. After hiking all day, as he was about to go to sleep he remembered the pebbles. When he removed them from his pocket, he found that they had turned into gold. He was very glad he had picked them up; he was very sad that he hadn't picked up bigger and more pebbles.

"We must recruit more of the `marginal' students: at the end of four years we'll be both glad and sad. We'll be glad that we paid

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4 Remarks made during a public address at Rennsselaer Polytechnic Institute, titled "As a Venture Capitalist, Would You Invest in America's Engineering Education Enterprise?" The address was given on May 18, 1990 and recorded in a paper prepared on June 11, 1990. Copies are available upon request from the author.

attention to the ones we did and we'll be sad that we didn't pay attention to more of them. We must develop a mentoring capability within engineering, we must pay much more attention to the development of the human resources made available to us; we must acknowledge their scarcity; and we must replace a 'weeding out' philosophy with a 'bringing in' or 'cultivating' philosophy. We must place greater emphasis on nurturing and developing. This will require a major change in the culture of engineering education. Pogo was right in identifying the enemy."

Unfortunately, it appears that academia is making the same mistake industry made for decades, trying to "inspect quality into its products." Under TQM, firms design quality into the products; less emphasis is given to inspection and more emphasis is given to "front-end" planning and design. How does this apply to academia? Entrance exams; tests, quizzes and final exams in courses; and qualifying exams, comprehensive exams, and dissertation defenses are forms of inspection -- they are attempts to "inspect quality into the product."

I am not advocating an elimination of all "inspections", but I am advocating an attack on "defects" where and when they occur. In industry it is far better to cure the cause of the defect than to continue to reject defective parts! Likewise, in academia more attention needs to be given to identifying the source of the "failure." In my judgement, when a student fails a course, it is because of a failure in the teaching/learning process; both the student and the professor are jointly culpable. However, under our current system, only the student pays the penalty for the lack of successful education on the part of the professor.

Engineering is losing market share to law, medicine, accounting, and business in the competition for women students. We must redesign our products to appeal to this and the next generation of students; we must improve the quality of our products. TQM provides the mechanism for accomplishing the needed transformation. To ensure that changes are made consistent with the demands of our "customers", we need to spend more time listening to our students, to the employers of our graduates, and to our faculty. We must understand much better the nature of the "business" we are in.

Peter F. Drucker[5] says that every manager must answer the question, "What business are we in?" Next, he asks that managers answer the question, "What business should we be in?" Some would argue that academia's business is the knowledge business; however, I believe it is the business of producing knowledgeable people. Higher education is in the people business. As such, academia must maintain its focus on its people: its students and its faculty and staff.

How important is the teaching mission of research universities to their faculty? Students know how important they are to the faculty. They are reminded daily of their importance. For that reason, it is not surprising that "last minute" attempts to recruit undergraduate students to attend graduate school are so unsuccessful; what is surprising is the few faculty who recognize the connection between their own attitudes toward teaching undergraduate students and their recruiting difficulty. You cannot suddenly recruit students for graduate school in the latter part of their senior year and expect them to discount all of the messages you sent during the previous 3 1/2 years. By the end of the sophomore year, it is fairly obvious which students have high-potential for graduate school. Yet, we don't pay much attention to them until they're seniors.

What business is academia in? I believe it is in the human resources development business and the business of producing knowledgeable people. However, it is not necessarily the case that the institution which produces the most knowledgeable people does the best job in educating its students. Why? Because the "value added" by some institutions is questionable; they produce the "best people" because they attract the best people. In some cases, it appears that academia is no more than a convenient "holding ground" for students to mature. Hence, the greatest competition is not in the classroom, but in the admissions process. Since there is little confidence in the institution's ability to discriminate once a student is enrolled, applicants are carefully scrutinized and "only the best" are admitted.

In statistical experiments, as well as in establishing statistical quality control limits on a process, we guard against two kinds of error: rejecting an hypothesis that should be accepted (Type I error) and accepting an hypothesis that should be rejected (Type II error). Similarly, educators are concerned with two kinds of errors: not

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5 In *Management: Tasks, Responsibilities, Practices*, Harper & Row, Publishers, Inc., 1974.

passing a student who should pass a course (Type I) and passing a student who should not have passed a course (Type II). Unfortunately, faculty appear to be more concerned with reducing the Type II error than with reducing the Type I error.

If TQM is to be applied to the teaching mission, we will have to develop a mechanism for coping with the inherent process variation that exists. Sources of the variation include: students, their previous educational backgrounds, attitudes, abilities, and goals; faculty, their preparation for teaching, attitudes, abilities, and goals; and the infrastructure, including laboratory and computing equipment, involvement with industry, library resources, furnishings of classroom and study rooms, and housing.

Due to the diversity of students, faculty, and infrastructure combinations that exist, it does not appear reasonable to expect "cookie cutter" approaches to be effective in carrying out the teaching mission of the university. To the extent possible, tailored curricula should be used to meet students' educational needs. This does not necessarily mean smaller class sizes, though that would help; neither will it be necessary to increase substantially the number of courses offered. What it does mean, however, is allowing greater flexibility in terms of the courses taken and the speed at which a student moves through the curriculum; it also means adopting computerized instruction to a greater extent.

United Airlines flight test facility in Denver is an example of the kind of approach to education I believe should be provided for more students in the university; their philosophy, basically, is that every student should graduate. They accomplish their objective by paying careful attention to a student's progress continuously, by allowing the student to establish the educational pace, and by providing considerable computerized instruction and feedback to the instructors.

It is generally the case that universities are attempting to perform "high tech education" by using "low tech processes". Faculty tend to use teaching techniques that have not changed in decades. Perhaps flexible teaching systems (FTS) and computer integrated teaching (CIT)[6] are needed.

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6 FTS and CIT are the teaching counterparts to FMS and CIM technology used in Manufacturing.

For a number of reasons, universities have focused on the high cost, low volume end of the market (i.e., the doctoral market) and are giving less attention to the higher volume market that sustained them for years (i.e., the undergraduate market). As a result, the process could be characterized as producing Washington Monuments when Capitol Buildings are in demand. The Washington Monument is tall and narrow and symbolizes the belief that undergraduate students will only have value if they become doctoral students. Many faculty appear to believe that every student is in the university in order to one day be a faculty member. For engineering, a new model is needed; we should be designing the Nation's Capitol Building, not the Washington Monument. "We need to recognize that the vast number of undergraduate students will enter professional practice. They will help American industry be competitive; relatively few of them should go on for a master's program and even fewer should go on for doctoral studies.

"We should not focus our educational system on the production of the very few who will be Ph.D's. Rather, we should give greater recognition to the base of the Capitol, i.e., those who do not go beyond the bachelor's degree. We should make the bachelor's experience a quality experience, one that will benefit the student and industry. Next, we should focus on the few who go on to the dome of the Capitol by becoming graduate students. Finally, we should consider the pinnacle of the Capitol, those who might get their doctorate. We must give greater focus to the basic mission of undergraduate engineering education; we must pay more attention to the base of the Capitol."[7]

Practicing TQM in the Research Mission of the University

As we turn to a consideration of practicing TQM in research, I must admit that I have been impressed with the apparent ability of NSF's program directors (as well as the research community, itself) to judge the quality of research *before it is performed* and on the basis of surrogate (and in some cases, scant) evidence. When a reviewer or a program director is asked to justify their recommendations with respect to a research proposal, the response is always the same, "The

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7 John A. White, ""As a Venture Capitalist, Would You Invest in America's Engineering Education Enterprise?"

ones with the highest quality are funded." I'm not as confident that my quality judgements are as error-free as they.

In fact, because of the surety of the claims regarding quality, I often wonder if we aren't erring on the side of conservatism in our judgements, taking the safe path instead of the more risky path. Is our quality measurement system filtering the off-beat, the radical, the potentially highly innovative idea?

Ideas are not like screws and bolts. We cannot employ calipers in measuring the critical dimensions of an idea; hence, we cannot make perfect judgements as to the quality of an idea. At NSF, our calipers are the peer review process. As such, we recognize that the judgement of quality is a qualitative judgement. While I do not claim that it is perfect, I do believe no better system is in use.

Yet, improvements can be made. We periodically revisit the peer review process in search of ways to improve it. In fact, we are currently engaged in such an exercise.

Not only can improvements be made in NSF's peer review process, but also the national research system can be improved. For example, greater accountability and scientific openness are needed, especially in the case of federally funded research. The recent difficulties at NIH have raised our consciousness regarding scientific integrity.

On the one hand there is the need for greater accountability; on the other hand there is the impact of bureaucratic accretion on the performance of academic research. To be sure, a balance is needed. Since taxpayer dollars are being used, we are charged with investing them wisely, to be good stewards of the Nation's scarce resources. Resisting added scrutiny are the universities who cannot afford to participate in the process, which is escalating the cost of research.

On a different note, it appears that many in the academic research community believe it is their inherent right to receive research support from the federal government -- *no strings attached*! Many in academia (including faculty members and university administrators) appear to view NSF as an academic entitlement program. Such is far from the case! The NSF's mission is inextricably tied to the Nation's condition; the economic health of the Nation will affect NSF ability to support research and, I believe, that support should be related to the impact of NSF's research on economic

competitiveness. As such, I believe more attention should be given to meeting the needs of U.S. industry in forming NSF's research agenda.

In engineering research, new paradigms are needed. Specifically, more emphasis should be given to "making a difference" with one's research; less emphasis should be given to publishing yet another paper in a prestigious archival journal that relatively few will read, and its only impact will be to serve as the launching point for another paper by the same author! Less emphasis should be given to pseudo-scientific research and more should be given to industrially relevant research.

In academic research, I believe the educational experience of the student involved in the research is more important than the research results. As such, it is especially important for attention to be paid to the quality of the student's research experience. For, I believe that the quality of that experience is far more important than the quality of the research output. Academic research has a two-fold purpose, educate students and produce results; I believe the former is far more important than the latter. Yet, the recognition/reward system in the university places greater weight on the latter than the former.

In academic research, more emphasis must be given to what is in the best interest of the student, what is in the best interest of the Nation, and what is in the best interest of the university. Less emphasis should be given on what is in the best interest of the professor.

Why do I make such a claim? Most faculty appear to make decisions as to what to teach, what to pursue in research, and which graduate students to support as teaching and research assistants on the basis of what is in the interests of the faculty member. As a result, there are few incentives for a professor to accelerate a graduate student's academic program; there is little incentive to recruit American undergraduate students for graduate school as long as there is a ready supply of hard working, uncomplaining, highly capable foreign students; and there is minimal incentive to perform service functions for the university. Unfortunately, the "what's in it for me?" attitude is evident to all, especially the students.

Practicing TQM in the Service Mission of the University

From the foregoing, it is evident that I believe considerable progress

is needed in improving the quality of the service mission of the university. Not only should TQM be practiced in the university's service to society, to the state and local region, and to alumni and supporters of the university, but also it should practice TQM in its service to its students and employees.

Sadly, the quality of the service function is abysmal at many universities. Unfortunately, too few service functions understand they are in the business of providing quality service; too few who staff the functions are service-minded. From my perspective, the quality of the service it provides to its students and employees should be the highest priority of a university's administration. In the case of students, every effort should be made to make the student feel important, rather than a number. The registrars office, the student aid office, the office of student fees, the housing office, the athletic office, buildings and grounds, security, food service .... these are just some of the organizations in a university that were established ostensibly to assist students and make their stay at the university tolerable if not pleasant. A similar list could be constructed for faculty and staff.

On numerous occasions I have heard it said by faculty, administrators, and those employed to perform a service for students, "The university would be a great place to work if it weren't for the students!" Obviously, such individuals did not recognize their own dependence on the presence of students; furthermore, TQM was not part of their job performance. Unfortunately, too few in the university appear to truly care about students. For this reason, it is essential that TQM be introduced to academic institutions.

Summary

In summary, TQM will not be adopted within the university without strong support from the upper administration. Furthermore, that support should be tangible and highly visible. An essential part of the administration's support package is a recognition/reward system that promotes TQM performance.

Because of the inherent competitiveness among academic institutions, a national award like the Malcolm Baldrige Award could stimulate widespread adoption of TQM. However, because of the copycat tendency of universities, its success depends critically on having "the right universities" participate. If the institutions that

others "want to be like" (i.e., the Top Ten in the *U.S. News & World Report* rankings) are among the participants, then I am more confident of the success of the award process.

I have no misgivings concerning the time and commitment required to implement TQM in an academic institution. To be successful, systemic change must occur; however, it has long been the case that managing change is a key to success in today's world. Rosabeth Moss Kanter, in her book *The Change Masters*[8], emphasizes the importance of integrated thinking within organizations that are facing dramatic change. In most institutions, the level of change required for TQM to be successful is total cultural change. To remain competitive, many firms have undergone cultural changes; there has been a major restructuring of "corporate America"; similarly, a restructuring of "academic America" will be required to accommodate TQM.

In their book, *Corporate Cultures*, Terrence E. Deal and Allan A. Kennedy stated, "Changing the culture of an organization is a difficult, time-consuming, often gut-wrenching process. This is as true in public corporations as it is in the private domain. In fact, effecting such changes in a public institution is, if anything, more difficult because of the number of legitimate constituencies -- the public, legislators, unions, employees, special-interest groups -- that can raise barriers to change. But change can be accomplished if a sufficient level of commitment is applied to the process for a long enough time."[9]

Changing an academic culture is surely more difficult than changing the culture of a public corporation. Further, to do so will take a strong commitment from the university administration, a commitment of time and resources. With respect to the time and expense of a cultural change, Deal and Kennedy also noted, "Once it becomes obvious that change is necessary, there are two other tough facts to face: change is time-consuming and very expensive."[10]

In conclusion, TQM would appear to be appropriate for the academic

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8 Published by Simon & Schuster, New York, NY, 1983.

9 Published by Addison-Wesley Publishing Company, Reading, MA, 1982, pp. 169-70.

10 op. cit., p.161.

institution that is "in search of excellence"[11], "managing for excellence"[12], "creating excellence"[13], or just has "a passion for excellence"[14]. If anything, academia needs TQM more than industry. Will it be adopted? The answer to that question will depend on what comes from this conference.

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11 Thomas J. Peters and Robert H. Waterman, Jr., *In Search of Excellence*, Harper & Row, Publishers, Inc., New York, NY, 1982.

12 David L. Bradford and Allen R. Cohen, *Managing for Excellence*, John Wiley & Sons, Inc., New York, NY, 1984.

13 Craig R. Hickman and Michael A. Silva, *Creating Excellence*, New American Library, Inc., New York, NY, 1984.

14 Thomas J. Peters and Nancy Austin, *A Passion for Excellence*, Random House, New York, NY, 1985.

Quality Education in Business Schools*

John P. Evans

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Introduction

In this session on the academic role in national competitiveness, many of the participants will be able to speak from the perspective of engineering education. My colleagues on the program can provide valuable insight into the things that are happening in engineering schools to address issues of total quality management and what opportunities exist for improvement in that environment. My comparative advantage is to talk about:

a. Present coverage of quality in business schools,

b. What we can do to improve that coverage.

As a lead-in to those comments, I want to share two personal viewpoints with you. During the last 2 years of my TQM teaching in TQM and service as a Baldrige Award Examiner, I have been impressed with the eagerness of members of the business community to urge and help people in the academic community to improve the attention given to Total Quality Management. In this regard, I feel that some of today's best teaching is being done by corporate leaders who are relaying their convictions and commitment to those of us in the academic world. Teaching effectively depends on commitment, and David Kearns and his associates at Xerox, along with many people in other companies, have been excellent teachers for those of us in the academic world.

I want to share one other personal experience. For the last 2 years I have intentionally visited several companies in order to learn more about how they have approached quality improvement. One of those visits was to a Fortune 500 company in a process industry. At the

* No figures available.

end of my visit I had an hour scheduled with the VP-Quality (formerly VP-Engineering), who had been responsible for the early planning, selling, and implementation. I expected that he would want to discuss how much progress they had made (it was considerable), and what major directions they were taking for the future. Instead, immediately after the introductions, he said, "Jack, for the next hour you are my customer. How can I help you meet your needs?" That experience had a profound effect on me. It is also relevant to our agenda here, today.

I am here as one representative of a large number of organizations that are suppliers (of business graduates) to the business world. I can tell you a few things about the teaching of quality in the world of business schools and about some of the problems with which we deal. I also hope that my comments will stimulate discussion during the rest of this symposium about what we can do in the future to meet needs of the corporate world more effectively.

Present Status

First let's create a baseline describing the current situation. About 18 months ago, I finished gathering data on the coverage of topics in operations management, quality, operations strategy, and newer topics such as JIT production, management of technology, and related "modern" topics in operations management. My data come from 85 of the accredited and nearly-accredited schools of business in the United States, and I obtained the data from actual course syllabi. Thus, the data should be an accurate indication of what those schools are doing, and the 85 schools ought to be representative of the nearly 300 schools that are accredited or about to be. Let me also be clear that I was not investigating what the students in the "manufacturing option" were getting. I wanted to know what exposure all students are getting. Those are the students who are going out of our business schools into jobs in marketing, finance, and control, as well as operations. I wanted to know how much exposure to quality we're providing for the broad range of students.

I've analyzed my data on two different perspectives that might be of interest here. We'll look quickly at several slides, for both undergraduate and graduate programs in business. For this first set of slides I've sorted my data to reflect differences due to research mission -- separating the schools with doctoral programs and strong research missions from those with only undergraduate or masters

programs. These first slides indicate the extent of coverage of Operations Management in a course required of all students.

[Show Figures 1 and 2 about here.]
[Data: Opns Mgmt sorted by doctoral vs. non-doctoral schools.]

The good news is that in both undergraduate and graduate programs, more that 60 percent of the schools are providing reasonably broad coverage of operations management. (I defined broad coverage to be coverage of seven or more topics usually associated with the subject -- examples include forecasting, inventory, quality, etc.). The bad news is that nearly 40 percent of the schools are providing only light to moderate coverage. I defined light coverage to be coverage of three or fewer topics and moderate coverage to be coverage of four to six topics. Broad coverage (of seven or more topics) is approximately equal to one semester if each topic receives an average of about 2 weeks of coverage.

Later in the symposium we will be discussing the role of accreditation. My data are for accredited and "nearly accredited" schools, so we might look quickly at any differences that appear when the data are sorted for that difference.

[Show Figures 3 and 4 about here.]
[Data: Opns Mgmt sorted by accredited/nearly accredited schools.]

The story here is much the same as before. At both the undergraduate and graduate levels, about 60 percent of both accredited and nearly accredited schools are providing broad coverage. One note of clarification. My data came from accreditation studies. The initial accreditation studies are for schools going through their first review. Those nearly accredited schools are close enough to being ready for accreditation to go to the trouble of preparing a self study. It's not surprising that they aren't different from the already accredited ("veteran accredited") schools. My data shed no light on the situation in the non-accredited schools.

Now let's move to the specific coverage of quality. These next slides indicate the extent of coverage of quality, operations strategy, and any topics in the list of Modern Topics in Operations.

[Figures 5 and 6 about here.]
[Data: Quality, Strategy, new topics by doct/non-doct schools.]

These slides indicate that quality is being presented in about 3/4 of the undergraduate programs and in about 65 percent of the graduate programs. However, by looking reasonably carefully at the syllabi, I could tell that the usual coverage was something like one week on control charts and one week on acceptance sampling. Many individual schools are doing better than this, but this is a summary of the general situation. Of course, it's one thing to concentrate on the technical aspects of constructing control charts. It's quite another to teach the students about special and common causes of variability and about process capabilities. It's still another thing to present Quality Improvement as a fundamentally different way of managing an organization.

We might look quickly at the data sorted so as to display any differences associated with accreditation.

[Show Figures 7 and 8 about here.]
[Data: Quality, Strategy, new topics by acc/nearly acc school.]

Here again, we see about the same picture as indicated by the previous two slides. It is interesting that the coverage of quality seems to be more widespread at the undergraduate level than at the graduate level.

Interaction between Business Schools and the Business Community

Last summer, I participated in a 3-day program sponsored by Xerox Corporation that involved people from some 20 business schools and some 10 different businesses. We discussed a wide range of issues related to quality: quality in the business curriculum, specific aspects of quality that are important to cover and explain, things that companies are doing, problems that schools face, and things that companies need. Two important results from that program are relevant here:

1. It added to the understanding among the corporate people about the fact that the business school curriculum is rather slow to change for a number of reasons. Competition is fierce for "market share" in the curriculum and we defend turf like anyone else. In addition we have a longer product development cycle than we would like. (That may sound familiar.)

2. Second, our discussions identified a number of needs that we can address in business schools. Those of us who are interested and involved are working now to develop more and better teaching materials for the topics in quality that are important in the modern view of the subject. I hope this symposium will identify similar opportunities for engineering schools.

I might mention in passing that as I went through accreditation studies collecting data I tried to look for links between business schools and engineering schools or other academic units or curricula that would involve technology. As an unreconstructed engineer, I was sorry that I found very few such links. I know that some exist, and I think they represent a great opportunity.

What Are the Needs?

Let me illustrate what I hope might happen.

[Figure 9 about here]

The table in this slide shows the traditional business functions across the top -- Accounting, Finance, Marketing, Operations, and Organizational Behavior. Bob Jaedicke, former business Dean at Stanford, uses a table similar to this to make what I think is an important point. We may be teaching the material in the "columns" moderately well. However, there are a number of vital business issues that don't fit neatly in one column. We need to improve our treatment of all of those issues, and quality is one that I think has fundamental importance. There are places throughout the curriculum where quality ought to be emphasized.
[Figure 10 about here]

As Figure 10 suggests, in each of the traditional functional disciplines there are important points to make about quality.
Accounting -- measurement of quality results
Finance -- cost of quality issues, the payoff for good quality
Marketing -- customer satisfaction, quality as a competitive factor, the front end of quality Function Deployment
Operations -- problem solving, the importance of variability, uses of cross-functional teams, continuous improvement
Organizational Behavior -- motivation, recognition, and security

Where to from Here?

[Figure 11 about here]

Figure 11 shows one way of looking at the challenge that we all face. The issue that links the interests today is: Graduates from Business Schools Who Understand Total Quality Management. Drawing this Cause-and-Effect diagram has helped me to think about some of the things that can be done and who could be doing them. Here are some examples of possible initiatives.

[Figure 12 about here]
Texts - few current texts in Operations treat quality as other than a technical topic. Most texts are written by academics. I recognize the time problem, but wouldn't it be interesting to see a text written to include a manager's perspective of quality? Let me add a point. There are lots of books on quality, but those aren't the books that are used as texts in courses on Operations. It's the one or two or three chapters on quality in the Operations texts that have to take on a new perspective.

Business-academic programs - the Xerox program in 1989 was frankly the best of its sort in which I have participated, and I am delighted that it is being repeated this year. However, a one-time discussion will not produce a complete solution. We need more programs of that sort, and this symposium is an encouraging sign.

Curriculum Development and Research - Here those of us interested in quality in the business school world need to work on our colleagues in other disciplines to persuade them of the opportunity and the need. Some possible directions were outlined in an earlier slide. We also need to learn enough about how our colleagues teach in those other disciplines so that we will be taken seriously. That work is progressing. Next month at the Xerox Quality Forum II we will explore relationships between the Baldrige criteria and research/curriculum issues. Research activities should begin to show more activity related to the managerial issues in TQM. (By the way, Harry Roberts at the University of Chicago has compiled a summary of the research opportunities in this area.)

Teaching materials - We have plenty of technical items. However, we need more cases, projects, and illustrations of the modern world of quality. This is going to take collaboration between the business

and academic communities.

Accreditation - The American Assembly of Collegiate Schools of Business conducts a nationwide accreditation process. It happens that AACSB has just started a major study of that process. Since I am actively involved in it, I hope to have a role in representing the quality needs in the new process. We may have more opportunity to explore this in the tomorrow's panel.

Business community - Finally, let me conclude as I began. The business community is our customer. We need to know the needs of the business community in a consistent way over the long term and we need to work together, as good suppliers and customers, to meet those needs.

I am personally interested in these initiatives and I look forward to our discussions in the remainder of the Symposium. Fortunately, there are indications of movement:

- Faculty appointments
- Curriculum development
- Research and case writing
- Academic-business partnerships projects.

Momentum is building. Big changes will be seen in the next couple of years. My data may already be obsolete. Within the next 2 years we should begin to see a different picture. There is also still much to be done. Thank you.

TQM Curriculum Needs
An Engineering School Survey

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INTRODUCTION

Total Quality Management (TQM) is an evolving philosophy for continuous improvement of products, processes, and services to enhance quality while reducing cost. It is a socio-technical approach to the integration of all systems and processes of an enterprise to achieve customer satisfaction.

It has been reported that business spends more than $30 billion a year to train and retrain its employees. Many believe that the higher education system does not produce appropriately qualified graduated. The National Science Foundation predicts that the United States will be short more than 700,000 scientists and engineers between 1989 and 2010. The number of engineering graduates will decline by 40 percent and the demand is expected to increase by 70 percent ("America's Next Crisis: The Shortfall in Technical Manpower", a report by Aerospace Education Foundation).

SURVEY MOTIVATION

Given the above statistics and increasing pressures of competitiveness, it is imperative that the higher education system produce engineers and managers who are adequately educated. The TQM strategy is regarded by many as being critical to achieving world-class excellence. Application of TQM requires knowledge of quantitative statistical tools and human resource management techniques. The prerequisites being an in-depth understanding of products and processes. The quantitative methods and the associated product and process knowledge is generally taught by the engineering colleges. The management of human resources are typically covered by the business schools. During February 1990, the college of engineering at West Virginia University conducted a national survey to determine the current status of TQM education

and to determine the curriculum, training, and research needs of TQM. A survey form was sent to 147 engineering deans, to be filled out by an appropriate person from any academic unit of the university. Thirty six universities responded to the survey.

The purpose of the survey was to determine: a) the coverage of TQM related course material in engineering and management programs, b) the course material required for a strong TQM background, c) the possible approaches to integrating new courses in the existing undergraduate curriculum, d) the critical training needs of TQM, e) the critical research needs of TQM, f) the key drivers of TQM, and g) the key barriers of TQM.

SURVEY RESULTS

1. In the domain of tools and techniques the following courses were deemed "needed":

a) Design of Experiments
b) Basic Probability and Statistics
c) Statistical Process Control
d) Reliability
e) Quality Control
f) Manufacturing Processes
g) Production Management/OR
h) Design for Quality/Robustness
i) Data Analysis and Regression
j) Engineering Economy
k) Case Studies.

2. In the management domain the following courses were "needed":

a) TQM Philosophy
b) Team Building
c) Organizational Behavior
d) Basic Management
e) Communication
f) Strategic Planning
g) Case Studies.

3. For curriculum integration it was suggested that statistics, basic management and quality control courses be required, and advanced

statistical quality control, design of experiments, data analysis and regression be offered as electives.

4. Industrial engineering was the only program of study that required the above courses. Industrial engineering accounts for only 6.7 percent of all engineering graduates (1988 data).

5. Statistical thinking and human resource management were identified as the most critical training needs for TQM.

6. Integration of quality/life cycle/testability with design was the predominant research need.

7. The key driver to TQM was industry need.

8. The key barrier to TQM was resistance to change (i.e., established modes of thought in academia)/skepticism.

RECOMMENDATIONS

In order to address TQM curriculum needs it is critical that ALL engineering and management undergraduate students be exposed to statistical thinking and human resource management techniques. Special emphasis should be placed on experimentation, with statistics as an experimentation tool. The accreditation agencies should require this knowledge in all graduates.

TOTAL QUALITY MANAGEMENT
SLOGAN OR SUBSTANCE?

(Luncheon Address)
July 18, 1990

John A. Betti
Under Secretary of Defense (Acquisition)

Thank you very much for that kind introduction.

I appreciate the opportunity to join you for this First National Symposium on the Role of Academia in National Competitiveness and Total Quality Management.

The title of my remarks this morning is, "Total Quality Management-Slogan or Substance?"

I don't know about you, but quite frankly I'm getting a little sick and tired of hearing about TQM almost everywhere I go. You may have heard the story of the three people condemned to be shot by a firing squad. Each was granted one last request. The first person, a Catholic, requested a priest. The second, a consultant, asked to be permitted to give one last speech on TQM. The third, a defense contractor, begged to be shot before the consultant.

Some in this audience may feel like the third person -- you'd rather be shot than hear one more speech on TQM. I can certainly sympathize with you. The reason I'm tired of hearing about TQM is because the term is overused to the point where it is in danger of becoming a buzzword, if that hasn't already happened.

There are many well-intentioned total quality management advocates in our country today. I worry, however, that many of these advocates are doing the concept serious damage, as a result of their incomplete or misunderstanding.

Let me pause for a moment while you silently finish this sentence. "Total Quality Management Is....(Pause)"

Now think about how these examples fit your definition of total quality management. You receive a brochure from a company that is

marketing their complete TQM services. The brochure describes TQM as a philosophy based on participative management and employee involvement. It focuses on how they can help your company achieve total quality management by training your managers in more participative styles of management.

Is that total quality management?

What about the Chief Executive Officer (CEO) who tells you that it is important to start production of a new product as quickly as possible in order to find the production problems early?

Is that total quality management?

Or you listen to a senior manager give a speech on TQM. He says he's totally committed to its implementation in his company. The rest of his speech described how his workers use SPC, his engineers use design of experiments, and how he is committed to involving the manufacturing people much earlier in the design process through concurrent or simultaneous engineering.

Is that total quality management?

I'd agree that two of these examples have elements of total quality management, but one is dead wrong. What they all seem to lack is an understanding of the concept of total quality management.

I liken the problem to the story of the seven blind men who, never having seen or heard of an elephant, were given the task of describing one. Each was allowed to touch one part of the elephant. Thereupon each man described the elephant in terms of the one part he touched.

The man touching a leg said the elephant was similar to a tree; the man touching the tail declared the elephant to be similar to a rope. The man touching the side said the elephant was like a wall. And so it went for the ears, the trunk etc. Neither individually nor collectively could they correctly describe the elephant through this process.

Like the blind men in the story many who profess to be advocates or practitioners of total quality management, either intentionally or through ignorance, latch on to one or more elements of TQM and

define TQM in terms of those elements.

They define TQM in terms of employee involvement and cross functional teams; or statistical process control; or focus on the customers; or elimination of management layers through participative management; or the use of tools, such as: quality functional deployment, design of experiments, Taguchi, and other structured problem solving methods; or use of concurrent engineering.

Each of these can be considered an element of TQM, but neither individually nor collectively do they capture the power of the concept of total quality management. The unfortunate result is that too many are convinced that their narrow view of TQM is correct and complete, and are not motivated to pursue a deeper understanding.

For most, embracing the concept of total quality management requires a cultural change, which, by definition, involves a modification of the fundamental beliefs -- and both the stated and unstated rules which govern the behavior of an organization. It is not a program which can simply be superimposed on an existing set of beliefs.

If I were Winston Churchill, I might say that my own convictions concerning total quality management, and the need to change the stated and unstated beliefs of an organization to effect cultural change were forged in a "crucible of crisis."

Starting in 1979 and into the mid-'80s, the U.S. auto companies were in deep trouble. In early 1979, I returned from an assignment in Europe, just in time to participate in a review of Ford's North American Automotive Operation's plan to respond to the CEO's declaration that quality was to be Ford's first priority.

In my first meeting on the subject, the operating groups described the resources that would be required to support that plan. The requests involved tens of millions of dollars and thousands of people. We had once again proven a fundamental belief or paradigm of our culture -- quality costs money. We concluded that we couldn't afford that much quality, and the new program seemed destined to go the way of its predecessors -- only sooner.

But, within 6 weeks the Shah fled Iran, gas lines formed, and

overnight big luxurious American cars became a glut on the market. Customers quickly found a fuel-efficient, low cost, high quality substitute for our products.

The bottom fell out of our market and our profit forecasts dove deep into red ink. When we looked at the products our former customers were buying, we found stodgy styling, ho-hum performance and last year's technology. What the customers found were fuel efficiency, low cost and high quality.

Low cost and high quality didn't compute for us. We could understand Mercedes' quality -- we couldn't understand Toyota's. Mercedes fit into our paradigm that quality costs money; Toyota didn't.

To make a long story short, when we cut through all the excuses we made for ourselves, we concluded that by eliminating poor quality, with all its attendant scrap, rework and repair -- we would indeed reduce overall costs.

The realization that cost and quality could be compatible required a change in paradigms -- a fundamental change in beliefs. To support that change in beliefs, we had to change our thinking about quality, from defect detection and correction to defect prevention.

The inspection required to detect defects and the scrapping or reworking of parts required to eliminate or fix defective parts incurred significant costs. Building the parts right the first time avoided those costs.

Once we began to think about quality in terms of defect prevention, it caused us to think differently about statistical process control, preventative maintenance, product design for manufacturing, and the importance of disciplined problem solving directed at building parts right the first time. These became powerful implementing tools for the new paradigm.

The point I'd like to emphasize is: real progress began to be made after we changed our fundamental beliefs about the relationship between quality and costs -- after a change in paradigms. The techniques we adopted to help us improve both quality and costs were the results of that change -- and not the drivers.

Another example of a paradigm shift occurred when we realized that to improve results, we had to concentrate on the process that produced those results -- not on the results. For example, if you focus on managing costs rather than focusing on managing the causes of costs, you're always behind the power curve.

For example, all of us have been involved in situations where cost reduction tasks were imposed on our organizations. The results are predictable. Some dumb things are done that provide measurable short term cost reduction, but end up costing more in lost effectiveness and cost even more to rectify the longer term damage done.

Unless you manage the process, you're like a coach who depends on locker room rhetoric to save games rather than concentrating on preparing his team to play the games.

Like most of American industry, we at Ford operated within the paradigm that most of our employees were either lazy or incompetent, or both. We believed they couldn't be trusted and clearly had little or no pride in their work. To our surprise, we discovered, as many others have, that poor quality and generally poor overall performance is at least 80 percent of the result of the process -- not the employee -- and the process is the responsibility of management.

Accepting that the unacceptable performance was primarily the fault of the process, and that management -- not the employee -- was responsible for the process, was another change in paradigms; Another change in fundamental beliefs.

We began to work on improving processes and involving the employees in that effort. We began to treat the employees with respect and to listen to their ideas and suggestions. They responded with increased effort and commitment to help us improve the processes in which they were involved.

As a matter of fact, that paradigm shift even impacted how we thought about training. For example, training the worker to improve performance in a flawed process is certainly a plus, but it is far from the answer.

We would be far better off to educate our people to help improve our

processes, than to train them to better execute a fundamentally flawed process. As we were struggling with these paradigm shifts as largely independent events, some of our people saw the documentary, "If Japan Can, Why Can't We?" in which great tribute was paid to Dr. Deming.

Someone suggested we invite him to explain to us what he had taught the Japanese. I distinctly remember some of Dr. Deming's first visits. We wanted to talk to him about quality. He wanted to talk to us about management. We wanted to talk about the quality improvement tools we could use. He wanted to talk to us about culture change. We wanted to know what programs would work. He wanted to know senior management's vision for the company.

It took time for us to understand that the profound cultural change he was advocating required an even more basic and far reaching change in our fundamental beliefs than we were achieving through our individual paradigm shifts. His fundamental message was that what we were doing was interesting and important, but we were missing the synergy possible if we would consider the individual paradigm shifts in the context of a fundamental cultural change. The power of a cultural change was in changing the way we looked at and thought about the fundamentals of our business.

It would be great to say that once Dr. Deming helped to turn the light on, the answers fell into place. Unfortunately, becoming convinced that cultural change was necessary turned out to be the beginning of a long, slow arduous journey. And frankly, much of the time we were on uncharted waters.

In the process of that change we discovered that our growing convictions fit well under the developing definition for total quality management.

Simply put, I believe that total quality management is about managing the basics of the business. Total Quality Management includes four fundamental paradigms or basic beliefs involving The Customer, Quality, Continuous Process Improvement, and People.

The Customer

Knowing and satisfying the customer must be the first priority of an

enterprise and everyone in it. In addition, identifying each individuals internal customer and satisfying his or her wants and needs is the imperative for an effective and efficient process.

Quality

Quality, as defined by the customer, provides the ultimate measure of the value of an enterprise's product and an individual's or organization's output. The drive to improve the quality of product and processes can be a powerful unifying force that involves all aspects of an enterprise, its customers and its suppliers. Focusing on quality increase the prestige of an enterprise and the pride of its members. Reduced costs and time are natural results of improved quality.

Continuous Process Improvement

It's a fact of life that customer expectations will continue to rise and we must continue to improve in anticipation of that fact. Durable improvement can only be obtained by focusing on the process, not on the product. By the time a product exists, it's too late for anything except inspection and remedial action. Durable process improvement is only possible if we identify and correct root causes of problems and not operate on their symptoms.

Inherent in this approach is the absolute need to manage with facts. It is important to gather and analyze data before decisions are made. We must not mistake activity for accomplishment. It's axiomatic that a high quality process will yield a higher-quality and lower cost product or service.

People

People are the most important ingredient of an enterprise and of a process. Unless they have a common vision of success, share common goals, and are willing, as a team, to devote their minds and energies to their achievement, the enterprise will fail.

Professor Pete Senge of MIT describes an organization as a collection of arrows. If the arrows are generally pointed in one direction, their effect is additive and the organization moves in that direction. He refers to this phenomenon as alignment. If, as is true in most organizations, the arrows are pointed in a somewhat random fashion,

the resulting direction and output of the organization is dependent on the net effect of all the arrows.

If the arrows are not aligned generally in the same direction, and you spend your time and resources in increasing the "capabilities" of the individual arrows through empowerment, training, etc., the end result may not be a meaningful increase in output of the organization. Alignment of everyone in the organization is crucial to the achievement of the organization's objectives.

These four paradigms coupled with a total commitment to the concept of total quality management from the top leadership of an organization, are the essential ingredients for affecting the cultural change that will result in durable improvement and separate TQM from short-lived programs.

The top leadership must demonstrate their total commitment with actions, not just with words. They must "walk their talk."

As I understand it, you are in the early phases of that commitment. In November, 1989, the First National TQM Symposium was held in Denver, Colorado. That symposium endorsed and advocated full support of academia to join industry and government in full support of the National TQM movement.

This symposium here in Morgantown is a follow-on and the direct result of industry and government endorsement. You are primed to start the process which will define academia's role in our national efforts to achieve world class quality and services. As you proceed with your deliberations, please think again about the question I asked in the title of my remarks "Total Quality Management--Slogan or Substance?"

Fundamentally, I believe the answer depends on whether TQM is approached as another program or a fundamental cultural change. Fundamental cultural change takes a vision of what success looks like, commitment and patience.

H. L. Mencken said, "For every complex question there is a simple answer, and it is wrong." There are no silver bullets for cultural change; it is a long, slow arduous journey with no end.

There are many roles that academia can play in helping the nation to

understand and implement the concept of TQM. I would propose that the most important of these roles could be that of example -- by adopting TQM in the education process. The input to the process is an incoming student. The product of the process is a graduate. I believe the questions that need to be asked are:

- Does academia understand who the customers for their products are and how well their products are satisfying the wants and needs of those customers?

- Have the educational institutions made their wants and needs clear to the suppliers of their incoming students?

- Are our educational institutions dedicated to continuous process improvement?

If the answer to any of these questions is less than a resounding yes, then you have an exciting challenge before you.

There is little doubt in my mind that the global competitiveness of American industry would be significantly enhanced if the U.S.educational institutions provided high-quality graduates that meet their current and anticipated wants and needs.

In closing, let me summarize some of the main points of my remarks.

- Total quality management is in danger of becoming a buzzword because of incomplete or misunderstanding of the concept and the cultural change it requires.

- The four paradigms of a total quality management culture are:

  a) Knowing and satisfying the internal and external customer must be the first priority.
  b) Quality, as defined by the customer, provides the ultimate measure of value.
  c) Continuous process improvement is critical to maintaining customer satisfaction.
  d) Alignment of everyone in an organization is crucial to the achievement of the organization's objectives.

There is no questions in my mind that total quality management represents real substance, if it is approached as a concept involving

cultural change and not as a program with slogans and bells and whistles. I have been involved personally in its successful application and experienced the power of the concept. I have no doubt that application of the concept of TQM is mandatory if our institutions are to be globally competitive.

In this instance, I hope I'm preaching to the choir. Thank you very much. Thank you for your attention.

TQM OVERVIEW

July 18, 1990

Curt W. Reimann
National Institute of Standards
and Technology

TQM OVERVIEW
Questions to Address:

- What is TQM?
- Why is TQM important?
- Why are the criteria for the Malcolm Baldrige National Quality Award widely accepted as the definition of TQM?
- What are the implications of these criteria, especially to academia?

EVOLUTION OF QUALITY

- Craft-based
- Mass production - interchangeable parts
  - measurement, inspection
- Statistical methods
  - process control
  - sampling
  - acceptable quality - specifications
- Total quality control
  - all processes: manufacturing, non-manufacturing
- Customer driven quality
- Total quality management
  - customer driven
  - all processes

PROBLEMS WITH QUALITY AS A DISCIPLINE

- Multiple meanings of quality
- Mix of techniques and assertions
  - not strategic, systematic, or integrated
  - internal focus
  - "prescriptive"
- Primary emphasis on error reduction
- Unclear economic foundations

PROBLEMS WITH QUALITY Consequences:

- CEOs bewildered
  - start, stop, change
  - quality as a department or "add on"
- Poor communications
- Difficulty with assessment
- Lack of integrated framework inhibits academic interest

MOVING TOWARD A MEANING FOR TQM
Key Requirements:

- Convey all important requirements and their interrelationships
- Non-prescriptive
- Actionable / diagnostic power
- Foster communication

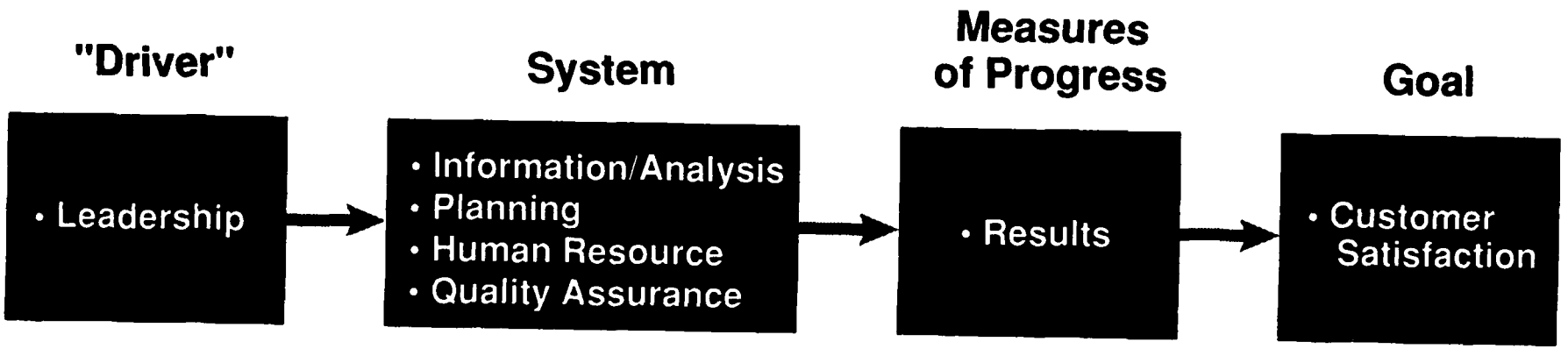
A de facto definition of quality requirements for all organizations

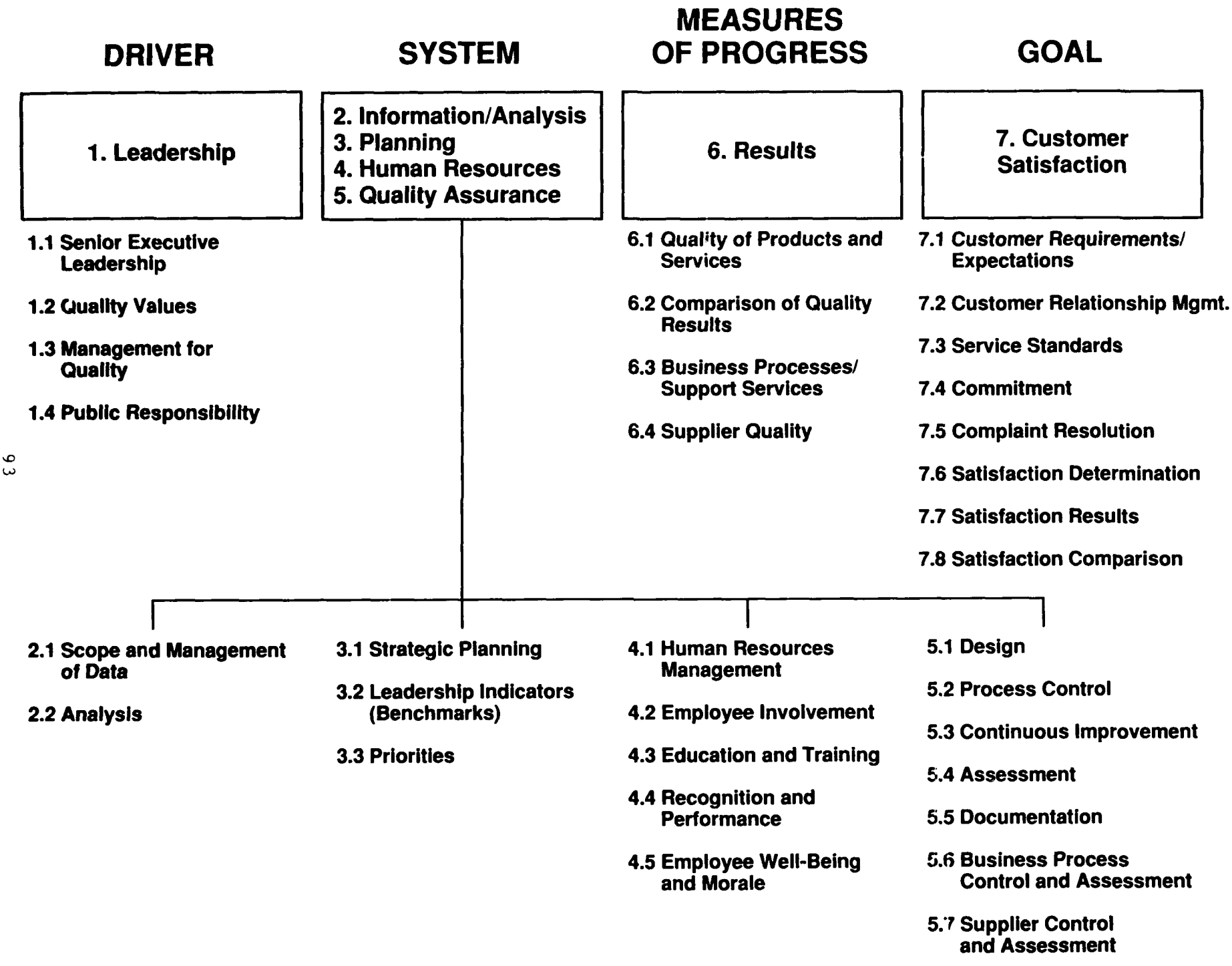
"BEDROCK" CONCEPTS IN TQM

- Quality is customer driven
- Prevention basis
- Management by fact
- Cycle time reduction
- Optimization of all processes
- Assurance / assessment
- Experience factors: leadership, strategy, human resources

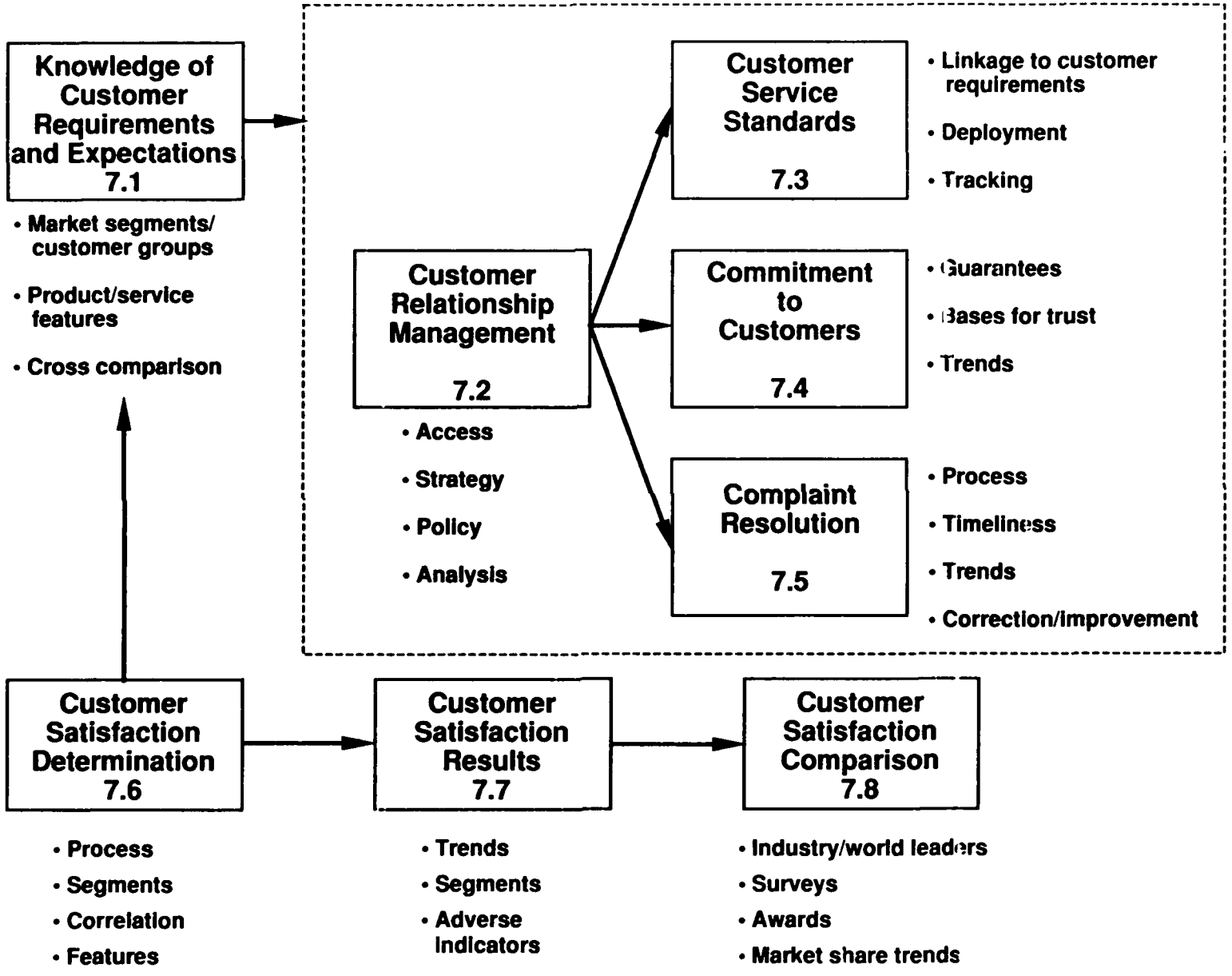
Together, these concepts define a system that is capable of competing on quality and cost!

QUALITY AWARD EXAMINATION FRAMEWORK

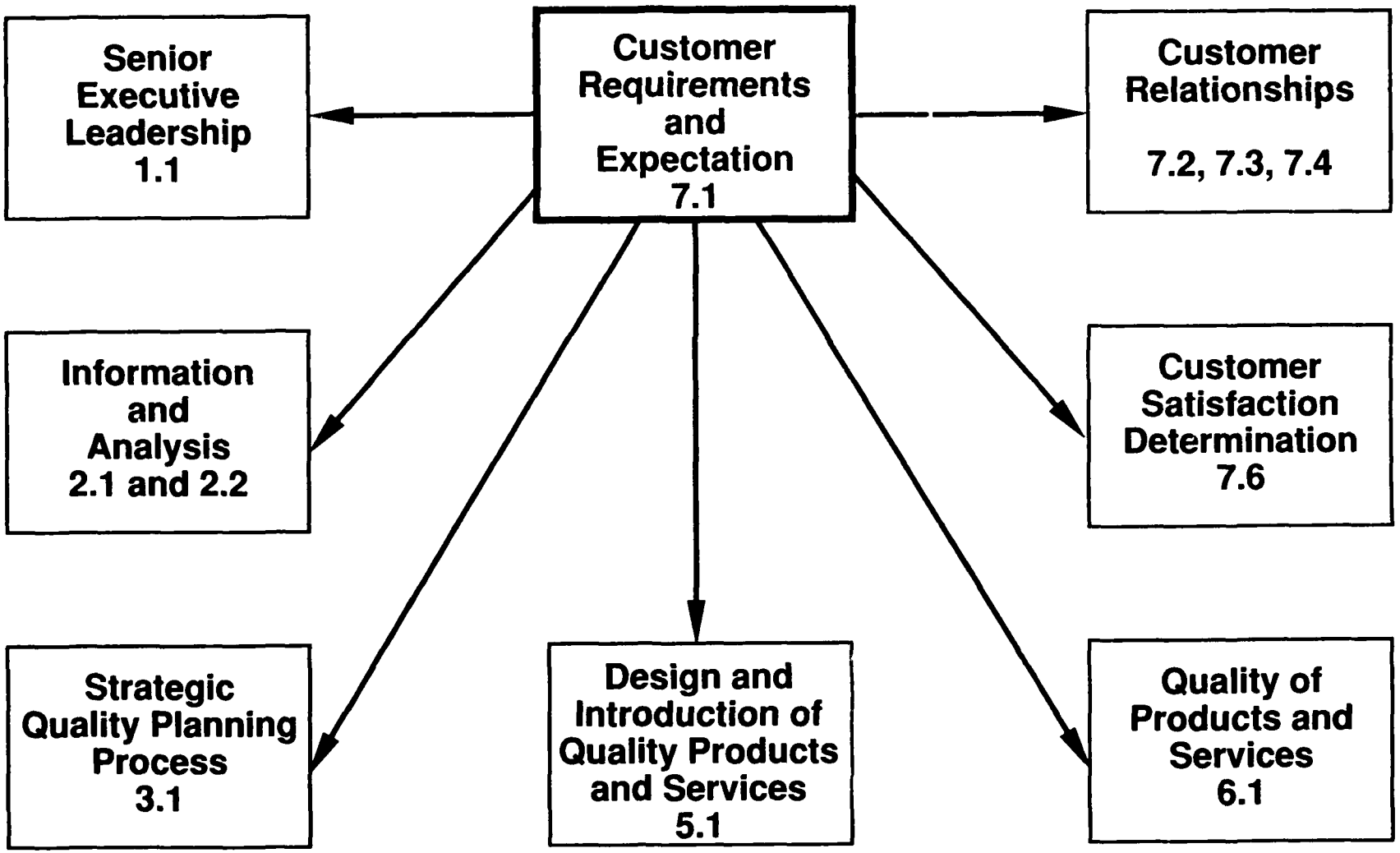



DRIVER
SYSTEM
MEASURES OF PROGRESS
GOAL
1. Leadership
2. Information/Analysis
3. Planning
4. Human Resources
5. Quality Assurance
6. Results
7. Customer Satisfaction
1.1 Senior Executive Leadership
1.2 Quality Values
1.3 Management for Quality
1.4 Public Responsibility
6.1 Quality of Products and Services
6.2 Comparison of Quality Results
6.3 Business Processes/ Support Services
6.4 Supplier Quality
7.1 Customer Requirements/ Expectations
7.2 Customer Relationship Mgmt.
7.3 Service Standards
7.4 Commitment
7.5 Complaint Resolution
7.6 Satisfaction Determination
7.7 Satisfaction Results
7.8 Satisfaction Comparison
2.1 Scope and Management of Data
2.2 Analysis
3.1 Strategic Planning
3.2 Leadership Indicators (Benchmarks)
3.3 Priorities
4.1 Human Resources Management
4.2 Employee Involvement
4.3 Education and Training
4.4 Recognition and Performance
4.5 Employee Well-Being and Morale
5.1 Design
5.2 Process Control
5.3 Continuous Improvement
5.4 Assessment
5.5 Documentation
5.6 Business Process Control and Assessment
5.7 Supplier Control and Assessment

CUSTOMER SATISFACTION



KEY DIRECT RELATIONSHIPS AMONG ITEMS



IMPLICATIONS OF TQM

- Basis for planning / assessment
- Monolithic communication system
  - within organizations
  - among organizations
- Basis for competitive comparisons
  - practices
  - results
  - strategies
- Modeling of barriers to quality improvement
  - organizational
  - human
  - technology

IMPLICATIONS OF TQM

- Design of courses, curricula, and texts
- Accrediting standards
- Case studies
- Needs assessment / modeling
  - companies
  - industries
  - regions
  - states
  - nations
  - professional disciplines
- "Quality literacy"
  - all disciplines
- Management of schools
- Targeting research, proposals

The Quality Management Revolution and Its Impact on Engineering and Management

Myron Tribus, PE
Community Quality Coalition
Jackson, Michigan[1]

INTRODUCTION

Figure 1 sets the stage for our discussions.

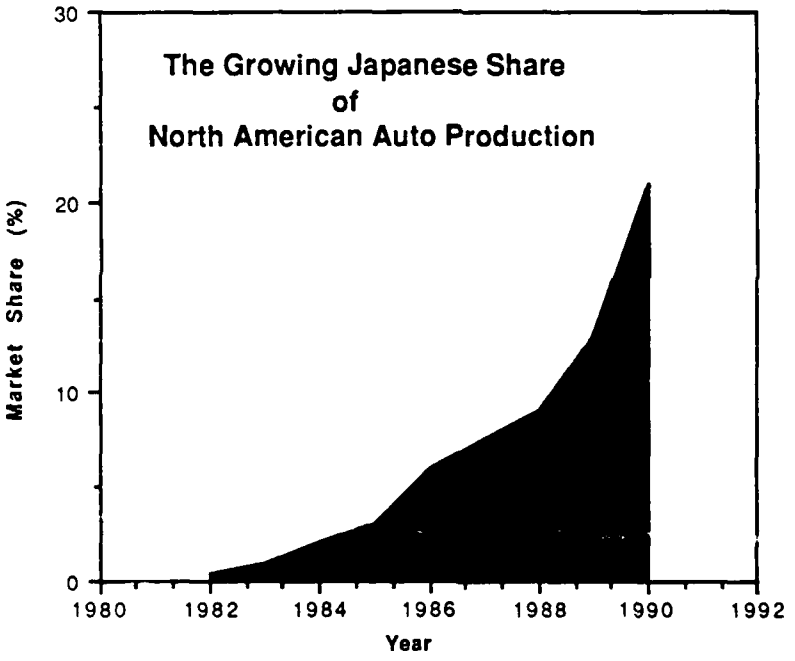


Figure 1. The invasion of the US Automobile industry.

We have to ask ourselves "Why?" Some people think it is a cultural phenomenon and that the Japanese work force is more dedicated. However, experience with Japanese managed plants in America shows that the same records for quality and productivity can be obtained here as in Japan. Figure 1 is not unique to automobiles. Similar figures may be drawn for a variety of industries.

[1] The Community Quality Coalition is a coalition of approximately 35 community quality councils dedicated to the fostering of total quality management in their communities. The CQC is sponsored by the American Quality and Productivity Institute and the Transformation of American Industry Project.

The workers in these Japanese plants in the USA have been Americans, so the primary fault cannot lie in the workforce.

The fact is that while GM was closing ten plants in the USA, Japanese companies were opening ten. Again, we must ask "Why?"

One reason seems to be that the plant layout and the designs of the cars were made in Japan. The system for selecting, training and instructing the workers has been directed by Japanese managers.

After ten years of actively studying and practicing the principles of quality management I have concluded that the root causes lie in the training of managers and engineers.

Because I have been a practicing engineer for almost 50 years, I understand the mind set of most engineers. Too many engineers believe that if they "go into management", they have left engineering. They do not understand that management is a part of, not apart from, engineering.

I have also been an executive and have worked with managers from other disciplines. Before I met Dr. W. Edwards Deming and learned about Total Quality Management, my practices were no different from my peers in the Executive Suite.

Many people sincerely believe that the problems are not with our managers and engineers. Instead they talk about the need for a level playing field, discriminatory Japanese practices, differences in interest rates and, of course, the education of the Japanese work force. I do not deny the importance of these factors, but if they were to vanish overnight, we would still be left with the stubborn fact that products, made in America, by American workers, in factories engineered in Japan, making products engineered in Japan and managed according to TQM outperform our own by a very large margin. Professor Daniel T. Jones of the Cardiff Business School in the UK drew these conclusions from a study of US versus Japanese managerial practices:

A TWO TO ONE PERFORMANCE GAP EXISTS

- **Half the effort in manufacturing.**
- **Half the effort and time in design.**
- **Lower volumes per product.**
- **Half the defects.**
- **Half the investment in tooling.**
- **Twice the number of products**
- **Half the inventories.**

THE GAP EXISTS IN ALL ACTIVITIES...Design, Manufacturing, Supply, Distribution, Job Shops, Project Teams, Volume Production

I have concluded that the gap represents deficiencies in engineering and management. It will not be closed until we adopt a different approach to management and engineering. This approach is called "Total Quality Management" (TQM). TQM represents a radical departure from the way we now manage and engineer. It is a fundamental change in paradigm.

Adopting TQM is not going to be easy for the engineers and managers we already have in our industries and in government. They learned the wrong paradigms when they were in school and their experiences in industry have hardened their understanding. We who are involved in trying to re-educate (or "rework" in the jargon of TQM) the existing work-force are now appealing to the educators: "Please don't continue to do this to us. Please change your paradigms."

FLAWED EDUCATIONAL PROCESSES

Before discussing what ought to be done, it is useful to review why engineers and managers turn out the way they do. Typically a student begins by studying "engineerics". After graduation the engineer encounters the "-ing" face of technology. After many years, some of the more successful engineers meet the "-tion" face. Each face is orthogonal to the others in its philosophy, values and procedures.

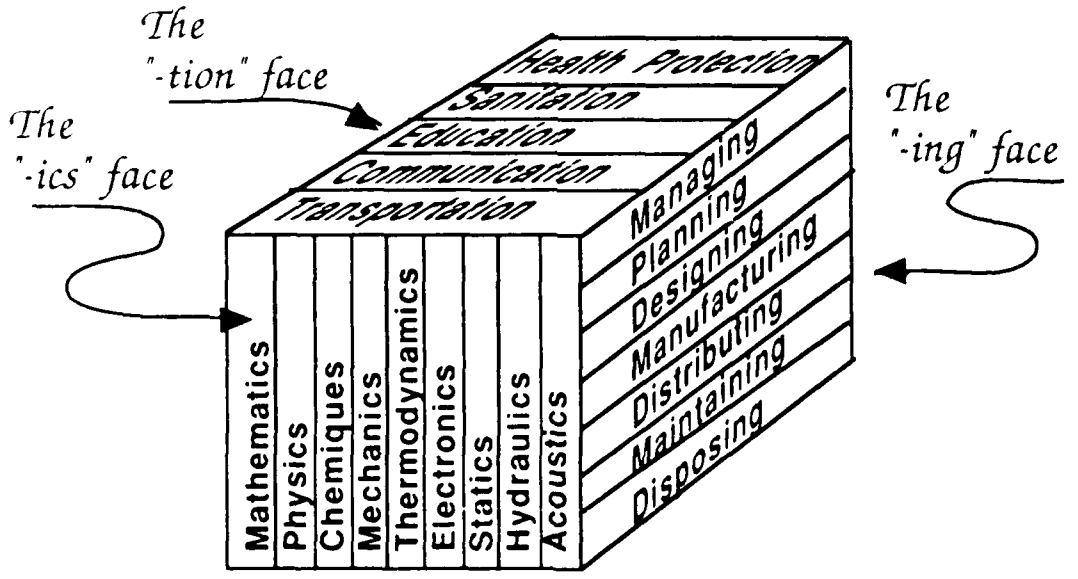


FIGURE 2. The three faces of engineering. The "-ics " face starts with academics. The "-ing " face is concerned with doing. The "-tion " face is concerned with the functions of society.[2]

[2] This diagram was first presented as part of a lecture in honor of Dean Davis of the College of Engineering, University of West Virginia, Morgantown, WV. ("The Three Faces of Technology and the Challenge to Engineering Education", Eighth R.P.Davis Lecture, March, 1975)

At the "-ics" face, human values are purposely omitted. The approach is scientific, analytic and academic. At the "-ing" face human values are a constraint on the doing. The human appears in the production system as something to be eliminated if possible and treated as a limiting factor where unavoidable. Customers are often treated as a necessary evil; at best a nuisance. Young engineers seldom consider humans as a resource.

At the "-tion" face, the engineer finally discovers that the human is the central force. The "-tion" face is not only where the functions of society are met and where the engineer must deal with the institutions of society; it is also the home of the politician. As I have written elsewhere, most engineers when confronted with this face of technology discover their technical education is a handicap.[3]

A similar cube could be drawn for the education of managers, but in their education, they are taught much more about human behavior. Many managers have a liberal arts background, and this helps them to appreciate the many non-quantitative aspects of management, though I think they retain this understanding, in spite of, not because of, the MBA curriculum.

ARE GOOFS, FLAWS AND ERRORS INEVITABLE?

Let me begin by asking a question:

If put to a relatively routine and non-demanding task, would be able to do your work with an error rate of no more than 5 per thousand, that is, at a rate of 0.5% errors?

Very few people will say they can reach this low level of error making. Now ask yourself another question:

"How many steps are there in the development of a new product--taking it from the date of conception to the date of delivery of the first product to someone who is willing to pay to use it?"

Finally, ask this question:

"What do you think is the error rate in a company in the introduction of a new product?"

Before answering the last question, take a look at figure 3, which depicts only a small portion of the complexity of the process of product introduction.

[3] Tribus, M. "Technical Education as a Handicap in Public Service" (Published in IEEE Spectrum, pp 48-51, April 1978 under the title "The Engineer and Public Policy Making")

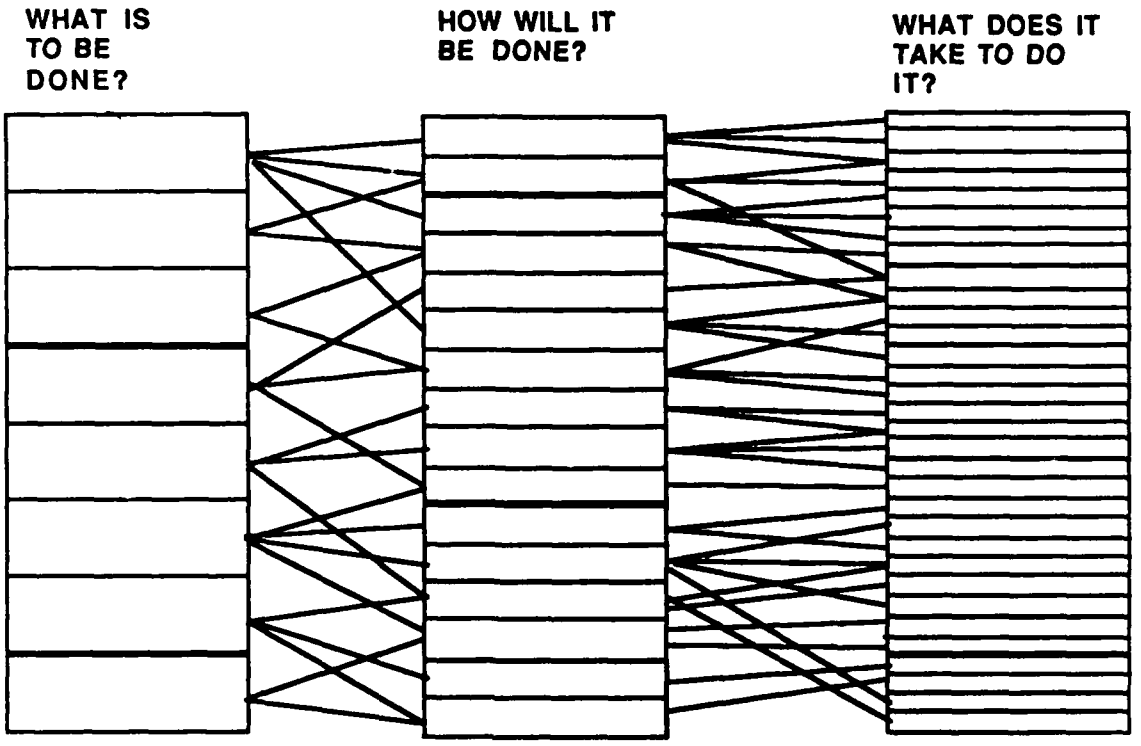


Figure 3. A portion of the challenges of the manager of an engineering project. There are processes before and after this set of processes. Only the tip of the iceberg shows here.

Each of the lines drawn in figure 3 represent a process which, itself, consists of a number of processes. All of these processes must be managed. They don't happen by themselves. In a typical transfer of an idea from a laboratory to the end of the manufacturing line[4] there are at least 10,000 separate operations. If the error rate per process is 1%, this means there will be 100 things to be redone!

Project engineering is a form of management unique to the engineering profession. It is not discussed in many schools of business administration, though certainly many of the ideas which have grown out of project management are applicable and useful outside of engineering.

When I worked as an engineer (and I still do) I was aware that things do not always go right. I knew about Murphy's law and knew Murphy still lives. Until about a decade ago, I thought errors were things that just "happened "; they were unavoidable, and the smartest thing to do was to hurry up, get the product out, find the errors and then fix

[4] Of course we should not just stop at the end of the line. As Dr. Deming says, "The product in the hands of the customer is still in the development cycle".

them. I didn 't invent that idea. I learned it from my bosses, many of whom I respected greatly. Unfortunately, it is not a smart idea. Quality teaches otherwise.

Recently the President of the United States awarded the Malcolm Baldrige Prize to Motorola, in recognition of excellent quality. Figure 4 is taken from a recent Motorola presentation describing what they did to transform themselves.

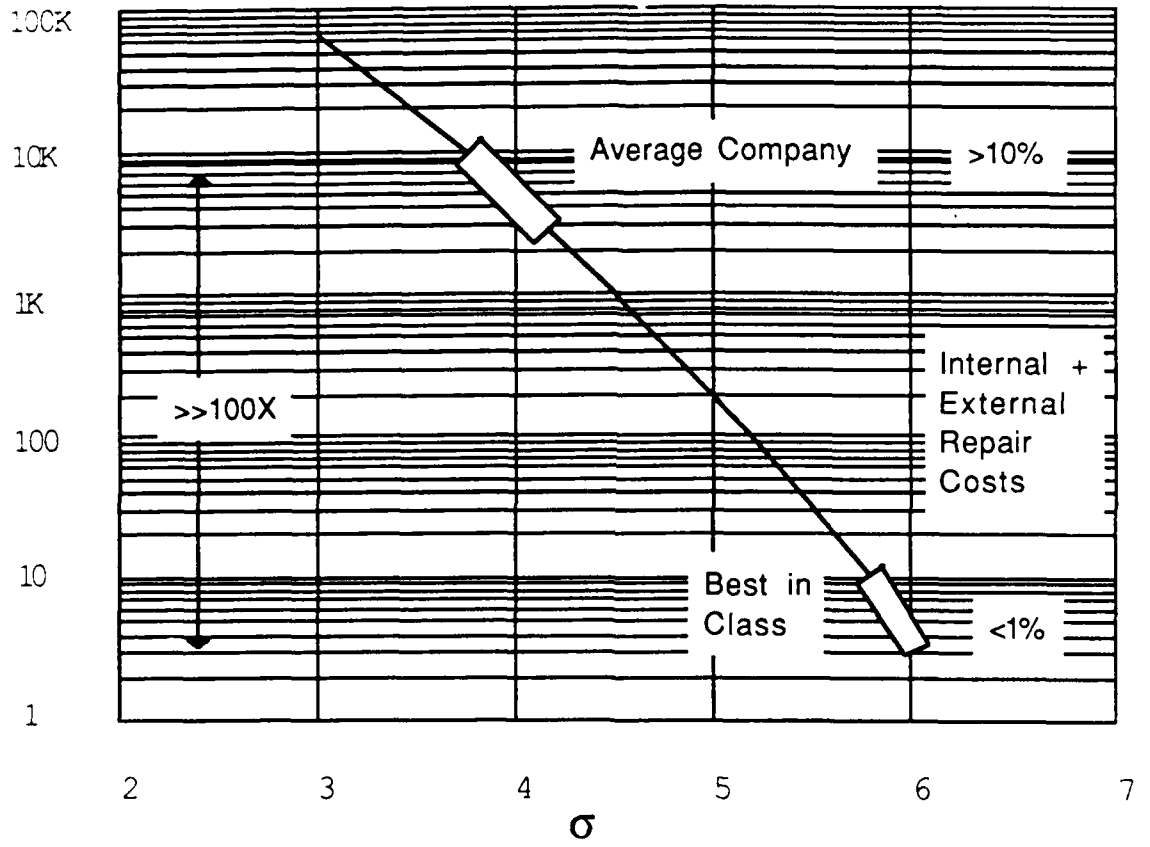


Figure 4. (Courtesy of Motorola Company.[5]). The rectangles show where the data points usually fall for "best in class" and "average" companies. Best in class usually have internal plus external repair costs 100 times lower than average companies.

The vertical scale in figure 4 represents the error rate, measured in parts per million. The horizontal scale represents the ratio of the tolerance limits to the number of standard deviations of the process (process capability). A value of "Six Sigma" (from which the title of the paper is taken) represents a process capable of error rates approaching one per million operations.

[5] "The Six Sigma Thrust", available from Motorola Company,

The important finding of the Motorola Company is this: When they surveyed good companies and compared their performance to the best in class, they discovered there was a quantum jump in performance. **Good companies generally have error rates measured in parts per thousand. In companies rated "best in class" the error rates are measured in parts per million.**

Their findings agree with a previous independent report by Garvin of Harvard University.[6] Garvin compared the performance of several air conditioning manufacturers in Japan and in the USA. He, too, found that there was a difference in error rates in the two sets of factories. In Japan the error rates were 500 times fewer. In his report, however, he did not attribute the difference to management.

Many people have come to believe that the lower error rates in Japan were "cultural", that is, derive from the Japanese general culture. However, Motorola's experience, achieving the same low error rates with American workers denies this myth.

Motorola's conclusions, covering many different kinds of industrial operations, may be summarized as follows:

If you hire the best people,
Give them the best equipment,
and
Provide them with a good reward structure,
They will produce at an error rate measured in parts per thousand.

To reach an error rate measured in parts per million,
requires something more.

IT REQUIRES TOTAL QUALITY MANAGEMENT.

The astonishing feature of the Motorola charts is that there are no companies with error rates between the "best in class" and the "good competitors".

What these diagrams tell us is that conventional approaches to management have reached a limit. Conventional approaches to management cannot achieve error rates of less than 0.1%. Something else is required.

[6] Garvin, David A., "Quality on the Line", Harvard Business Review, Sept-Oct, 1983, pp 64-65

IT'S A NEW ERA

We are in a new era, characterized by several factors, many of which have changed dramatically over the last 25 years. These are:

- Global Marketplace
- Instant, Worldwide communication
- Resource depletion
- New competitors in developing countries
- Advancing technologies
- Population explosion
- Shared environmental decay
- Political instability

Our enterprises now are required to meet ever changing demands. Speed of response, accuracy of response, and the ability to do things right the first time are essential for survival. By adopting a new way to manage, many companies are learning how to get back into the competition.

WHAT'S NEW ABOUT TQM?

Total Quality Management (TQM) may be likened to a three legged stool. If any one of the three legs is absent, the stool cannot function.

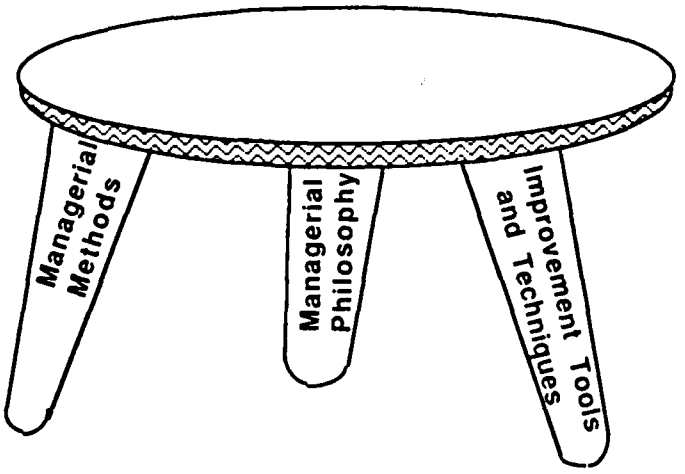


Figure 5. TQM is similar to a three legged stool.

THE THREE SUPPORTING ELEMENTS OF TQM

1. PHILOSOPHY

The new way to manage depends upon a philosophy of management different from that normally taught in schools of management. It begins with a reconsideration of the justification for the existence of the firm and a re-examination of its relationship to its stakeholders--not just shareholders. The new philosophy recognizes that the changing demands of the marketplace require the harnessing of the intelligence of all employees and that continuous improvement is a requirement for survival.

2. TOOLS AND TECHNIQUES

TQM introduces new methods to diagnose the performance of an enterprise and improve it. These new methods include new techniques for leading teams engaged in improvement, new methods to gather data and analyze the data and new approaches to the deployment of policy and distributed decision making.

3. NEW APPROACHES TO GOVERNANCE, ORGANIZATION AND DECISION MAKING

The new way to manage requires a redistribution of power, the empowerment of lower level employees and the building of an entirely new relationship between those who manage and those who conduct operations.

A DIFFERENT PHILOSOPHY

People are so used to doing what they do that a re-examination seems to them unnecessary. Often the chief executive does not realize that the philosophy by which the enterprise is managed is important. A measure of leadership is the ability to articulate a coherent philosophy and make it meaningful to those who are invited to follow.

To be useful, a philosophy should answer the questions: "What is the purpose of the enterprise? What are the long term goals and objectives of the enterprise? What kind of an enterprise do we want to be?" In the past, too many company leaders have said that the purpose of the enterprise was to make money. This will not suffice. People need a better guide to action. A statement of purpose for the company should addresses at least the following issues:

QUESTIONS A GOAL STATEMENT SHOULD ANSWER

A Purpose of the enterprise
B Relation between manager and work-force
C Organizing principle
D Constant improvement
E Relation to customers
F Relation to suppliers
G Obligations to the public

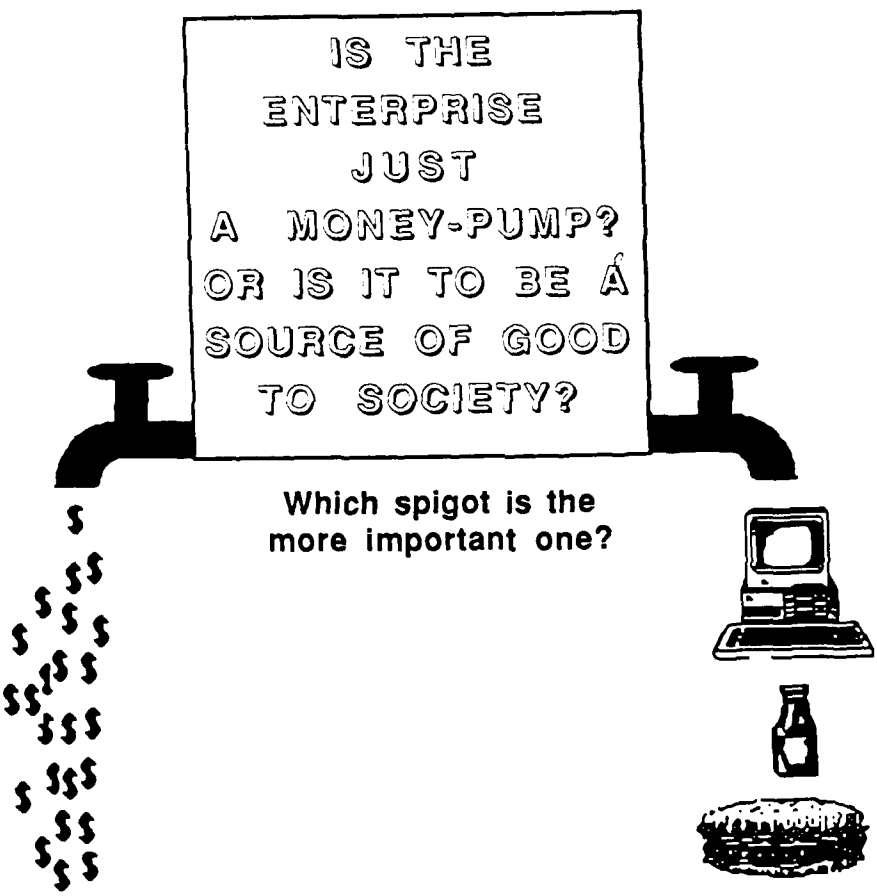


Figure 6. Every enterprise has two spigots. From one there flow goods and services From the other, tokens with which to buy goods and services. Which spigot does the management believe is the more important of the two?

TQM and Engineering

Closely allied to the question of purpose is the question of the relationship between the management and the work-force. Many managers seem to function on a simple principle, handed down to us since biblical times:

MANAGEMENT IS A PRIVILEGE
LABOR IS A COMMODITY

This philosophy cannot work in the era of the knowledge worker. Those who manage according to TQM have learned a different paradigm:

MANAGEMENT AND LABOR ARE IN THE SAME BOAT
THEY SHARE THE SAME FATE.

IF THEY EXPECT TO SURVIVE,
THEY MUST ROW TOGETHER, IN THE SAME DIRECTION,

In engineering, I have observed a spectrum of behavior patterns among managers. I suppose a similar spectrum can be observed in all professions.

SPECTRUM OF MANAGERIAL APPROACHES IN ENGINEERING

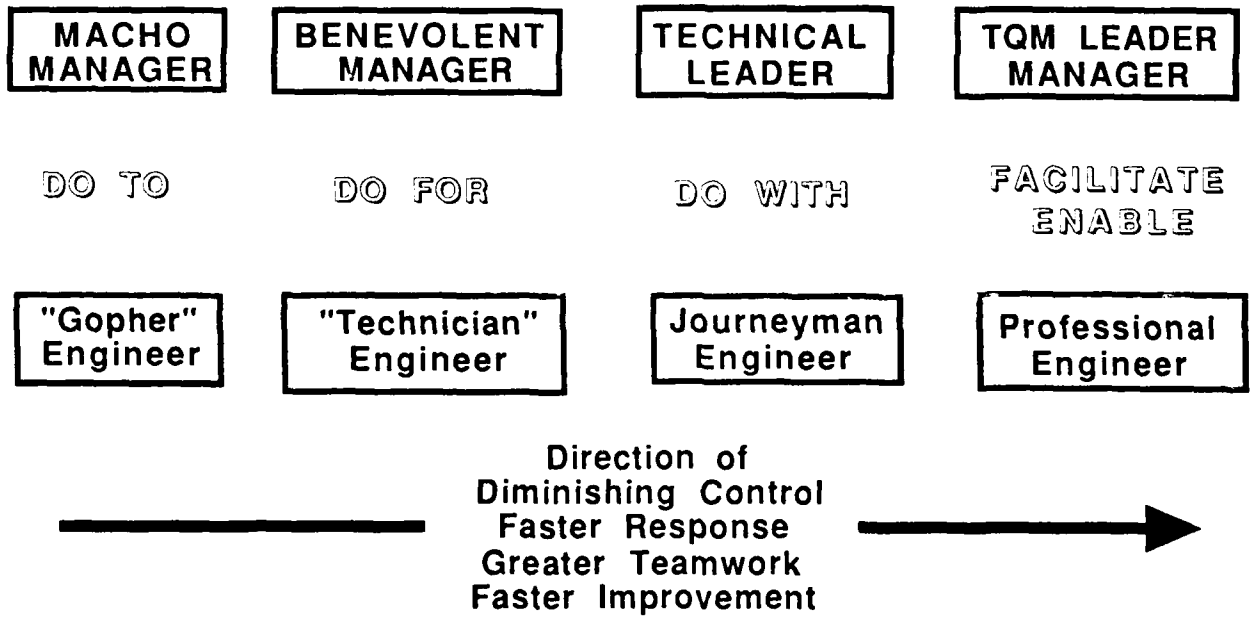


Figure 7. Managers need to shift their position on the "Control Spectrum".

TQM and Engineering

A manager who follows TQM understands:

THE MANAGER'S JOB HAS BEEN REDEFINED

THE PEOPLE WORK IN A SYSTEM.
THE JOB OF THE MANAGER IS TO WORK
ON THE SYSTEM
TO IMPROVE IT, CONSTANTLY,
WITH THEIR HELP.

This redefinition implies a different paradigm for management.

TQM managers understand that Quality Management requires a different organizing principle. Old style management requires people to take orders from above and to follow the dictum proposed by Frederick Winslow Taylor, many years ago:

> *"Every day, year in, year out, each man should ask himself, over and over again, two questions. First, 'What is the name of the man that I am now working for?' and, having answered this definitely, then, 'What does this man want me to do, right now?'"*
>
> *"Not, 'What ought I to do in the interests of the company that I am working for'. Not, 'What did I agree to do when I came here,' but plainly and simply, 'What does this man want me to do?'"*

If each worker is not to simply obey orders from above, how does each employee decide what to do? The answer is the "customer first" principle.

EVERYONE HAS A CUSTOMER
THE NEXT PERSON IN LINE IS YOUR CUSTOMER.

EACH PERSON SHOULD STRIVE TO PLEASE THE CUSTOMER
BY PROVIDING THE HIGHEST POSSIBLE QUALITY PRODUCT.

ONLY THE CUSTOMER CAN DEFINE QUALITY.

The difference between what Taylor proposed and what is here described is that instead of looking to the hierarchy of management for direct orders, each person works to provide the best possible result for the customer. Information about customer requirements flows upstream, opposite to the direction of the flow of goods and services.

Note that the customer defines quality, not features. This is an important distinction.

Features are what you put into your product or service to attract a particular market.

Quality has to do with providing these features in such a way that they are pleasing to the customer.

QUALITY IS A UNIFYING THEME

Every enterprise is staffed with people with different needs and concerns. For the young man, newly hired, his concern may well be with getting new clothes, meeting new girlfriends and doing those things which belong to his stage of life. For the forty-five year old machinist, the biggest concern may be to have a stable job, with adequate pay and promise of a good retirement, the ability to pay for a college education for his son and meet the mortgage requirements. For an engineer it may be a need to be involved in advanced technology and to sharpen professional skills so as to retain a good market value. For a top executive, conscious of the flows of money into and out of the enterprise, and that the differences between the two streams is very small and can easily go negative, the major concern is that the company remain profitable and show good performance in the eyes of the shareholders.

Every person has a different agenda. Everyone has different needs. Under TQM these needs can be satisfied. The concept of a company in which everyone works to make life better for the next person in line and every manager strives to remove the barriers is totally different than the company in which everyone looks up the chain of command, asking, *"What do you want me to do?"*

This paradigm shift pervades every aspect of an enterprise.

SUPPLIERS AS PARTNERS

Another difference between this way to manage and the old fashioned way is in the relationship to the suppliers. Just as the management and workers need to understand that they are in the same boat and will share the same fate, so, too, is it necessary to develop a different relationship to suppliers. Deming sums this notion up in one of his famous "14 Points for Managers" when he says:

> **"End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust."**[7]

[7] W. Edwards Deming, Out of the Crisis, pg. 23. CAES MIT Cambridge, MA (1982)

This is but a small sampling of the many points of difference between the old style and the new way to manage. It suffices to give the flavor the the philosophy.

PROBLEM SOLVING TOOLS AND TECHNIQUES

A philosophy is important, of course, but having a different philosophy is of no avail if the people do not know how to make it work.

The most important tool for managers to learn is called "Deployment Flow Charting". The redefinition of the managers' job requires that a manager be able to improve a system and involve the people who work in the system as partners in the improvement process. Deployment flow charting is a simple way to show not only how the system operates but also how the people interact with the system and one another.

"Deployment Flow Charts"[8] differ from the conventional flow charting of computer programs or chemical processes in an important way. Consider, for example, the conventional flow chart for the processing of an order as shown in the following figure.

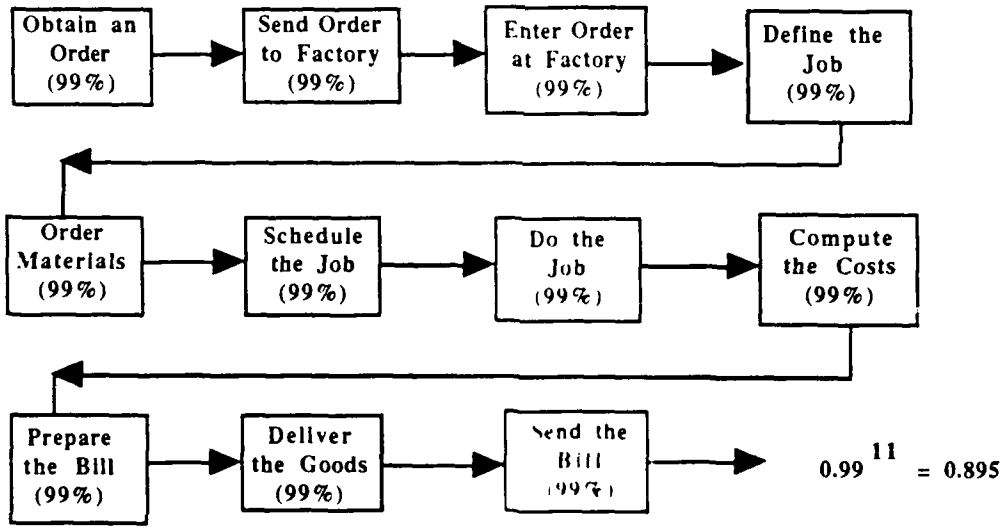


Figure 8. A conventional flow chart. Even if each step in the process has an error rate of only 1%, approximately 10.5% of the orders will require rework.

The next figure shows the same process when depicted on a deployment flow chart. The boxes at the top of the chart provide a coordinate system showing who is responsible for a process step. Horizontal transfers describe customer-supplier relations. Time flows, more or less, downwards in the chart.

[8] Videotapes giving detailed instructions on the preparation of deployment flow charts are available from QUALITY AND PRODUCTIVITY, INC., 1081 Westwood Blvd., Suite 214, Los Angeles 24, CA.

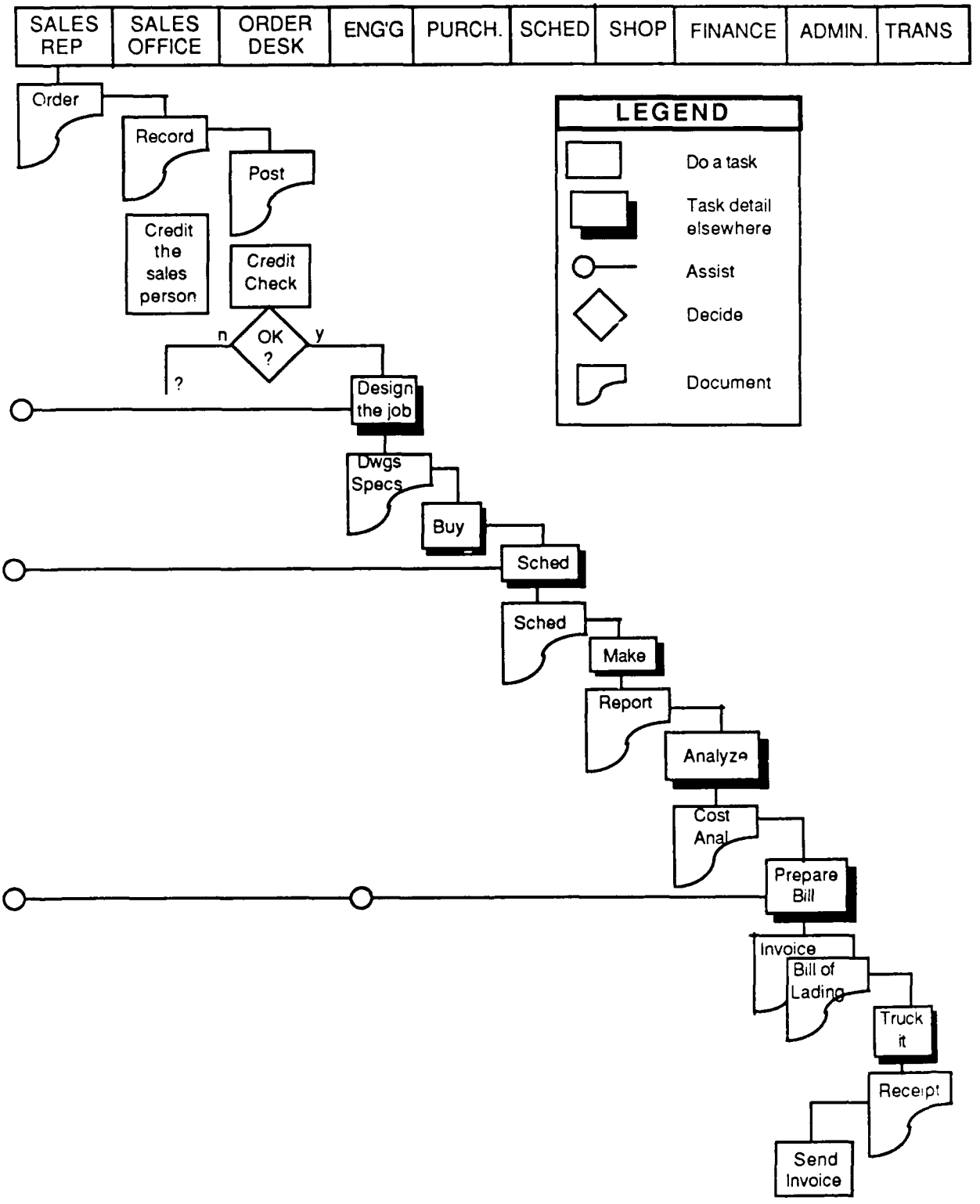


Figure 9. Deployment flow chart for process depicted in figure 8.

When a deployment flow chart has been prepared for any process, the manager should confer with the people who work in the process to find out if they actually are following the process as diagramed. Most likely they are not. For example, there may be cases in which the shop cannot make what is requested and goes directly to the sales force for advice. Purchasing may not be able to get the materials specified and may make unauthorized substitutions because engineering personnel are now involved in another job or the person who did the original design is no longer with the company. The point is, these flow charts enable a manager to diagnose a process to understand how people interact with the process and with one another.

Flow charts are not limited to making of hardware. Figure 10 is a deployment flow chart depicting how the top management can provide constancy of purpose to the enterprise and yet change course as conditions require.

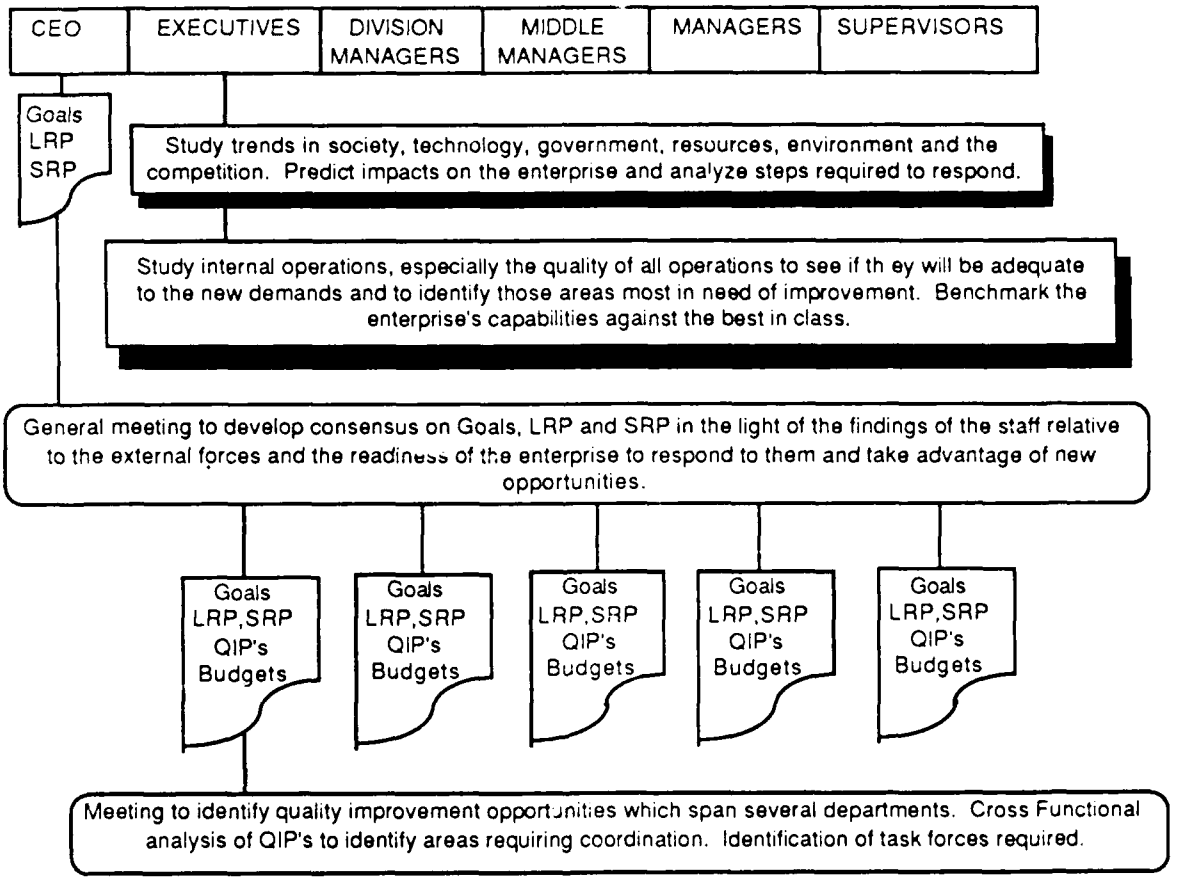


Figure 10. A Deployment Flow Chart depicting the activities and responsibilities of management in setting the annual goals and objectives for the enterprise.

By using the "layering" technique, it is possible for many people to develop flow charts for one process at the same time. For example, the manager of marketing can make a chart at the executive level while people at a sales office can prepare subsidiary charts, each thereby gaining a better understanding of how the work gets done.[9]

STATISTICAL REASONING

TQM differs greatly from conventional management in the way statistical reasoning is used. Under TQM everyone is taught elementary methods of statistics. This is one area in which the Japanese seem to have an advantage over all other societies. For the last 25 years they have included statistical reasoning in their school curricula, starting in the elementary schools. They celebrate "Statistics Day" and fifth grade children compete to show clever ways to use statistics in their daily life. The CEO of Motorola has said that superior worker education gives Japan a big advantage. When it is time to teach a statistical method to an employee, Motorola reckons it has to spend $200. In Japan they spend 47¢...they just give a little booklet to an employee, who then reads and understands it. The list of simple problem solving techniques is not long, but these simple tools are powerful. The difficulty for engineers, of course, is that if a technique is not complicated they are apt to think it is not powerful.

SEVEN SIMPLE TOOLS[10]

1. **Data Collection using Check Sheets**
2. **Pareto Analysis for setting priorities**
3. **Cause and Effect Diagrams**
4. **Histograms**
5. **Scatter Diagrams**
6. **Control Charts.**
7. **Telling the QC Story--a method for problem formulation and reporting.**

[9] For an example of such layering, see Quality First, Creating the Quality Service Company", NSPE Publication 1459, Pg. 111. [National Society of Professional Engineers, 1420 King Street, Alexandria, VA, 22314. Fax: 1 703 836 4875, Phone: 1 703 684 2882

[10] These tools are actually the chapter headings in a small book used by the Japanese Association of Overseas Technical Scholars to teach management to people in developing countries. It is part of the Japanese strategy to have managerial talent available as they move low-tech production off-shore in joint ventures, while retaining in Japan the manufacture of high-value added products to raise the living standard of the people. [Hitoshi Kume, Statistical Methods for Quality Improvement, AOTS, 30-1, Senju-azuma, 1-chome, Adachi-ku, Tokyo, 120]

In addition to these elementary tools, which should be known to every person from the floor sweeper[11] to the President of the company, there are more advanced methods which are of particular interest to engineers.

I have detected that engineers, in general, do not like to learn design of experiments. It seems to me that there are sound reasons for this. First of all, engineers learn to think deterministically. They are usually taught in rather sterile surroundings in which all variables are controlled and they verify that what they are taught about theory can actually be used to make predictions. From this experience they consider that all deviations from theory are examples of error. When they get into real life situations, in which few things are properly controlled or controllable, they first think it is all unfair and then they develop ways to choose variables so they are "safe". A few engineers learn to grow beyond this stage and actually begin to use statistical methods. But when they do, most of them feel they have left "real engineering" behind. I have heard otherwise competent engineers say, "If you have to use statistics to prove something, you probably don't have a good explanation."

I have written and lectured to statisticians to say that a great deal of the fault for the poor communications lies with them and that to bridge the gulf between statisticians and engineers, it will be necessary for both sides to make a good effort.

As far as I am concerned, the best book on statistical methods for engineers was written 62 years ago. The textbooks seem to have gone downhill from then![12] Of course there have been important developments in statistics since then, but the style and spirit of Fry's book seem to have been lost.

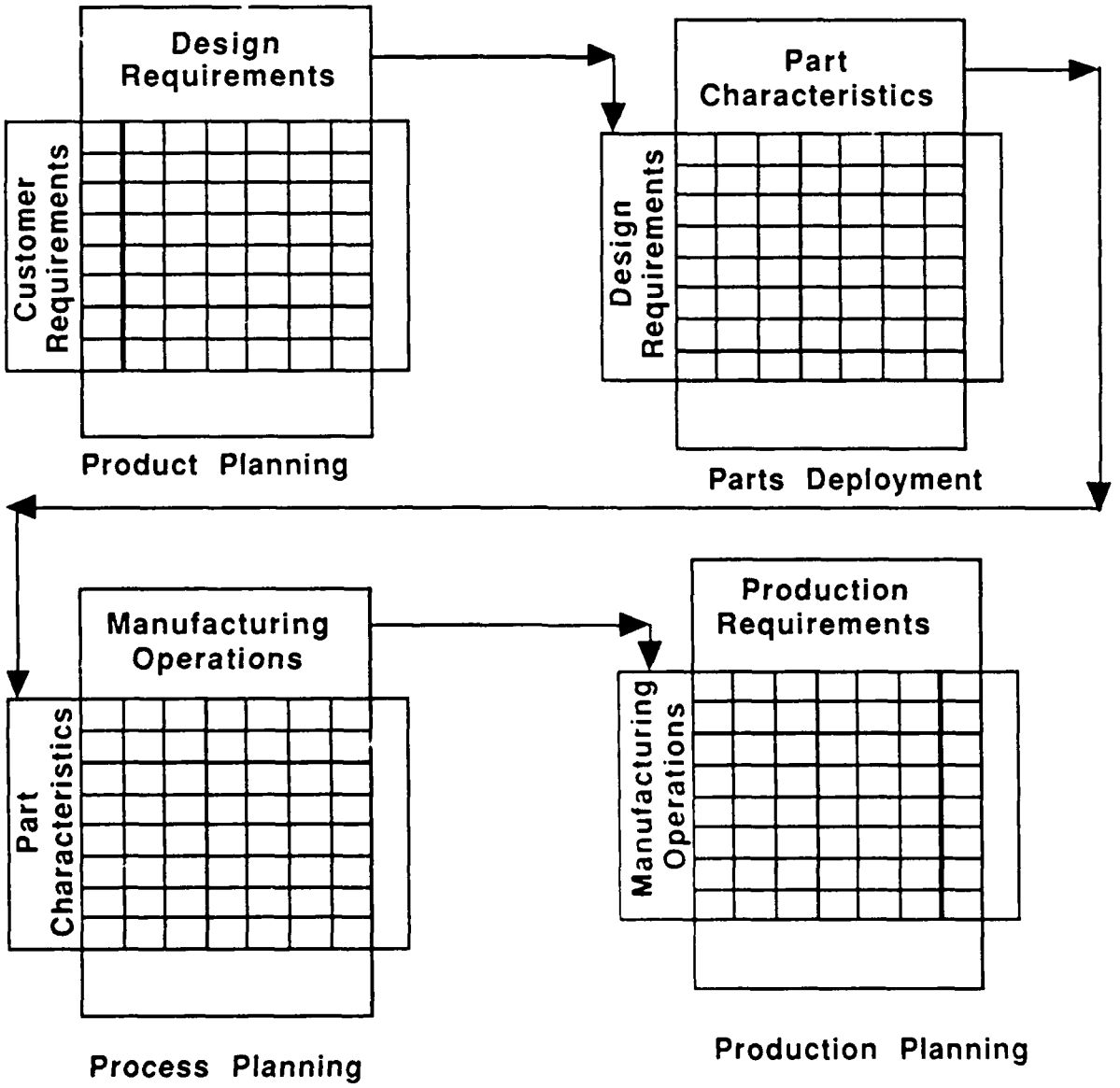
[11] A useful technique for those who clean the floors to use is to weigh and categorize the materials swept up each evening and prepare run charts which may be used to locate the sources of dirt and reduce them. Elementary data gathering and plotting techniques can be used, even by those who are illiterate.

[12] Fry, Thornton C. Probability and its Engineering Uses, D. Van Nostrand Company, Princeton, NJ, Twelfth Printing, 1928 (Dr. Fry was a member of the Technical Staff of the Bell Telephone Laboratories, a compatriot of Dr. Shewhart and a very practical engineer.)

QUALITY FUNCTION DEPLOYMENT

Quality function deployment is a tool for use by project managers to provide a more systematic way to deal with the complexity depicted in figure 3.

The American Supplier Institute has proposed a "Four Phase Approach" which presents the various relationships in matrix form as indicated in figure 11.



"The Customer Driven Company", William E. Eureka and Nancy E. Ryan
American Supplier Institute.

Figure 11. The matrices of QFD

Figure 11 replaces the many steps in figure 3 with a family of four matrices. Bob King has identified 30 different matrices which could be used in a similar manner.[13] Each matrix arrays the requirements from the previous step against the actions in the next step.

The following example was provided by Don Makie of Masland Industries and demonstrates how to construct a QFD matrix.

	Yarn Type	Yarn Size	Backing Weight	Yarn Twist	Backing Type	Back Coating										
Purchasing																
Cost																
Lead Time																
Delivery																
Dealers/Consumers																
Stain Resistant																
Durability																
Texture																

Figure 12 Starting to build a QFD "house of quality". (Example courtesy of Don Makie Masland Industries, manufacturer of automobile interior carpeting)

In the next diagram the various interactions between choices and requirements are displayed.

[13] Bob King, Better Designs in Half the Time, publication of GOAL , Lawrence, Massachusetts.

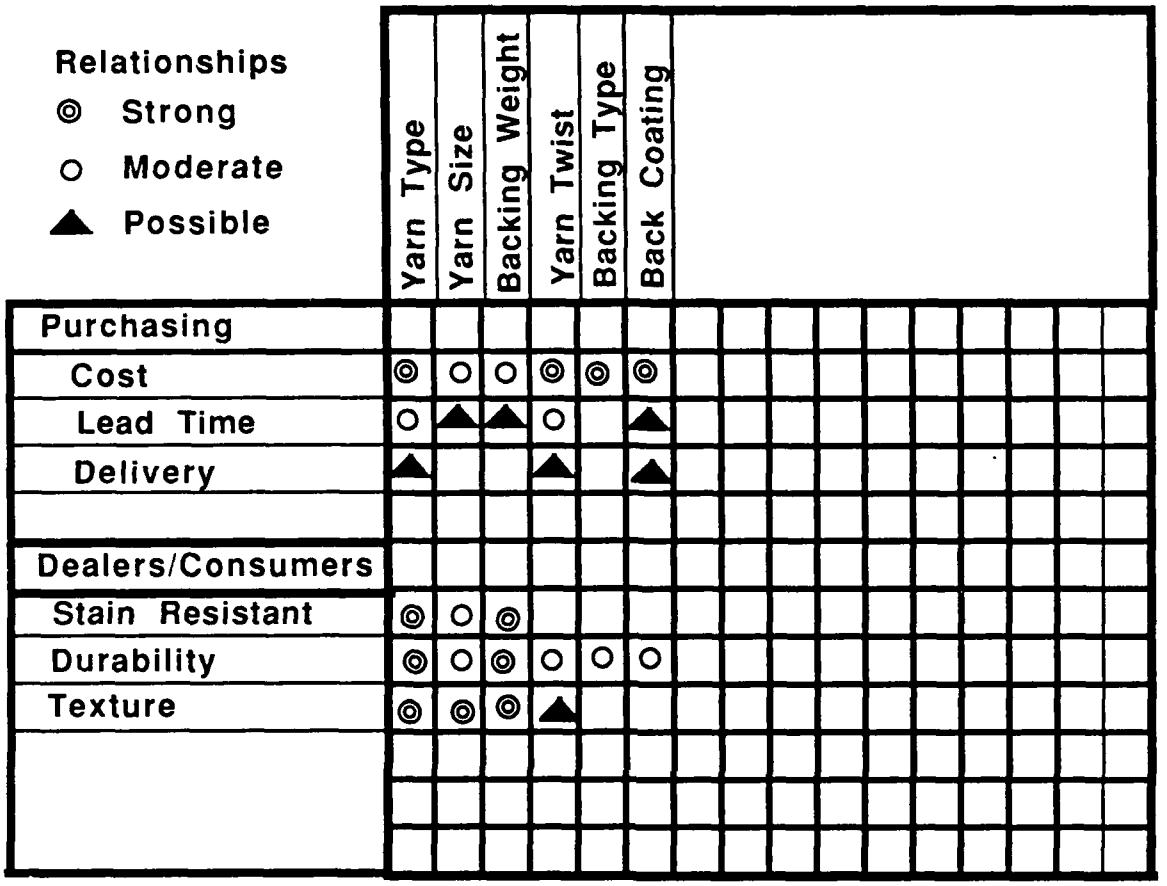


Figure 13. Add value judgments to the house of quality.

The entries in the matrices allow the project manager and the engineer working at detailed design to discuss the various tradeoffs which are inherent in the design process.

When a particular choice is made to satisfy one particular requirement, it often happens that this choice is in conflict with a choice made to satisfy another requirement. This conflict in potential actions is displayed in the "roof of conflict" which is shown in the next figure.

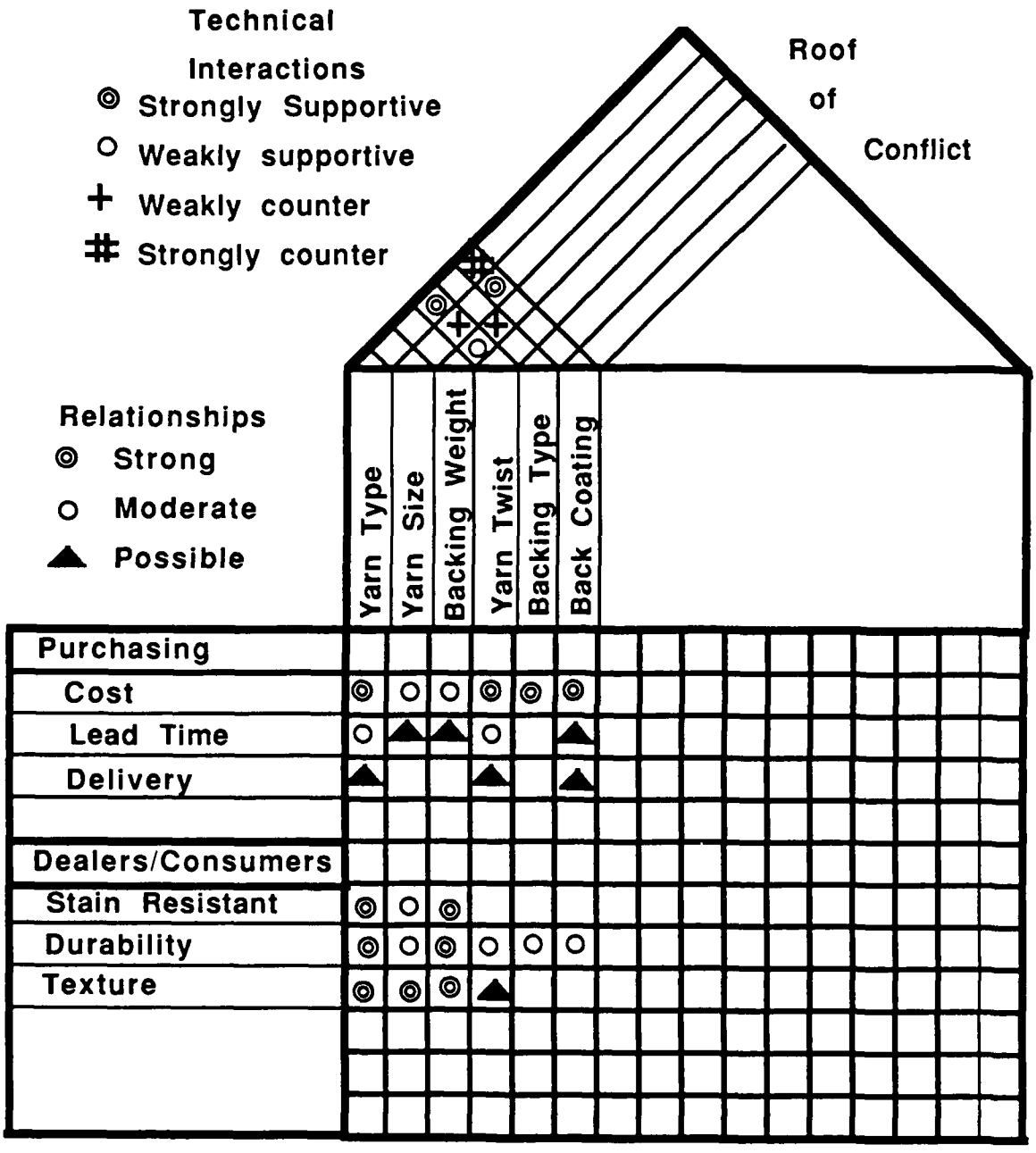


Figure 14. The roof of conflict displays the conflicts which occur when various choices are made.

These charts can easily become very complex. On the other hand, as anyone who has ever written a computer program understands that even the most simple of human activities, when written out in detail, turns out to be incredibly complex. Design remains an iterative decision making activity, even with these tools, but the iterations

can be handled by groups of people much more efficiently if they are displayed in matrices such as are used in QFD.

The examples given here are not complete. In addition to portraying the customer requirements arrayed against the actions taken, QFD matrices are often prepared with extra panels on the side and bottom to indicate the degree to which competitors meet the customer desires.

QFD enables us to trace how well we are heeding the "voice of the customer". The process begins with the development of the customer requirements, expressed in customer terms. The first matrix enables us to see what the designer is doing in response to each customer requirement, and which areas of the design present a difficulty. After the design requirements have been settled and the design checked for consistency with requirements, the design requirements become the inputs to the second analysis, which considers part characteristics. (Translation of system requirements to component requirements). The next matrix relates the part characteristics to the manufacturing operations, i.e., to process planning, and so on through all the steps required to produce the product.

APPLICATIONS OF QFD BEYOND MANUFACTURING

The literature on quality is rich in examples taken from manufacturing. However, the methods are applicable far beyond the manufacturing floor, as Shewhart knew 60 years ago.

The following figure shows a **quality characteristics evolution diagram** for a research and development laboratory. Starting at the left the two main features of the output of the development process are shown. The second level of detail elaborates the requirements as given in the first level. The third level of detail then elaborates on the second level.

The tertiary level of detail is used as the input to the first QFD matrix which displays the activities undertaken by the management of the laboratory to meet the customer requirements. As can be seen from the matrix, some of the rows are not covered, which is an indication that the management does not have a process to see that the requirements will be met.

A similar QFD matrix can be developed for every department in an enterprise. Each department has a set of customers and it is the responsibility of the management of the department to understand the needs of its customers. When these have been sufficiently elaborated using a Quality Characteristics Evolution Diagram, the management can then examine its own practices and procedures to see if its managerial activities are consistent with the requirements of its customers.

This approach, of course, will at first be considered unacceptable to the manager of the R&D laboratory who, in general, believes that his elite corps of research and development engineers does not have customers but rather is surrounded by people who should be grateful for the magnificent gifts which flow from R&D!

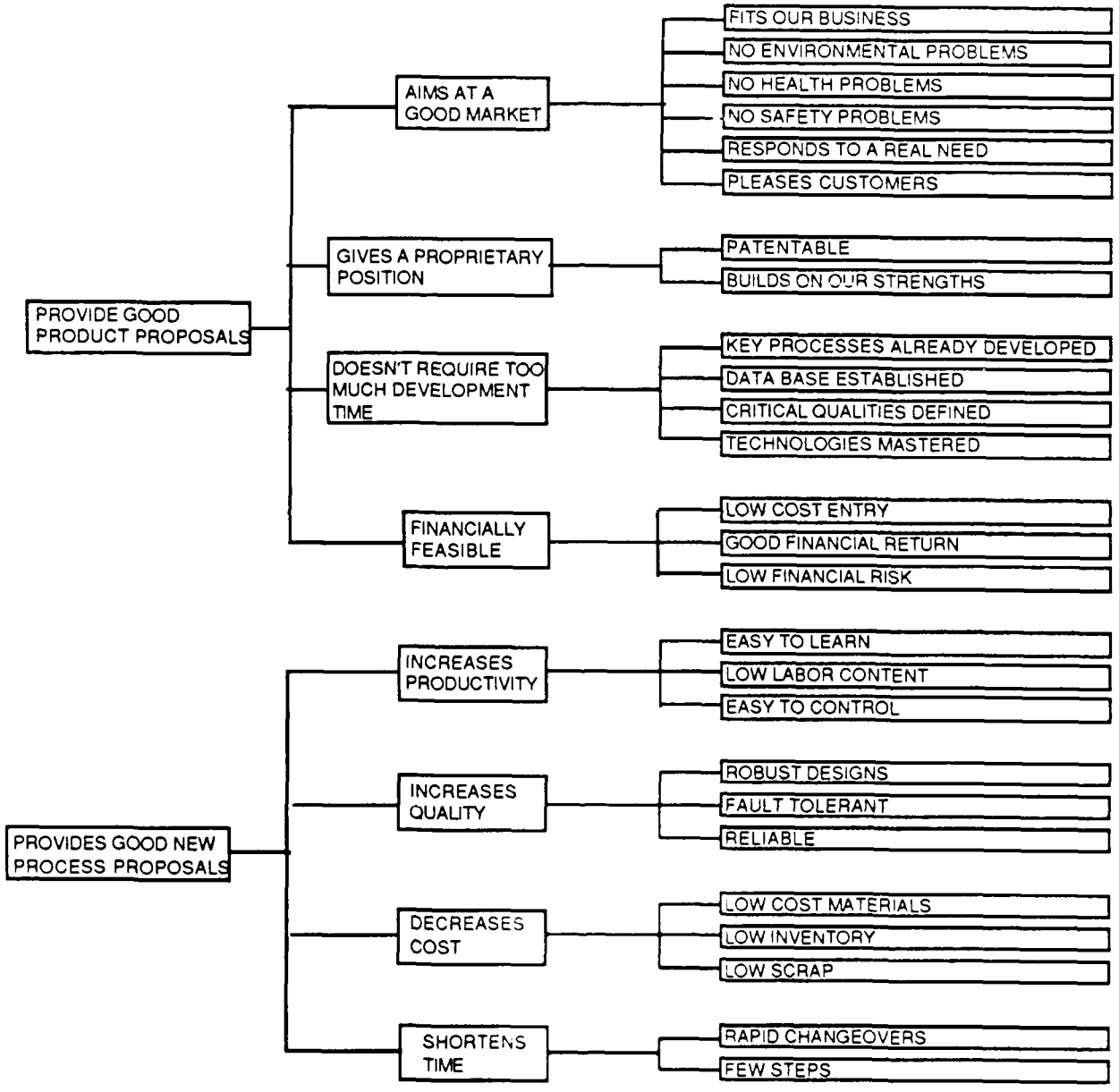


Figure 15. A quality characteristics evolution diagram for a Research and Development Laboratory.

◎ Covers Completely

○ Bears Upon

	Joint Quarterly Report With Marketing	Research Lab Quarterly Review of EPA Regulations	Research Lab Quarterly Review of OSHA Regulations	Research Lab Quarterly Review of Patents	Research Lab Standard Process Release Procedure	Joint Project Review with Engineering	Joint Project Review With Finance
FITS OUR BUSINESS	◎						
NO ENVIRONMENTAL PROBLEMS		◎					
NO HEALTH PROBLEMS			◎				
NO SAFETY PROBLEMS			◎				
RESPONDS TO A REAL NEED	◎						
PLEASES CUSTOMERS	◎						
PATENTABLE				◎			
BUILDS ON OUR STRENGTHS							
KEY PROCESSES ALREADY DEVELOPED					◎	◎	
DATA BASE ESTABLISHED					◎	◎	
CRITICAL QUALITIES DEFINED					◎	◎	
TECHNOLOGIES MASTERED					◎	◎	
LOW COST ENTRY						○	◎
GOOD FINANCIAL RETURN	○						◎
LOW FINANCIAL RISK	○						◎
EASY TO LEARN						○	
LOW LABOR CONTENT					○	○	
EASY TO CONTROL						○	
ROBUST DESIGNS						○	
FAULT TOLERANT						○	
RELIABLE						○	
LOW COST MATERIALS						○	
LOW INVENTORY						○	
LOW SCRAP							
RAPID CHANGEOVERS							
FEW STEPS					○	○	

Figure 16. The Quality Function Deployment matrix for an R&D Laboratory. The left column of the matrix is the tertiary description taken from the Quality Characteristics Evolution Diagram in the previous figure.

TOOLS FOR DEALING WITH THE VIRUS OF VARIABILITY

TQM requires managers to adopt a new paradigm, a new way to think about the world. The shift in perspective is so radical that very few managers are able to do it in a short span of time. History tells us that this is never an easy transition. There is an interesting analogy with the changed paradigm which occurred in medicine when the germ theory of disease was introduced.

The germ theory of disease began in 1867 when Louis Pasteur, working in the south of France, discovered the existence of two kinds of bacilli. Today we call them "germs". These were mysterious creatures. They were invisible. They were carried in the air and were all about us. They could infect living systems and produce profound changes. Yet they could not be detected except with special techniques. Nothing like them had been found before.

Within a year Lister in England had discovered that carbolic acid was an antiseptic. When he introduced it into surgery he was able to prevent infections. Prior to this time it was a foregone conclusion that surgery would be followed by infection.

Before the germ theory of disease, doctor's had explanations for what they saw. They believed, for example, that certain diseases could be caused by bad air, so they called it "mal-aria". Sometimes patients died. Sometimes they lived. Always there was an explanation.

Today, sometimes businesses succeed and sometimes they die. Always, our managers have an explanation.

When the Bell System decided, in 1926 or thereabouts, that they would put long distance lines underground, they needed to have repeater amplifiers which would have long and predictable lives. The analogy I am about to draw with the germ theory of disease is a bit stretched here, because they wanted to have healthy amplifiers so they could bury them. If the amplifiers died, they would have to be dug up. But no matter. The analogy still holds.

Walter Shewhart, working in the Bell Labs, studied what it took to produce reliable repeater amplifiers. In the process he discovered the importance of what I like to call the "virus of variability".

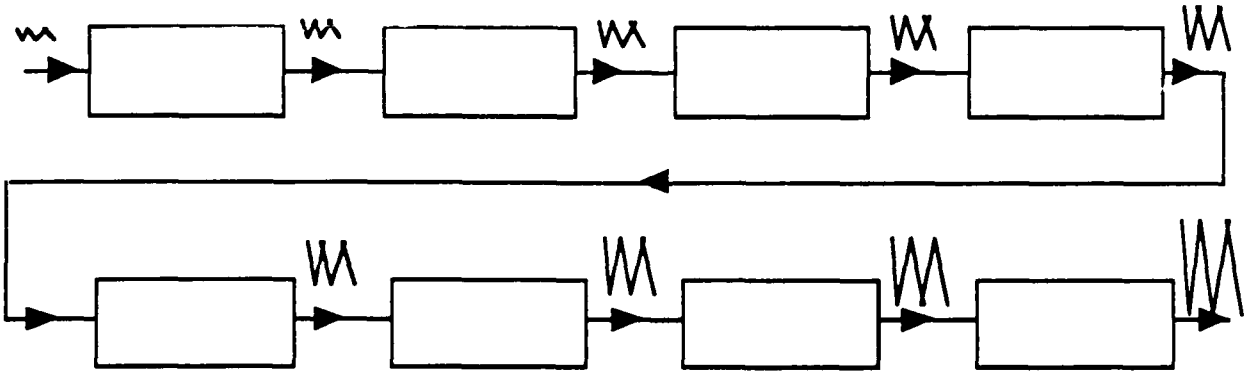


Figure 17. The variability of one process can infect all succeeding processes.

Although Shewhart's work was initially concerned with manufacturing processes, in which it was relatively easy to see and understand the effects of variability, it soon became apparent to him and his co-workers, that the concepts were applicable to all processes, including the processes of managing.

AN EXAMPLE FROM AN ASSEMBLY PROCESS

The following table shows the data for eight workers over a period of 12 weeks.

FLAWS PER WORKER/WEEK

	WEEK												
	1	2	3	4	5	6	7	8	9	10	11	12	sum
Mary	0	0	0	0	0	0	0	0	0	0	0	0	0
Joe	0	0	0	0	0	0	0	0	0	0	0	0	0
Eva	1	0	0	2	0	0	3	0	0	1	0	0	7
Fred	0	0	0	1	0	0	2	0	0	0	0	0	3
Jim	0	0	0	0	0	0	0	0	0	0	0	0	0
Ed	0	0	0	0	0	2	0	0	0	0	0	0	2
Kate	0	0	0	0	0	0	0	0	0	0	0	0	0
Carl	0	0	0	1	0	0	0	0	0	0	0	0	1

Figure 18. Flaw production allocated to 8 workers doing essentially the same task over a period of 12 weeks.

I have shown the data in the above table to over 3000 people around the world and each time asked the same question I now put to you: "If you were the manager of the supervisor over these 8 people, what would you expect the supervisor to do?"

Generally the audience proposes a predictable set of responses.

"Fire Eva"

"Put Eva next to Mary so she can learn"

"Give Eva more training"

After these suggestions have been made, I tell the audience that the numbers in the table were, in fact, generated by the random number generator on my personal computer and assigned randomly to the workers. The process is infected with variability! If the managers do not understand the "germ theory of management", that

is, do not understand that a process can be infected with the virus of variability, they will not understand that they are now engaged in a fruitless search for a "cause" for Eva's performance. The variability in the process will affect the process of management. For example, maybe Eva will be sent to classes for special training. Maybe she will be censured and thereby caused emotional stress which will show up in some other process.

The important tools for dealing with the virus of variability come from the field of statistics. The important tools are simple, requiring only a few hours to learn. They include statistical process control, design of experiments, and many forms of graphical data analysis.

The biggest source of the virus of variability is often the front office where the management is unable to maintain a constant direction. This idea has been encapsulated in Deming's admonition to "maintain constancy of purpose".

ROBUST DESIGNS

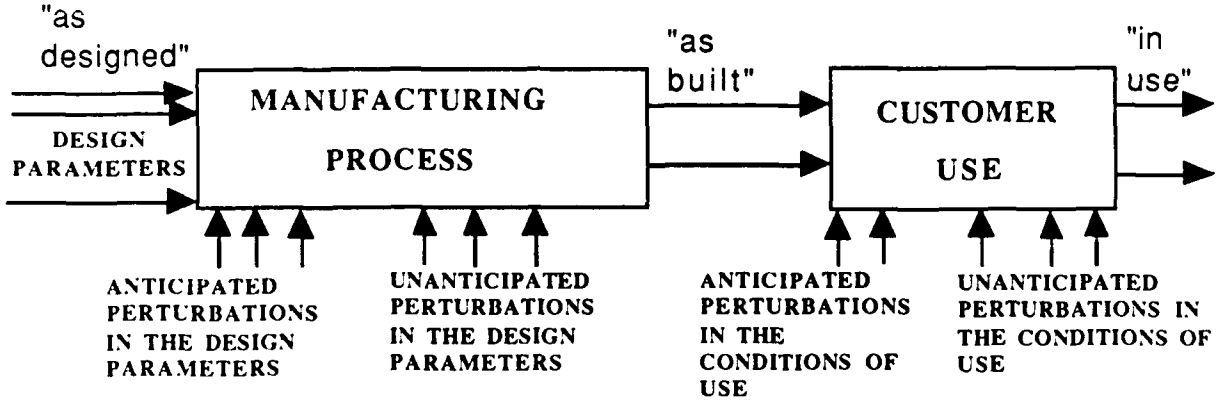


Figure 19. The role of uncertainty in a product development and use.

Dr. Genichi Taguchi has been very active in calling attention to the possibility of changing an engineering design to make it more robust against variation. (His approach is sometimes called the Taguchi Method[14]) The fundamental idea has been known to engineers for many years, but the connection to quality performance has not been properly appreciated until Dr. Taguchi made it his personal campaign. The basic idea can be understood quite simply. An engineering design is defined by a choice of parameters. When the design is undertaken, usually the engineer does not have complete knowledge of the process of manufacture, the materials which will be used and the tightness of control. When the product moves into use the engineer is even less likely to know the conditions of use. Customers often subject the equipment to unexpected usage. Environmental conditions may vary. What is even more disturbing to the engineer is that combinations of events may occur which will make the equipment unsatisfactory.

The conventional approach to this problem has been to set tolerance limits on devices. Unfortunately, the interpretation of a tolerance limit has been that anything which falls within the limits is as good as anything else inside the limits. In terms of decision analysis, it is as though the "loss function" were shaped like a " square well".

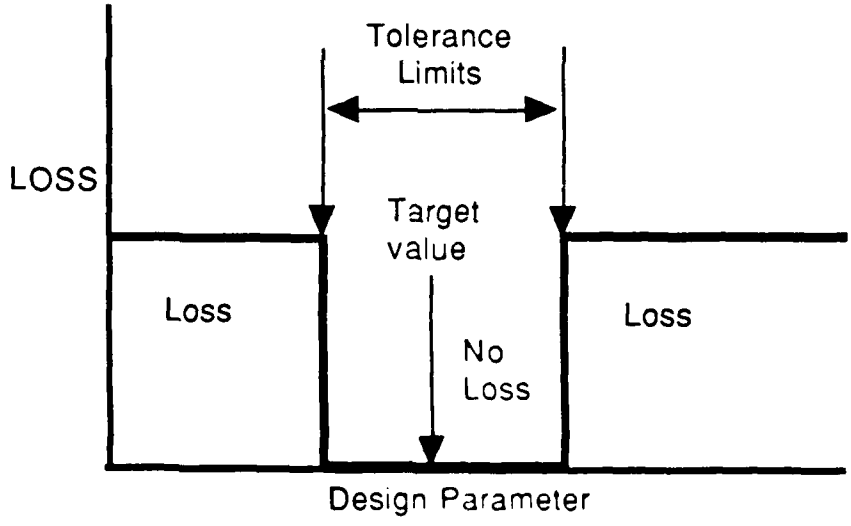


Figure 20. The square well loss function.

According to this way of thinking, any part which falls within the well is "good", and causes no loss, and any part which falls outside the well is "bad", and causes the same loss as any other bad part. The dividing line between the two is sharp.

[14] While I have great admiration for Dr. Taguchi's contributions to the theory of robust design, I believe that some of his methods are cumbersome and unnecessarily complicated. For a discussion and an example of a simpler alternative, see Tribus, M and Szonyi, G. "An Alternative View of the Taguchi Approach", Quality Progress, May 1969 pp 46-52. v22, N5

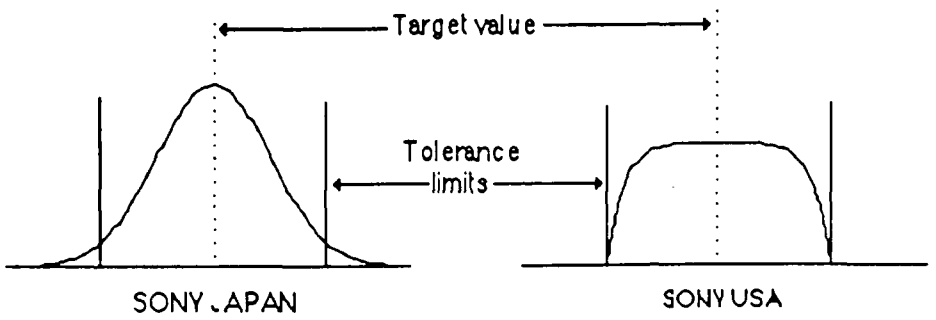


Figure 21. Comparison of distributions of color saturation values for television sets made in Sony Japan and Sony USA. Some of the Japanese sets lie outside the tolerance limits.

Figure 21 shows a famous comparison between Sony television sets built in the USA and in Japan. The design parameter in question is the saturation value of a color setting. For customer satisfaction, this parameter should lie between the tolerance limits shown in the figure. As can be seen from the figure, some of the Sony television sets built in Japan fall outside the tolerance limits and, therefore, are "bad" while all of the sets built in the USA are inside the tolerance limits and, therefore, are "good". Nevertheless, when questioned about their television sets, owners of the sets built in Japan were happier with their sets than those who owned sets made in the USA.

The question arises, therefore, why should the Sony sets be rated more favorably than the sets made in the USA if all the sets from the USA are within tolerances while some of the sets from Japan are outside the tolerance limits?

The answer to this apparent paradox lies in the difference between the "customer's loss function", shown in figure 23 and the "manufacturer's loss function" depicted in figure 20.

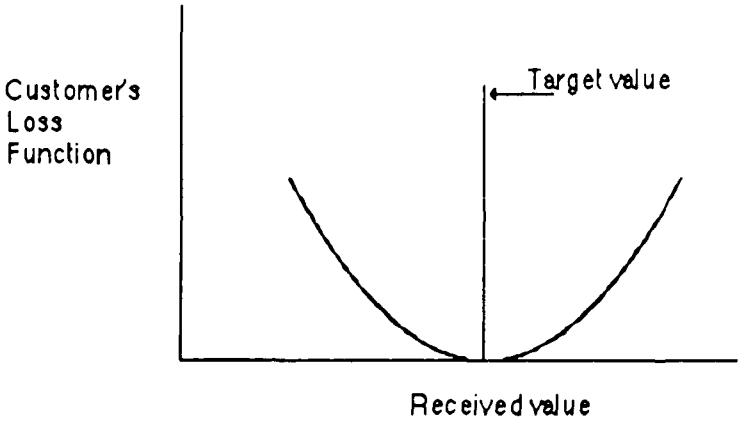


Figure 23. A "customer loss function".

According to figure 23, there is a "most desirable" setting, which we have designated as the target value. Any deviation from this value represents a loss to the customer. If now we multiply the loss function in figure 23 by the distribution function in figure 22, the area under the curve represents the "expected loss" of the customer. Figure 24 shows the result of this multiplication.

Figure 21. The result of multiplying the customer's loss function by the distribution of design parameters. The area under the curve on the left is significantly less than the area on the right.

Heeding the voice of the customer means using the customer's loss function, not the manufacturer's loss function when deciding what to do.

The design technique to achieve this lower expectation loss involves trading off the value of achieving a target value and achieving a lower variance.

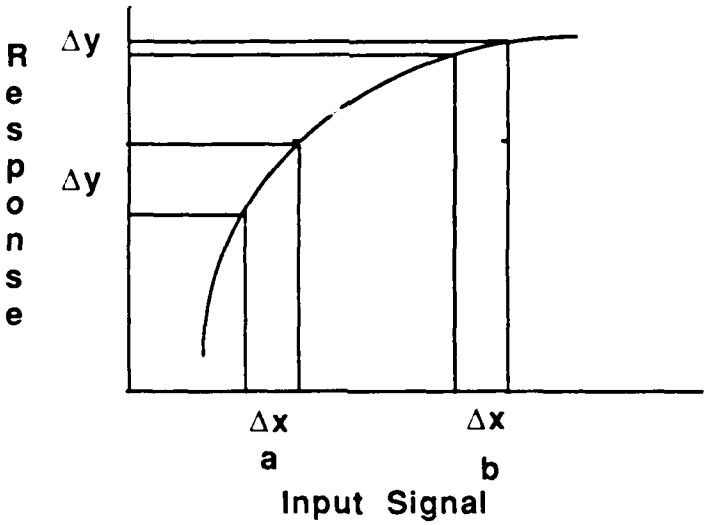


Figure 25. By shifting the design parameter, x, to the right from "a" to "b", even though the variation, Δx, is unchanged, the variation in the output, Δy, is diminished.

This approach has been known in engineering as "sensitivity analysis" but has not been dealt with systematically as a routine matter of engineering.

A DIFFERENT STYLE OF MANAGEMENT-- A DIFFERENT DIVISION OF RESPONSIBILITY

In the following figure we show a sensible division of time at the different levels in an enterprise. Note that everyone is involved in improvement of ongoing processes. The fraction of time involved in improvement increases as the level of responsibility increases.

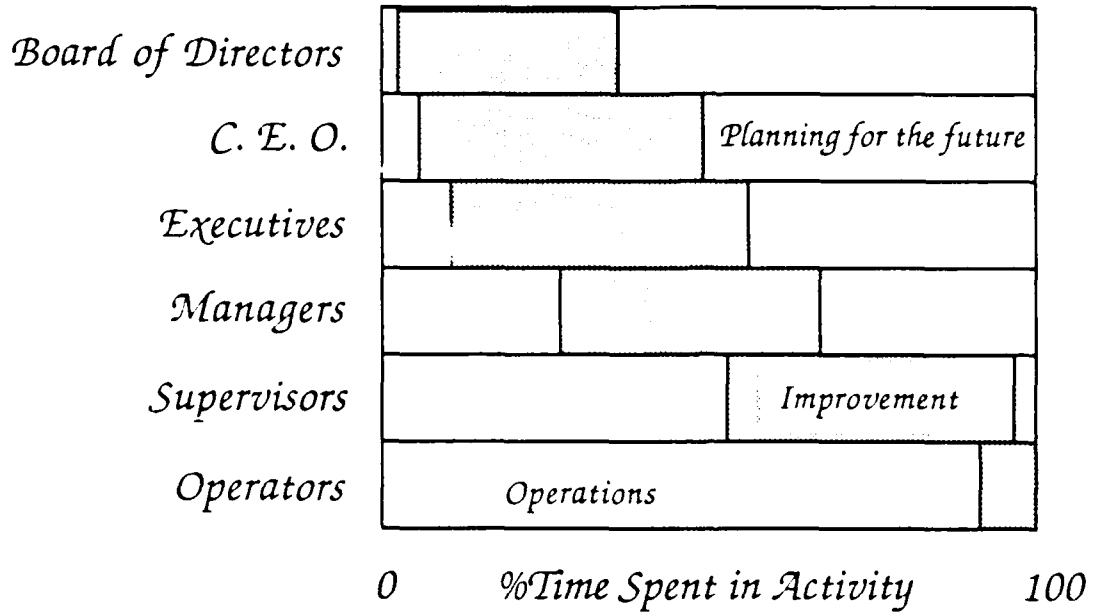


Figure 26. Division of labor under new style management

Note that the Board of Directors needs to be involved in the improvement process by examining how the management is working at improvement. Unless the Board is so thus involved, it may make the mistake of appointing a new CEO who will undo all that has been put in place to provide for constant improvement.

GROUP PROBLEM SOLVING

To attain error rates measured in the parts per million range, it is essential that everyone pay great attention to detail. Human beings cannot do this unless the system in which they work is designed to make errors difficult to make. This means that everyone in the system should consider how each task can be so structured that if an error is made, the system (i.e., the practices and procedures) will make it evident. There are many ways to do this. For example, parts to be assembled can be put in a tray in such a way that if a part is missing the compartment in which the part should be placed will be empty and easy to see (by choice of color, of design, of placement, etc., etc.). If forms are to be filled in, they should be designed so that it is easy to see if something has been omitted. Of course computer techniques are extremely valuable

at this point and can often be justified by a simple calculation of the cost of an error.

There are so many things to be improved that it is impossible for the management to hire people whose sole job is to go around improving things. To attempt to do so would be terribly inefficient. So much of their time would be taken up with attempting to become familiar with systems which are already familiar to the people who work in them. It is easier to start with people who are already familiar with the work and teach them to become problem solvers than it is to take "expert problem solvers" and teach them about the work.

Following this reasoning requires training in problem solving for groups of workers. There exist many excellent resources for teaching people to solve problems. The biggest barrier to this change in practice is the images managers carry around in their heads. This change in style also often seems threatening to the engineers and the researchers who do not always like the idea that other people can be creative, too, and sometimes even more creative than those who are paid to be!

POLICY DEPLOYMENT

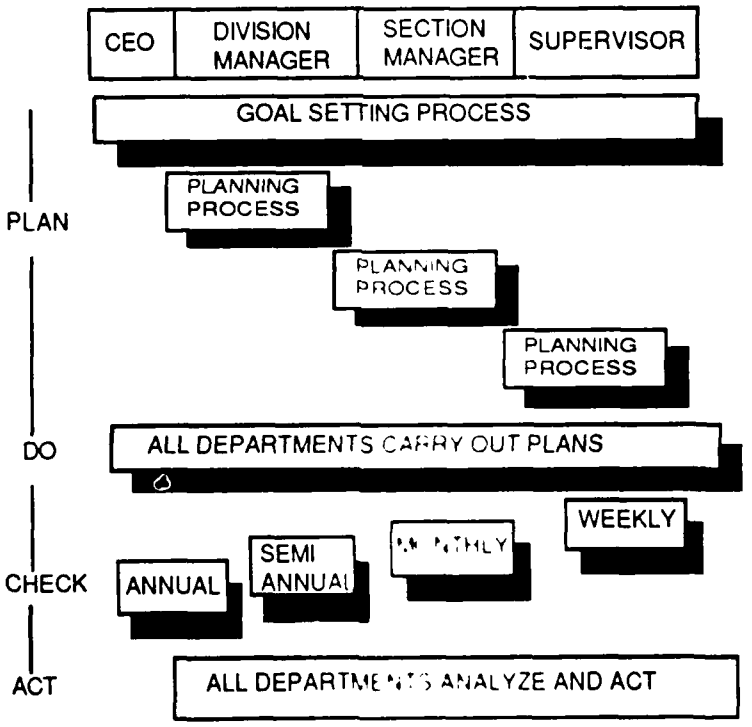


Figure 27. Policy deployment and managerial diagnosis.

TQM and Engineering

As the enterprise begins to operate with more and more distributed decision making, it becomes important to the management to see that the decision making is consistent. This activity requires two steps.

a. Policy deployment--to see that the criteria are promulgated and understood.

b. Managerial diagnosis--to find out if the criteria are being followed, what the difficulties with them may be and to see what can be done to bring consistency and harmony to the enterprise.

As indicated in figure 27, these actions correspond to the PDCA cycle for the top management.

Policy deployment requires the top management to be unambiguous about a few items which should be given priority for improvement. A common mistake is to ask for many things to be done--in which case few if any are accomplished. If the management proclaims more than three targets for the year, it will be too many. (Most companies under old style management cannot get even one!).

A method to achieve a genuine understanding of what a policy means is to require each manager down the chain of authority to rewrite the policy statement applied to his or her part of the operation.

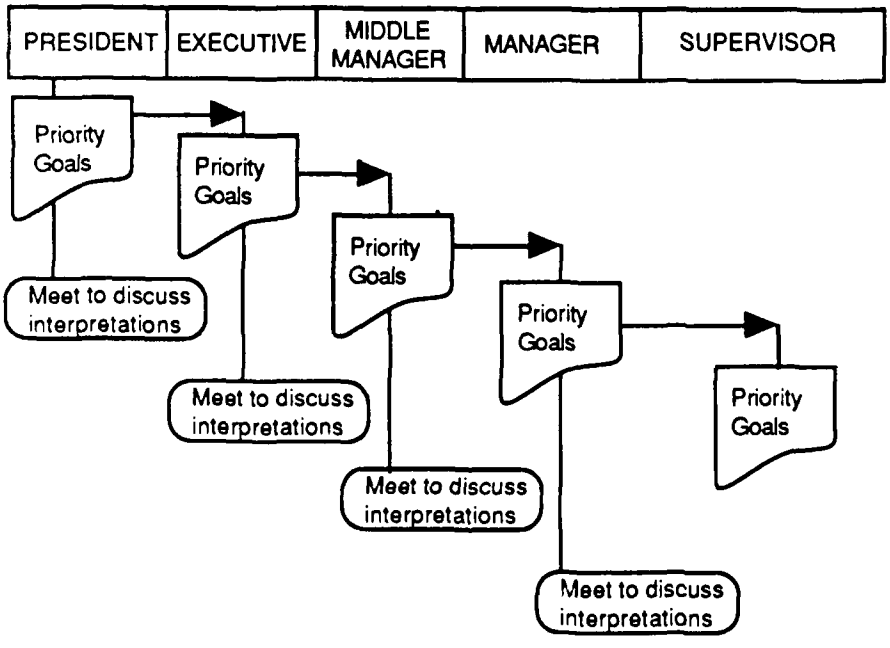


Figure 28. The first steps in policy deployment

After each manager writes an interpretation of the policy statement, the interpretation is discussed with the next manager above to reconcile differences in understanding and direction. In this way they play "catchball" with the policy and develop a consensus.

WORKER PARTICIPATION IN THE MANAGERIAL DIAGNOSIS

When the management attempts to make a managerial diagnosis it is important that the people whose work is being diagnosed be properly prepared to enter the discussion. For this purpose it is very helpful, indeed, essential, if everyone knows how to tell the "QC Story". Telling the story properly requires seven steps.

1. Definition of the problem.
   This step includes an explanation of why the problem is important (which will tie it to the priority statements of the top management or to a problem which is essential as seen at the lower levels). Normally this step includes a discussion of the losses which occur because of the problem, the team that will work on it and an estimate of what might be done. A target is often specified though it is understood that such a target cannot be guaranteed of attainment. A schedule is proposed.

2. Data
   This step involves observing the time, place, type and symptoms of the problem. It involves data gathering and display in an attempt to understand the important aspects of the problem.

3. Analysis
   In this step the various tools of quality analysis are used, such as Pareto diagrams, cause and effect diagrams, scatter plots, histograms, etc.

4. Action
   Based on the analysis an action is taken

5. Check
   The results are checked to see if they conform to what was expected. Data are taken to confirm the action.

6. Standardization
   Appropriate steps are taken to see that the gains are secured. New standard procedures are introduced.

7. Plans for the future.
   As a result of solving this problem, other problems will have been identified and other opportunities recognized.

These seven steps DO NOT describe how a problem is solved. As anyone who has solved problems knows, there problem solving requires a great deal of iteration and it is often necessary to go back to a previous step as new data are found and better analyses are made. However, when it comes time to report on what was done, the above format provides the basis for telling the story in a way which makes it comprehensible to the upper levels of management.

Some enterprises have developed a "storyboard" format for telling the QC story.[15] For example, at Yokagawa-Hewlett-Packard in Japan, the story is told using a flip chart which is 6 feet by 6 feet (2 x 2 meters). The project team uses colored markers to show the PDCA cycle the plus the SDCA cycle (SDCA=Standardize, Do, Check, Act).

MANAGERIAL DEVELOPMENT IN TQM

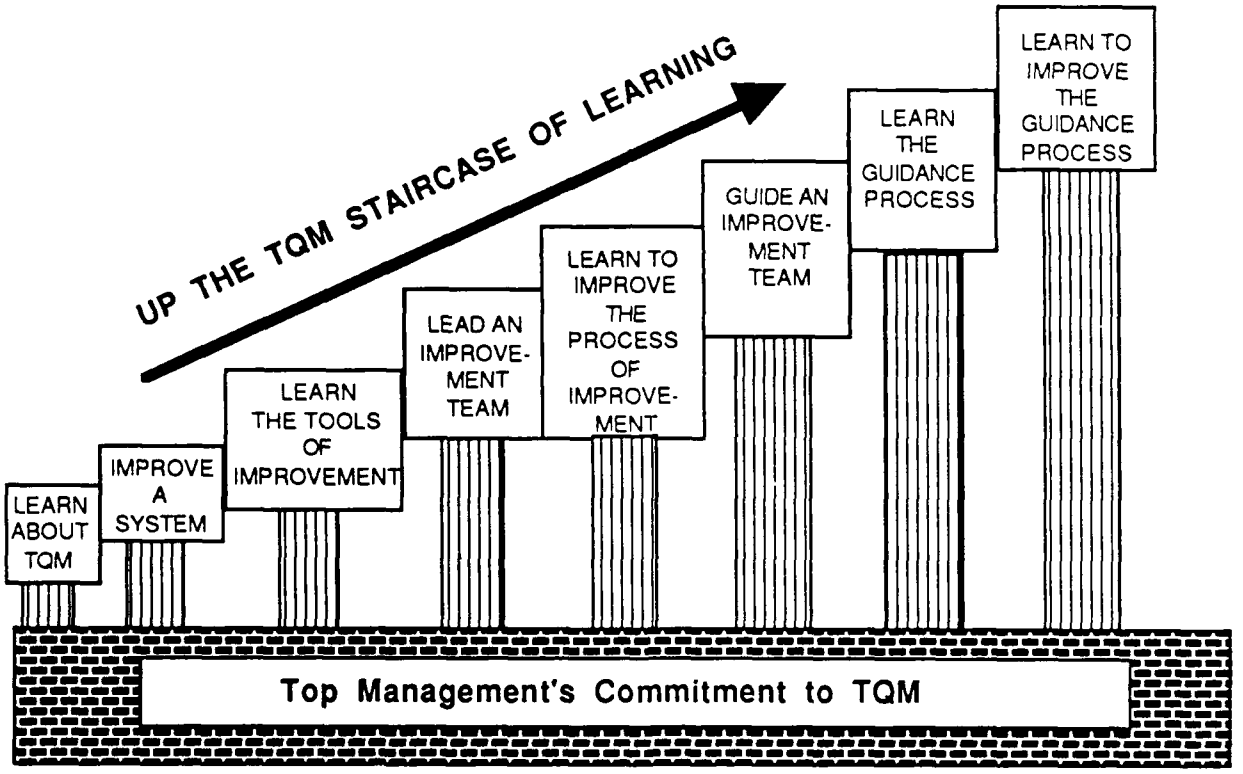


Figure 29. Managerial development occurs on pillars of education, supported by the commitment and actions of the top management.

[15] The concept of a "storyboard" was first developed at Disney Studios where it is used to enable all the members of a team to cooperate in the development of an animated cartoon.

WHERE DO WE GO FROM HERE?

All this talk will come to nothing unless it leads to action on the part of the universities. Having been a dean of engineering for 8 1/2 years, I have some experience with the office. Any dean who wants to make a difference with the faculty can do so. However, leading a faculty in a drastic change of paradigm is not for the faint hearted.

To begin, each Dean should recognize that you cannot lead a change you do not understand. The first requirement is for each Dean, personally, to become familiar with the field. This can be accomplished by reading the literature, going to seminars and meeting some of the consultants in the field.

Next, the Dean should begin to practice TQM in the operations of the front office. I can assure you that once you begin to train and work with the other administrators, the secretaries, the clerks and accountants, you will like it. Every manager I know who has changed to TQM has reported the same sense of exhilaration. The Dean, after all, has a number of customers, including the faculty, and can apply TQM to such things as running high quality meetings, seeing that all services are of high quality. These activities will not only please the faculty, they will also cut costs.

When the Dean has begun to understand how TQM works and has had a few small successes, it will be time to think about a strategy for changing the institution.

A SPECIFIC PROPOSAL FOR A CHANGE STRATEGY FOR USE IN EDUCATIONAL INSTITUTIONS[16]

When introducing TQM to an enterprise, it is important that the introduction process, itself, be an exercise in quality. In the first course in quality management ever given in Japan, in 1949, Homer Sarasohn wrote[17] :

THE LEADER MUST BE AN EXAMPLE
OF THE ATTRIBUTES
HE WOULD LIKE TO SEE
IN HIS FOLLOWERS

It is essential, therefore, that the Dean locate a few people in the faculty and administration who know about TQM and are committed to it. When asked, "What

[16] The material in this section was added to this manuscript after hearing a talk by Professor John P. Evans of the University of North Carolina, who outlined the difficulties of introducing the concepts of TQM in an institution with strong vertical divisions between departments, i.e., organized along the "-ics" lines shown in figure 1.

[17] Sarasohn, Homer CCS Industrial Management, published by the Civilian Communication Section of the MacArthur Government in Japan, 1949. (Microfilm copy available at Baker Library, Harvard Business School, Boston, MA 02163)

does it take to get started?", Dr. Deming once replied, "A critical mass of people who understand and who work consistently." My experience suggests that a critical mass will consist of about four or five people. After that, the group will grow as other people learn and begin to apply the concepts.

When this critical mass of people has been identified, they should be formed into a "TQM Steering Committee". This committee should begin by defining its purpose. Each steering committee will be guided by the local situation. Possible statements of purpose might be:

SAMPLE STATEMENTS OF PURPOSE FOR A TQM STEERING COMMITTEE IN A DEPARTMENT OF A UNIVERSITY

- *To guarantee that every student completing the MBA program understands and can apply elementary concepts of TQM and comprehends the nature of quality management.*
- *To apply quality management principles in the operations of the service activities of the department.*
- *To apply quality management principles in the teaching activities of the faculty.*
- *To involve the faculty in TQM research and development.*

The steering committee should develop a flow chart which depicts the process whereby the process occurs. For example, a flow chart might be constructed which shows what a student has to do to get the MBA degree. The committee might pick out a particular operation, such as enrollment in classes, and develop the flow chart.

Because of the importance of the introduction of TQM into the educational process, let us consider how the TQM Steering Committee might go about convincing the rest of the faculty to cooperate.

After drawing the process of education of students for the MBA degree, the committee should develop a list of topics which ought to be included. This should be done using the Quality Characteristics Evolution Diagram shown in figure 15. To begin, therefore, the committee will have before it a diagram similar to that shown in figure 30. The left side shows how the various customer requirements will be developed. The matrix will indicate which departments will respond to each requirement. For example, the material on statistics can probably be included in the operations research department

and the material on the role of fear on enterprises can probably be developed in the human resource development department.

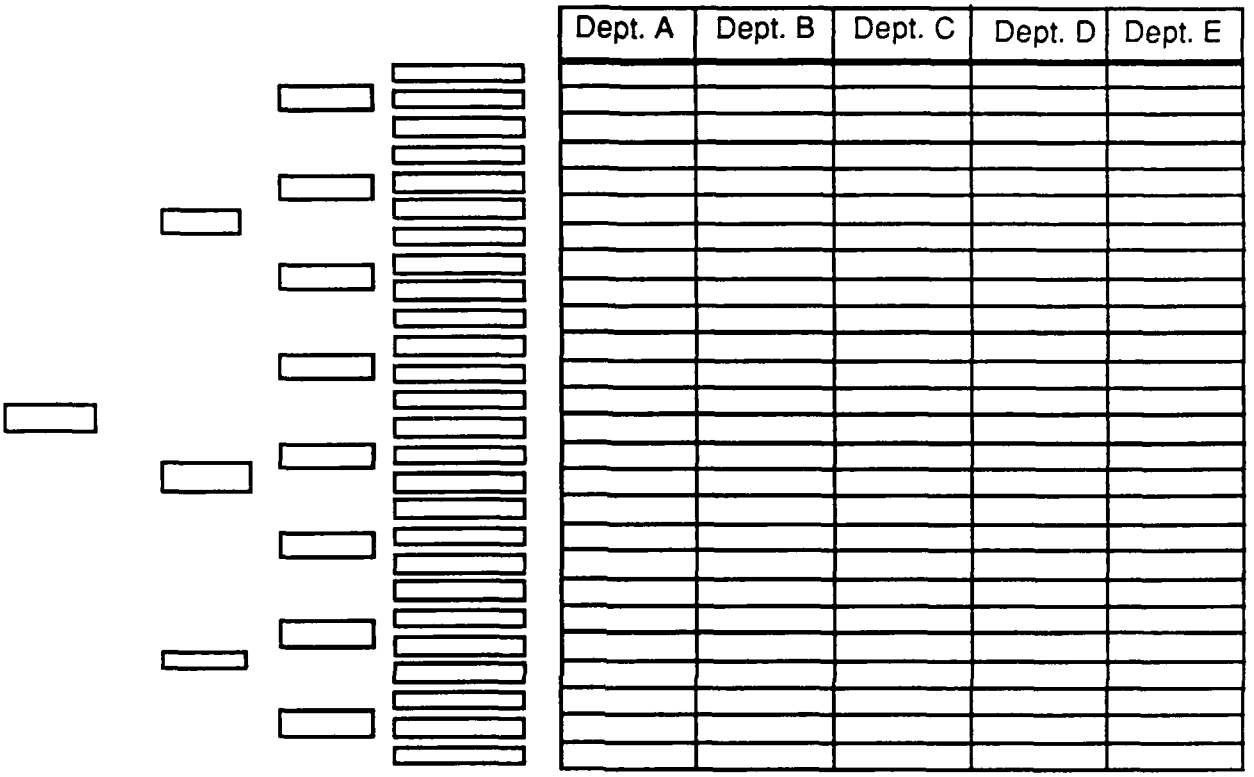


Figure 30. The use of elementary QFD methods in organizing the attack on the curriculum.

The steering committee may wish to see that the department which teaches accounting and finance incorporates quality considerations. The committee can arrange a meeting which involves their colleagues in these departments and representatives from the finance departments of companies which are successfully involved in TQM. It is always a good idea to have representatives from two or more companies, so that those members of the faculty who are encountering TQM for the first time will see that we are dealing with a trend, not an isolated instance. The steering committee will find there are many people outside the university who are willing to help. Those of us who are in the field feel very strongly about education and will help if invited to do so.

The steering committee should also form a sub committee of students who should be kept advised of these changes. In the few schools where an attempt has been made to change the curriculum, it has been found that the students are valuable allies in the change process.

CONCLUSION

The task of upgrading our managers and engineers is going to be with us for a long time. It will not go away. We are locked into a competition from which we cannot escape.

They say that a frog when placed in boiling water will quickly jump out. However, when placed in warm water which is slowly rising in temperature, the frog will remain until cooked to death.

The temperature around us has been rising for a long time. It is time to start hopping.

Luncheon Address*

July 19, 1990

Robert W. Galvin
Chairman of the Board
Motorola, Inc.

There was a football team with two outstanding quarterbacks, one was particularly gifted, not only in his absolute skill but in his showmanship. That was the one that the coach featured, but the team was never quite able to click. When he'd finally put the second quarterback in the second half the team would move along. After this had gone on for a few games the coach grabbed the captain as they walked off the field, victorious under the second quarterback, and said, "level with me, what's going on here." "Gee, Coach," he said, "I thought you understood. Quarterback number one has been in the game to make himself look good, and the second quarterback was there to help us look good." The consequence was the team pulled together.

I wonder if there isn't some relevance to that story as to what's going on here today. I've known about what you intended to do through the invitation process and the consultive process before I planned my travels to your fine meeting, and I've picked up vicariously through 15 or 20 minutes of the pre-luncheon affairs what you're about to do here. I'm immensely impressed with the fact that those of you who are from the world of scholarship are here in very large abundance and meeting with your associates in government and business, on this absolutely noble, in fact, essential purpose that you're working on.

And I'm also pleased that I have the privilege of interfacing with you for this brief period of time and I hope, without knowing of course what has been addressed by so many others of the credentialled speakers, that I can add some increment, some value to what I'm sure has been a superb survey of what the options and opportunities are for you. If nothing else I'll provide some emphasis by redundancy or maybe you'll capture a bit of my enthusiasm for a

* This text was transcribed from a video recording.

couple of things.

I've modified my message about three times in the 20 minutes that I was listening to the break-out groups. I always speak based on the most contemporaneous thought that I can bring to an audience.

Let me start with something that coincidentally happened to me as a customer on Monday. I spend a lot of time out with customers, but in this case I went as a customer to a supplier not so far from here. I went for them to tell me how Motorola could become a world class customer. When we look at our suppliers, we're asking how they can help us be better buyers. And they shared with me what their corporate objective was in it's most generic terms, which very simply was to consistently serve customer expectations. I said in response to their presenting that to me with a visual, that certainly no one will ever go wrong and will achieve immensely if they follow that class of an objective. But I said, "if you don't mind let me ask a question that is aimed at a hoped for value added. Answer to me honestly please, are our expectations high enough?" They were open and said, "on some things, your expectations do drive us, on others they are insufficient." I said, "Well, why would you only serve us to our expectations if there's a level of expectation that can be higher that you can bring to us." That stirred a new thesis between us. I don't know exactly what we're going to do about that, but something seminal could occur between the supplier and the user.

That leads me, therefore, to my first thought that I can't imagine hasn't been emphasized in your agenda so far. That is the issue of expectations. I respectfully suggest that whatever we represent here -- business, government or academia -- that our expectations are insufficient. If we raise our expectations on customer service or teaching results or report writing regarding this meeting that will truly make your investment here worth the time that you spend.

Let me characterize that in some simple ways. I was a good student. I went to Notre Dame for two years. Notre Dame had a system that, depending on the grades you earned in your freshman year, you got the pick of the better rooms for the sophomore year. I was about 18th or 19th in my class of about 700. My grade average in the decimal system was around 95, my folks were delighted. That could set a high level of academic expectations. But, it's an absolute failure level in business!

Why wasn't I better influenced by Sister Mary Norberdette at St. Jerome's School in about 5th grade, where you learn to convert decimals to fractions. On that subject, she said to our class, "Next Friday you're going to have a test on the conversions of all of the fractions of 12ths, 11ths, on down to decimals and back and forth. There's only one acceptable grade -- 100 percent. I went home to my folks and said this totally unreasonable nun has set this dumb standard. I wanted support from my mom and dad. Well, you can guess who got the support. My folks found a way of conveying to me that the Sister was right and "we" were going to get 100 percent on that test. I was one of seven in the class that made 100 percent. Why in the heck didn't I carry that over as the expectation level to our corporation?

I went to the head of our quality department in the 1950s. My father founded our company, so I had a chance to look around at all the things that were going on. I had something else that I was assigned to at the time. I thought I had an idea in that fellow's realm of business. We used die castings that were chrome plated as the escutcheons for car radios. When you looked at the mix of these you'd see some that looked like jewels and others had pock marks and problems with the plating. So I approached the quality director, a wonderful guy, who contributed much to our company. I said "Gus, look at these two die castings. Why can't we have all the die castings look just like this jewel? He said, "Bob you don't understand. Your dad has me at the head of quality because I have an experience base that allows me to judge what is good commercial quality. If we tried to get what you want, which is a perfect die casting and plating, the cost would go up, we'd overprice our product, your father wouldn't be able to sell his car radios at $49.95." I wasn't gutsy enough to stand up to that fellow in the '50s and say, that doesn't make sense. It didn't make sense, but I didn't follow through. That was poor leadership on my part. I seemed to follow the wrong signals and standards from my school experience. Could schools teach the new standards obliged by business?

Today we have only one expectation in our company and that is perfection. I really mean perfection. Our standards for 1992 are that there will be no mistakes. That doesn't mean not make a mistaken decision once in a while and so on. I'm talking about the execution in behalf of the customer. I respectfully suggest that any of our competitors that do not adapt to that standard, won't exist 20, 30 or 40 years from now. We will exist. I think that ought to drive

some of the considerations that you are dealing with in this conference or any follow-on conferences that come along. I started saying this 5, 6, 7 years ago as we were growing in our confidence levels with regard to what might be the potential in quality management in our corporation. People who were my peers in business would hear me say this in some semi-public arena. I remember one senior fellow who, said "Bob, you ought to stop talking about perfection, it's unbelievable, it's incredible. So don't say something that people can't identify with." I said, "That may be your opinion, Dick, and I respect you, but our customers say something different. They will accept only perfection. They question us every time we don't perform perfectly. That means quality, reliability, delivery, etc."

Incidentally, from a business standpoint, that is absolutely the most self-interest position anybody can take, because I now represent there is no way that any people in our company can improve quality and add cost. Or turn the statement around, as you improve quality you will automatically reduce cost. One must believe that. It's absolutely true. Somebody says, what if you apply gold plating? Doesn't the cost go up? That's improving the standard or feature of the product, and incidentally, may reduce some quality. If, for example, you want to make a microphone and you make the microphone better, it will lower the cost because all the quality degrading things that we haven't been paying enough attention to -- often obscured -- are costing us so much money. We are of the mind that at this stage in our corporate life, that poor quality is costing us upwards to 20 percent of our sales dollar and we're already a quality prize winner. People don't understand what poor quality is costing us dearly.

What about entering a contest for a quality prize -- the Baldrige Award? Many people wonder if it's going to cost an exaggerated amount of time and money to enter. Not true. If you invest wise efforts in improving quality, you will never have a negative cost effect. As soon as an institution decides that it is going to take a step function improvement in quality, it will almost contemporaneously reduce its cost. We've seen the proof of that. Additionally, I operate significantly, on what I refer to as acts of faith. These are acts based on extensive experience and uncommon good sense. I offer here some acts of faith that are a bit heretical -- contrary to common wisdom. I would be heretical if I were you in your roles, and question what needs to be done. The things that need to be done

have to start with a clean sheet of paper. If we stick with the traditions, practices and processes of yore, we're not going to end up with perfect quality. If academia decides it can't train people oriented to perfection then we're going to have a limiting of our quality objective.

A clean sheet of paper! Let me give you an example. This is a pager -- a beeper. It used to take us 44 days to process an order that you, the customer, would give to our salesperson before we finally put that in a shipping container to ship to you. We check your credit, that would take a couple of days, we'd send the order by mail. Paperwork would stack up. Errors were already creeping in. Then we'd order parts. Later we'd batch produce and so on. 44 days later, after stops and starts and mistakes, your pager would make it to shipping. We're supposed to be in business to serve a customer. We were way off the mark. A few years ago, in the context of quality, the quality of operation and its surrogate cycle time, we started from scratch. We now can take an order at 9 o'clock in the morning from a discreet customer, put that through the electronic system right on to the automated factory and have the pager that wasn't anticipated at 8:59 in a shipping container at 10:40 -- an hour and forty minutes later.

You don't do that by just slightly improving the process. So let me add another element of heresy to the deliberations on quality. People properly say we must have an objective of continuing improvement process. That's good -- up to a point, but it's not enough. There also have to be revolutionary changes. Orders of magnitude changes and they're possible. I've just illustrated with that little parable about the pager. You might say, well if you do that on products, you can't do that in the classroom. You can't do it in other process. We're doing it in the patent department, we're doing it in the accounting department. It used to take 26 days to close the month's books or the end-of-the-year books, it now takes us 4 days, it'll be to 3, it'll be to 2. And this is synthesizing a $10 billion corporation from all over the world and finishing the accounting job in a day or two. This is all doable. But we started with a whole new system to get the job done -- expectations levels -- expectation levels that are heretical. These are all possible.

Note the emphasis on time. Cycle time is the operative term. Cycle time and quality are virtually synonymous. Save time thoughtfully and you improve quality. Improve quality and you save time.

Quality is very personal. Very first person. If I've used I a couple of times here today I won't apologize. I typically do not do that in front of an audience, but for talking about quality, if a person can't convey to an audience a number of "I dids," then you haven't got a quality program. Whether it's somebody with a fancy title or somebody who is a fine operational person, you and I must be in the act. Each one of us has to have done many first person things. That is vital to the accomplishment of a quality program.

Training and education are essential. The most influential entity in our corporation today is our training program which we have the affrontry to now call Motorola University. I finally elected to allow that name because we're doing much university standards work. For example, we now have six Ph. D.s devoting their time exclusively to writing the seminal textbooks of the future on quality. We can't find a textbook that teaches what we need to teach on quality.

Here is a funny little parable from which I hope you can derive many related ideas. There is a senior officer of a giant corporation who is the head of his company's Chicagoland operation who is a very dear friend of mine and who has, coincidentally, gone to school on our quality program that we call the six-sigma program. He and his associates have been to our school three and four times and have gone through the detail material that we offer as a function of the privilege that we have of explaining our positions as a Baldrige winner. This fellow has come up with a resounding idea. It dramatizes personal involvement. He has a big title, a big job description, and major responsibilities in this tens-of-billions-of-dollars company. After he'd heard our stories on how one effects quality changes in one's institution personally, he decided that he was going to rate himself on every measurable thing.

Much of our quality program is focused on data on defects. Defects per million, defects per billion. Metrics is extremely important in quality. We haven't taught enough metrics to people in the past so that they can use the math tools to manage a quality program. Our executive friend, Bernie said, "metrics are important, they're personal, I'm going to have my own metrics." So, he would put metrics to work on his job. Remember now, he's a big shot. One of the things that he measures himself on is punctuality -- in two regards. Is he late or on time getting to things; secondly, because he's in the telecommunications business, he has set a standard that

he must answer his telephone before it rings more than twice. It must never ring a third time. A service to his respondent is that he will not make them wait on the telephone while it rings even a third time. So Bernie made up a chart. It has about 12 to 15 factors. They aren't necessarily the blockbuster decision-making factors that you think a senior executive would be doing. He carries around an 8-1/2" x 11" sheet of paper with a chart on it. It's simple. On that chart he puts a check mark every time he has a defect. What's a defect? He's late to a meeting, or he's late welcoming you into his office. Or if he doesn't get that telephone off the hook, and it starts to ring the third time or the fourth time, that's a defect.

He started doing this about 6 months ago. He did it openly. He told his associates that this was what he was going to do. He was going to start grading himself on measurable and observable things to his people. They thought it was kind of hokey to begin with, but he said, "I'm serious about this." He said, "a lot of things will be driven as a function of my measuring what I'm doing and improving. His early data showed an embarrassing number of faults. He took all that, put it down and every week or every month he draws a curve.

Here's an interesting thing that's happening in that institution. Everybody in the Chicago realm and/or headquarters knows that Bernie has this report in his pocket. He's a nice enough guy that people will stop him in the hall and say "how are you doing on your quality thing?" He says "let me show you," and he takes the chart out and shows them the number of check marks for this week, shows them what the curve is and how much better he's getting.

Well, let me tell you how much better he's getting. I'm gonna play on words here now for those of you who are metrics and statistics oriented. He's improved the quality of his performance by an order of magnitude. He's gone from 10 defects to 1 defect. A ten-time improvement, if I can play that statistic with you. It's very significant to his people.

Now what is he? He's a role model. He's a role model aiming at perfection; he's a role model of someone who has invested himself in the process. He is not above the process, he's in the process; but, nobody trained him to do that when he went to college. He's younger than I am but he's worked for 25 years without doing this very useful thing. How come we're not training these kinds of things when people are 17 or 27 years of ages. At least, now that we know

them, how about our training these very gutsy things. Somebody might say cynically "Yeah, but he's supposed to be doing some bigger things." I respectfully suggest that being a role model, being an example, causing everybody elsewhere in the institution up and down those corridors to say, "Boy, if Bernie is seeking perfection I've got to seek perfection. What do I need to do? What can I measure?"

Now, that company is sophisticated. They train, so they're providing tools, inspiration, statements of expectation. But what are we doing about teaching other people to have these expectations and giving them the techniques, the vocational tools that have absolutely world-shaking effect. It takes world-shaking processes like Bernies or institutions like ours to open new horizons. For example, our company opened the telecommunications market in Japan in 1980. Virtually no foreign telecommunications had ever been bought in Japan as of that date. Superior quality was an essential. Such standards and consequences start with little pieces of paper in the pocket of an open-minded listening leader like Bernie or you or me.

Here and now you are listening to each other. I take heart from that. I know that you will influence the rest of us to move to the highest level of expectation. Thank you.

Section IV

Panels

Panel 1: Models of Cooperation

Throughout the nation, centers of excellence are being established to support business and industry in their race to resolve the competitive issues related to quality and productivity. These organizations provide education and training in total quality management concepts and technical methodologies. In addition, community networks are established fostering teamwork and new partnerships whereby business, industry, government and education work together sharing information and resources in pursuit of the global quality race.

The panel comprised of members from nationally recognized quality management organizations presented the programs and services they are currently providing to help foster economic growth.

Highlights of their presentations follow:

Philadelphia Area Council For Excellence (PACE)

Maureen Glassman
Group V.P., Quality Management
Greater Philadelphia Chamber of Commerce

The Philadelphia Area Council For Excellence, PACE, is one of the oldest and largest regional excellence councils in the United States. Created in 1983 by the Greater Philadelphia Chamber of Commerce, PACE has served more than 10,000 people through the quality training program, Dr. Deming's annual seminar, the PACE annual conference, and the PACE Network.

PACE's Vision and Mission are as follows:

Vision

The Delaware Valley will be world-renowned for the quality and value of its goods, public and private services and its overall quality of life.

Mission

The PACE will provide regional leadership on quality issues and act as a catalyst for change so that all organizations, communities and individuals in the Delaware Valley become successful in the implementation of total quality.

The PACE was created to help existing businesses in the Delaware Valley to grow stronger by implementing total quality. Our vision and goals are based on the management philosophy of Dr. W. Edwards Deming, an American best known for his past work in creating a quality revolution in post-war Japan.

The PACE is the Delaware Valley's umbrella organization and comprehensive resource for total quality. A full-time staff of six, more than fifteen associated local and national consultants, and more than thirty corporate volunteers work with PACE to promote quality efforts in the Delaware Valley. We are seeking to create an

environment where quality is supported and encouraged in the work force, in the government, in education, in our healthcare institutions, and in the existing business community.

The PACE's CEO Board and corporate leaders, ranging from Boeing Helicopters to CIGNA to Rohm and Heas to Brooks Electronics, believe that the future of the Delaware Valley depends on our ability to offer quality products and services that have a unique value for our customers.

To achieve our vision of creating a community of quality and excellence in the Delaware Valley, PACE offers the following resources:

1. Training Programs and Seminars -- More than 20 courses featuring local and national consultants are offered annually. Length varies from a half-day workshop to a 6-day course spread over 2 months. Topics include Basic Statistical Process Control, Just-In-Time Manufacturing, Team Leader Training, Executive Forum, etc.

2. Resource Referrals -- Referrals to quality consultants and local colleges with expertise in total quality management.

3. Annual 4-Day seminar with Dr. W. Edwards Deming.

4. Annual Quality Management Conference.

5. Special seminars with internationally known quality experts such as Brian Joiner, Masaaki Imai and Eli Goldratt.

6. The PACE Network -- Bimonthly, low-cost evening meetings that encourage sharing experiences and networking with other local companies interested in quality improvement.

7. Network Directory - A comprehensive list of more than 150 companies in the Delaware Valley that are implementing total quality. The Directory provides demographic information, a contact name and number, and information on functional areas that have implemented TQM as well as quality techniques in use.

8. Book and Video Resources - Extensive collection of total quality

books, articles, cassette tapes, videos and manuals for loan or sale.

9. The PACE Membership Plan - Enables small companies to attend courses at half or less the normal seminar fee and provides many other benefits. Currently, PACE has 35 corporate and 150 individual members.

Finally, the PACE Board of Directors has established "Encouraging TQM in University Curricula and Administration" as a major initiative for 1990-1991.

As a first step in this process, a survey of local business leaders was conducted in the Spring of 1990. Survey results are available to excellence councils and/or colleges and universities at cost. The data demonstrates that businesses involved in TQM implementation strongly support the need to involve academia as partners in a national effort to achieve global competitiveness.

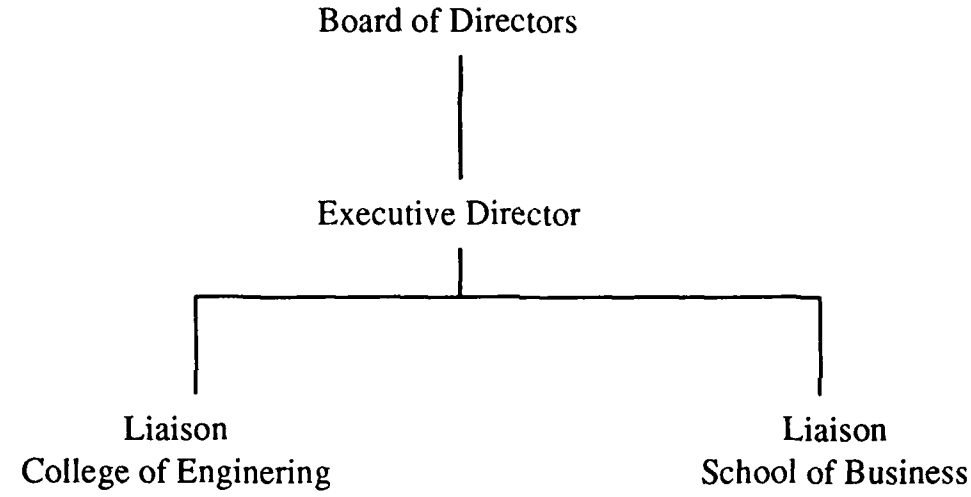
The PACE will share results of the survey with local academic and business leaders and will conduct follow-up focus groups in order to determine specific priorities and a plan of action to be implemented within this region.

Information on PACE, the TQM in higher education Task Force, or the Quality Network Directory can be obtained by contacting Susan Gallagher, PACE Training Manager at (215) 972-3977.

Institute for the Study of Quality in Manufacturing and Service

Dr. Jill A. Swift
Liaison, College of Engineering
Industrial Engineering Department
University of Miami

Quality Institute



Mission

To promote the improvement of quality and competitive advantage on the local, national, and international levels through the acquisition, dissemination and application of knowledge in the areas of science, technology and management as related to the improvement of quality.

Mission Objectives

1. Faculty Development
2. Research
3. Publication
4. Education and Training
5. Disseminate information

Unique Focus

Service sector
Faculty education and development
Relationship with JUSE

Faculty Involvement

College of Engineering
School of Business
College of Arts and Sciences
International

Faculty Development
1. Seminars
2. Educational Grants

Seminars

1. Sponsored

   - JUSE guest lecture series
   - Introduction to TQC
   - "Wednesday" seminars
   - TQC & Deming: a comparison of quality thought
   - Planning using the seven management tools

2. Attended

   - Taguchi Seminar
   - Deming Seminar
   - Inside America and Service Quality Conference
   - Malcolm Baldrige National Award Conference
   - Quality Function Deployment Seminar

3. In Development

   - Taguchi Applications
   - Statistical Quality Control
   - Quality and Productivity
   - Quality in Manufacturing
   - Quality in Service
   - Quality Function Deployment

- Simulation Modeling Techniques in Manufacturing
- Applied Reliability
- Quality in Engineering Administration
- Quality Concepts and Methods in Construction Management

Education Grants

- Manufacturing Systems
- Production Planning
- Statistical Applications
- Productivity
- Engineering Administration
- Construction Planning
- Electrical Circuit Design
- Software Quality
- Quality Function Deployment
- Accounting Practices
- Organizational Behavior

Quality Theory Grant

The purpose of this grant is to "determine the concept(s) of 'quality' in various disciplines" and to develop a unified theory of quality which incorporates the strengths of these different schools of thought.

Disciplines

- Philosophy
- Law
- Commodity Science
- Industrial Engineering
- Organizational Psychology
- Environmental Science
- Service
- Daily Usage
- Utility in Economics
- Customer Satisfaction in Marketing
- Reliability in Engineering
- Safety in Safety Engineering

No text available for John Etlie and Carole Schwinn.

Panel 2: Accreditation and Curriculum Changing Needs and Requirements

The challenge facing the United States as we earnestly strive to maintain/regain our competitive position in world markets require a major change in the way we manage our business. Emphasis on continuous improvement as the governing strategy requires massive retraining of the workforce in the total quality principles and tools.

In addition, new partnerships between academia and the business communities must be quickly established with the common commitment to develop and provide an education curriculum that would more effectively meet the requirements of this customer base. Continuous improvement applies to all processes, systems, activities and people.

The educational institutions have a critical role in the competitive economy.

A panel comprised of leaders from government, industry and academia outlined recommended changes required by the academic community to support the competitive challenges we collectively face as a nation. Highlights of their presentations follow:

Accreditation Board for Engineering and Technology

Leslie Benmark
ABET President-Elect

How do we assure that the graduates of engineering programs in the United States receive the best engineering education possible? One proven method of engineering education quality assurance is through accreditation of engineering and engineering technology programs. In the United States, this accreditation is performed by the **Accreditation Board of Engineering and Technology (ABET)** and its related Engineering Accreditation Commission (EAC), Technology Accreditation Commission (TAC) and Related Accreditation Commission (RAC).

The ABET (formed in 1932 as Engineers' Council for Professional Development, ECPD), is a federation of engineering and engineering-related societies (currently 25 societies). The ABET is recognized by the U.S. Department of Education and the Council on Postsecondary Accreditation (COPA) as the sole agency responsible for accreditation of educational programs leading to degrees in engineering. The ABET is not merely educators looking at educators or determining criteria; rather the ABET process involves the whole profession looking at engineering education. Those involved in the accreditation process are not only educators or knowledgeable practitioners but also are practicing professionals within each discipline.

The ABET provides leadership for the promotion and advancement of engineering education with a view of furthering the public welfare through the development of a better-educated and qualified engineer, engineering technologist, engineering technician and others engaged in engineering or engineering-related work.

To achieve this purpose, ABET is organized to carry out comprehensive accreditation of pertinent engineering curricula leading to degrees, provides guidance for the improvement of existing programs and development of new programs, promotes the intellectual development of those interested in engineering and

engineering-related professions and provides technical assistance to agencies having engineering-related regulatory authority applicable to accreditation.

The ABET publishes annually a list of accredited programs so that programs that meet minimum criteria can be identified to the public, prospective students, educational institutions, professional societies, potential employers, governmental agencies and state boards of examiners. Institutions are required to represent the accreditation status of their engineering programs accurately and without ambiguity.

As the sole agency responsible for accreditation of education programs leading to degrees in engineering and engineering technology, ABET provides leadership for higher education, especially those areas that impact the engineering profession. The ABET offers forums for discussion of engineering education issues and initiates and sponsors studies, conferences and seminars and cosponsors projects in cooperation with organizations with common interests in engineering education.

With the increased global mobility of engineers, there is an increasing need to understand credentials of engineers from other countries. As the lead federation of engineering societies with primary focus on the continuous improvement of engineering education, the ABET provides an infrastructure to assist in the recognition of engineers from other countries with an equivalent engineering education and assists agencies in other countries to develop their own engineering education accreditation processes.

It is the policy of ABET to accredit engineering programs rather than institutions, departments or degrees for it is well recognized that programs of quite different quality may sometimes be found at the same institution. Institutions are invited to submit programs for accreditation review without persuasion or pressure.

The ABET favors broad basic programs in engineering that will prepare the student for as many different career opportunities as possible. The ABET strives to encourage innovation in engineering education and to avoid rigid requirements as a basis for accreditation in order to prevent standardization or ossification. Considerable latitude is allowed in the choice and arrangement of curriculum subject matter as long as the minimum criteria are met.

Engineering programs are accredited for a specific period, usually 3 or 6 years. General review of ALL engineering programs at an institution is performed at intervals not to exceed 6 years.

The task of accrediting programs in engineering and engineering technology is extensive and involves over 2,000 volunteers. More than 1,400 programs at approximately 400 institutions are accredited in engineering and more than 750 programs at approximately 225 institutions are currently accredited in engineering technology.

Engineering Education Accreditation Process

The engineering accreditation process begins when the institution requests that ABET evaluate specific engineering program(s) at the institution. After request for accreditation review, the institution prepares and submits to ABET self-evaluation materials for the institution and engineering unit as a whole and for each engineering program being evaluated.

An evaluation team is assembled for each institution consisting of a team leader and a program evaluator for each program being reviewed. The program evaluators are selected from lists of qualified evaluators furnished by the professional society assigned curricular responsibility for the engineering program. It is desired that the evaluation team have an equal mix of program evaluators from academe and practicing professionals from industry and government. Prior to the on-campus evaluation by the team, a thorough review of the self-evaluation materials provided by the institution is performed by each of the team members.

An extensive on-campus evaluation of each engineering program and the institution and engineering unit, as a whole, involves discussions with faculty, staff and students, review of course materials and student work, discussion of financial and resource matters, examination of engineering and related-area facilities, observation of working conditions, evaluation of libraries, computer systems and other facilities, interviews with institution administration, etc.

After the on-campus evaluation, a preliminary report of findings is prepared. Prior to sending to the institution, this preliminary report is reviewed at several steps within ABET (program evaluator, team

leader, editor and Chairman of the EAC, TAC or RAC) to ensure consistency between all programs.

The institution has the opportunity to review the preliminary findings and submit information to correct errors in fact or observation (referred to as the "due process" step). Comments from the institution are studied and appropriate modifications are made to the preliminary report.

The modified report and recommendations for accreditation action for all programs are submitted for final accreditation action decision to the full Commission (EAC, TAC, RAC) at the Commission Annual meeting. After considerable deliberation at this meeting, the final report and accreditation action for each program are sent to the institution.

Engineering Program Criteria

There are six major areas that are examined during an accreditation review of engineering programs -- faculty, curriculum, student body, administration, institutional facilities and institutional commitment. General engineering criteria which must be met by all engineering programs and specific engineering criteria for each engineering discipline are included in engineering criteria.

Faculty -- The heart of any educational program is the faculty. Faculty must be large enough to cover, by experience and interest, all of the curricular areas of the discipline and to provide technical interaction and stimulation. Teaching loads must be compatible with the existing climate at the institution for research and professional development.

Curriculum -- A significant measure of an engineering education is the degree to which it has prepared the graduate to pursue a productive engineering career that is characterized by continued professional growth. The overall curriculum must provide an integrated experience directed toward the development of the ability to apply pertinent knowledge to the identification and solution of practical problems in the designated area of engineering specialization.

While ABET favors a flexible approach to the design of curricular content, it also recognizes the need for specific coverage in each

curricular area. Therefore, ABET requires that the curricular content of each engineering program include the equivalent of at least 3 years of study in the areas of mathematics, basic sciences, engineering sciences, engineering design and the humanities and social sciences. Courses must include at least:

- One year of an appropriate combination of mathematics and basic sciences: Studies in mathematics must emphasize mathematical concepts and principles rather than merely computation. The objective of the studies in basic sciences is to acquire fundamental knowledge about nature and its phenomena, including quantitative expression.

- One year of engineering sciences: The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics/basic sciences and engineering practice.

- Six months of engineering design: The engineering design component of a curriculum must include at least some of the following features: development of student creativity, use of open-ended problems, development and use of design methodology, formulation of design problem statements and specifications, considerations of alternative solutions, feasibility considerations and detailed system descriptions. Further, it is essential to include a variety of realistic constraints such as economic factors, safety, reliability, aesthetics, ethics and social impact.

Some portion of this requirement must be satisfied by a least one course which is primarily design, preferable at the senior level, and draws upon previous coursework in the relevant discipline.

- Six months of humanities and social sciences: Studies in the humanities and social sciences serve not only to meet the objectives of a broad education but also to meet the objectives of the engineering profession and the institution's educational objectives. Studies in this area must provide both breadth and depth and not be limited to a selection of unrelated introductory courses.

Student Body -- An important consideration in the evaluation of an engineering program is the quality and performance of the students and graduates. When students are carefully selected at the time of admission and/or by appropriate retention standards, the level and pace of instruction can be high. Performance of the student work is examined through examples of homework problems, laboratory reports and design experiences.

Administration -- The attitude and policy of engineering administration towards teaching, research and scholarly production and quality of leadership at all levels of administration is critical to the success of each engineering program. A capable faculty can perform its functions best in an atmosphere of good relations with the administration. Good communications between faculty members and administrators and a mutual concern with policies that affect the faculty is required.

Institutional Facilities -- An engineering program must be supported by adequate physical facilities including office and classroom space, laboratories and shop facilities suitable for the scope of the program's activities. The libraries in support of the engineering unit must be both technical and non-technical and include books, journals and other reference material for collateral reading in connection with the instructional and research programs and professional work. Computer facilities available to the engineering faculty and students must be adequate to encourage the use of computers as part of the institution's engineering educational experience. Laboratory facilities must reflect the requirements of each educational program.

Institutional Commitment —— Organizational structure of the institution should demonstrate a commitment, both financially and philosophically, to the engineering program. The ABET is specifically interested in the general status of the engineering unit, its programs within the institution and the overall administration as it relates to the engineering unit and achievement of its educational objectives.

Some Academic Considerations for Continuous Quality Improvement...And Our Future

Richard G. Foley
Director, Total Quality
Boeing Helicopters
Philadelphia, PA

The Chinese have an expression for it. It comes in two parts -- danger and hidden opportunity. The word is change, and change is upon us.

To understand the dangers and hidden opportunities that challenge those of us faced with change, we need to understand, where we are heading and the nature of the transition period from here to there. With this kind of understanding, we can then focus on the role of academia in national competitiveness and total quality management and perhaps sort out the long term and short term requirements that we in industry would identify for the products of educational institutions in this country.

I had the opportunity in 1989 to return to Japan and Korea after being there 35 years ago, and looked forward to seeing what had made Japan, particularly, the fierce competitor that it has become. I had prepared my basic list of 25 questions that I had planned to ask whenever the opportunity presented itself.

It soon became apparent, however, that my list of questions was not appropriate. I was interested in how the Japanese changed from being producers of junk to producers of quality; from being autocratic managers to being enlightened ones; from not being concerned with customers to treating them like sacred treasures. What I was after were answers to transitional questions; they changed decades ago and had no answers for me; no one remembered.

In Korea on the other hand, I found a full appreciation for the transition period because they are going through it now, and we can learn from their experiences and their struggles.

So, to make some useful organization of our thoughts, we should identify the skills and attitudes that are appropriate for the transition period and the quality "way of life" period, we hope to achieve.

I don't mean to discount traditional educational outcomes here. In fact some aspects of our past emphasis become even more important for our future -- specifically mathematics and language.

Let's leap then to the future and talk about when we are world class, highly-successful organizations. Here is my short list of critical requirements for graduates:

- Statistical comfort -- an understanding of what W. Edwards Deming calls "profound knowledge".

  The difference between special causes and common causes of variation.

- Process Orientation

  Recognition that all processes are candidates for improvement -- the ability to describe processes symbolically and collect and analyze appropriate data.

- Group Skills

  The ability to maximize the individual's contribution while working in a group/team environment.

- Communication

  Oral and written presentation skills.

- Facility in a foreign language

- Global markets, global customers, global competition.

Whether the graduate is working in banking, insurance, manufacturing, public utilities, hospitals, advertising or teaching, these will be necessary tools.

The requirements during the transition period are more difficult to pin down. We are still learning, still experimenting.

What we're talking about here may fall into the area of attitudes and dispositions more than skills. However, some new skills would be required. In addition, the skills listed above for the "way of life" state are also appropriate for the transition period. Here is my second short list:

- Technology Transfer (teaching)

  The graduate will be asked to teach the people working in the processes some of the technical aspects of what is going on. Process workers will be empowered to make beneficial changes and will need information.

- Data Retrieval and Organization

- For benchmarking purposes it will be important for information, available outside the organization, dealing with competitive and non-competitive processes to be gather and organized. Knowing the relative goodness or quality of what your organization is doing is critical during the transition phase. If it's not properly assessed then there may not be a "way-of-life" state.

- Customer Appreciation

  We do not have a strong history of satisfying customers. When we were the only game in town, the quality of our products was not all that good. The customer, however, had little or no choice. Even today, the times when we are treated with care and attention as customers are so rare that they become noteworthy.

- Patience and Persistence

  These qualities are essential if the graduate is going to survive. Change will not occur overnight.

- High Expectations

> The graduate needs to develop and retain high expectations for individual and organization success. Being satisfied with "less" will be a self-fulfilling prophesy. Transition will mean two steps forward and one step back. Expect the two forward; be disappointed with one back.

These skills and attitudes are pretty close to the mark in my mind. However, there is one additional and very powerful contribution the graduate can make during the transition period and that is exercising an intelligent selection process in initiating a career -- choosing the right kind of organization.

I would suggest as a possible aid in this regard that the graduate use the Malcolm Baldrige National Quality Award criteria to gauge the forward movement of any potential employer. Any organization that hasn't at least begun to transition should be suspect.

So here then is a possible framework for discussion and as we proceed we might keep the words of Will Rogers in the back of our minds, "Even if you're on the right track, you'll get run over if you just sit there."

Remarks

by
Michael J. Kelly
Chairman
Kelco Industries, Inc.

Recently the CEO of a Fortune 500 company was quoted on national public radio. His statement was meant to shed light on one of the most critical problems facing America industry today. He said, and I quote, "Education is too important to leave just to the Educators." With all deference to educators, I might agree, not only with the statement, but with the recognition from the industrial sector of the educator's importance.

Fortune recently directed an entire special issue to the subject of education and industry's involvement.

WHY

Well, simply, a superior education system produces more capable people and thus creates a competitive edge. This country is about to face the most serious competitive condition in its Industrial history.

We are entering a world economy. To be competitive, we must equip our greatest asset -- the human asset.

We no longer can muscle our way through with advantages in natural resources.

We are not number one in oil, minerals or even grain. But we can be number one with educated human resource.

If we are to grow our industrial power, we must concentrate on human capabilities. Human power equals industrial power and human power must grow to meet the need.

How is human power defined within the industrial community? It is defined, I might suggest, by multiple disciplined managers and multi-skilled production people.

We have to manage and deliver two, not one but two, products:

Quality of Performance

as well as Quality of Product

Quality of Performance

plus

Quality of Product

that will result in the Quality of Excellence needed to compete in our world economy.

A Quality of Performance that offers;

- Immediate response to changing marketing conditions
- Flexibility to manage fluctuating production needs
- Shorter through put with less lead time
- Major reduction in the product development cycle.

The ability to achieve this kind of performance is highly dependent upon the capabilities of all employees working within a team atmosphere. We must have managers trained in leadership techniques, group dynamics, interpersonal skills, communications, and other non-traditional disciplines. Multiple-disciplined managers trained to look at and respond to situations not from one narrow discipline but from a broader, more horizontal view which the capability to fully communicate their input in the various languages of all the disciplines involved.

In addition to the ability to communicate we must also have command over time. Time is wasted in the product development cycle, time is wasted in the response to new market conditions, time is wasted with go backs.

Quality of Performance also means multi-skilled production people. Production people with all of the production skills necessary to recognize and evaluate the quality necessary in each production phase.

To properly equip our human assets with the multiple-disciplines and skills necessary to complete in a global market, we need a closer relationship between academia and corporate America.

Degrees can no longer be viewed as finite. They must be structured to be dynamic and designed with a system that requires continuous and formal requalification.

The true multiple disciplined manager must view his or her degree as a starting point, not an end.

Degrees in themselves are too vertically oriented, restricted to the "science and not the art."

The subject bases should be broadened to meet the requirements of today and include leadership techniques, group dynamics, interpersonal skills, and communications, plus others.

Professional degrees should be extended to such major functions as operations management.

We must be capable of communicating in the languages of <u>all the disciplines</u>. Technically-oriented degrees such as engineering should be supported by exposure to law, finance, human relations, business management. Conversely, non-technical degrees should include some basic technical orientation.

Accounting courses deal with format and system. How about a multiple-disciplined function that is a true "financial engineer," capable of managing objectives and communicating to all the involved functions? <u>NOT JUST SCORE KEEPING.</u>

The education system must be examined:

How many campus classrooms have empty seats?

Why does the system seem to point only to degrees or certificates as the reason for education?

Shouldn't we consider every office, every factory, as a classroom joined to the learning institution via closed circuit television?

What should corporate America be doing?

Well, first, corporate America should address it's own organization design in order to manage fast response and flexibility.

An organizational design that takes full advantage of the multiple-disciplined approach which prevents go backs, and allows fast response, flexibility and shortened development time for new designs or design revisions.

Go backs are caused by organization designs that are dependent upon functions which are too vertical. As an example, many products are designed to meet market need, and then experience time-consuming go backs because the design did not recognize production feasibility with the proper quality/cost ration.

Multiple-disciplined managers require fewer players and provide a better solution in a shorter period of time.

Time cycles for product introduction must be shortened considerably to compete on a world class-basis.

NOTE: Currently a world class competitor in the automotive Industry is capable of introducing a new model in less than 2 years and we can't do it in 4 years.

Corporate America must not only address organization design but also its methods of promotions. Promotions must be awarded horizontally as well as vertically. Rotating people within functions is a key to multiple-disciplined management.

American labor management has a lot at stake and can provide significant contributions to meet global competition.

What happened to craftsmanship utilizing a variety of skills?

What has happened to trade schools? There is not enough concentration on subjects to support skill enhancement.

True job security comes from a person's ability to add value in a flexible format.

What should the role of government be?

I don't believe it should be the actual provider of multi-skilled or multiple-discipline training.

The role of government should be to encourage the capability to raise the skill level of our human resources.

Although this country may no longer lead in terms of "hard" natural resources, it does stand in a unique position in terms of its human resources.

Our society is a PLURALISTIC one. It has attracted and nurtured the best minds, experiences, talents and views from all sources of the globe.

Our government could be and should be the coordinator of opportunities to raise the capabilities of our human resources.

In conclusion, I believe that the contribution to value added that will come from a multi-skilled, multiple-disciplined work force with self-perpetuate the effort in terms of supplying the funds to make it happen.

If corporate America is going to compete in the global market, it must invest 20 percent of each person's time in skill and discipline development.

One day a week-8 hours. We waste 3 times this factor because of lack of flexibility from a design based upon a single discipline. I do believe that Murphys Law thrives in organizations with single-disciplined managers.

Is education too important to leave solely to educators?

No. We must have an alliance between academia and corporate America with government support.

Remarks

by
Clifford J. Kronauer
Martin Marietta Astronautics Group

If there is a common ground among academia, government and industry, it is that we all are amply supplied with problems.

I can confirm this from personal experience in government and industry, and it took only a little exploration to discover that there are serious problems on the minds of the educators, and certainly no shortage of those who would remind them of their problems.

One critique that comes to mind is Alan Bloom's book, The Closing of the American Mind. The subtitle of that book suggests the depth of discontent with education in this country. It is: "How Higher Education Has Failed Democracy and Impoverished the Lives of Today's Students."

A corresponding crisis in American management has been voiced ever more stridently over the past 10 years, until now there seems to be little remaining doubt that serious problems in U. S. management methods demand far-reaching change.

In my brief look at the state of higher education, I was impressed by the extent of the problems being described, and initially began to question whether we should add to the already sufficient burdens of academia by introducing the issue of education for total quality management.

Upon further reflection, I was persuaded that total quality management, if viewed in its full dimensions, deserves the serious attention of educators, both in its instruction, and in application to the systems and processes of academia.

In fact, I have come to believe that national competitiveness can be restored only if our schools, together with industry and government, cooperate to introduce total quality management with what Dr. W.

Edwards Deming calls "a sense of systems."

In 10 years of study and involvement in the problem of industrial performance improvement, I have observed that many companies fail for each one that succeeds in achieving significant breakthroughs in performance. More often than not, the failures, in my view, are attributable to "suboptimization," that is, seizing upon what turns out to be only a partial solution to the problem of improving performance. Two of a long list of examples that could be mentioned are Quality Circles and Zero Defects.

If there is anything you remember of my remarks today, I hope it will be that I raised the specter that suboptimization of effort, and the violation of Deming's "sense of systems," will occur if we fail to recognize the interdependence of industry, government and our academic institutions on the issue of total quality management for the national welfare.

Failure to integrate the three major interests represented here today into a national effort for management improvement would surely be a classic example of suboptimizing.

Looking at the problem from the industry side, I can state that I have observed deep and chronic ailments in the management systems that I have been associated with over the past 20 years. I have no reason to doubt that the crisis in U. S. management methods is every bit as pervasive as is suggested by Deming, Juran and others.

Specific handicaps that are prevalent in management include:

> Although a primary management task is to deal with variability, many managers do not understand variability in processes and systems.
>
> They often work in systems where processes are organizationally fragmented to the point that they have lost logical flow, and are the responsibility of no one.
>
> They have limited knowledge of the psychological principles that govern relations with and among the people they supervise -- a limitation often reflected in

the entrenched personnel management systems.

They are the victims of financial systems that serve up information in a form that assures wrong decisions, and distracts management attention from important problems that are not reflected in traditional financial data.

By their example, they perpetuate the unsound management practices that have been their sole experience.

Dr. E. D. Hirsch, in his book, Cultural Literacy, suggests that the nation suffers from a cultural illiteracy problem that he places on the shoulders of the education system. He also advances the interesting thought that, "It should energize people to learn that only a few hundred pages of information stand between the culturally literate and the illiterate...."

Is it possible that we face an analogous "management illiteracy" problem in the United States?

If so, one might hope that this illiteracy could also be remedied by defining a manageable number of concepts, philosophies and techniques that could become the basis for the continuing education of managers who already are in the work force, and preparatory education for future managers.

One basic question we need to face is what people need to know, and what they need to do in order to achieve the higher level of performance that is the objective of total quality management.

In the Martin Marietta Astronautics Group, we have asked ourselves this question, and are working to describe the knowledge base to support total quality management in our organization.

We also are attempting to allocate the knowledge requirements among the various components of our population, so as to answer the questions: What does top management need to know, what does middle management need to know, and what do the workers need to know to be effective at performance improvement?

Our objective is to agree on the relevant body of knowledge, in order

to be in a better position to manage the processes of infusing this knowledge into the minds of our people, developing their implementation skills, and stimulating in them the desire to change behavior.

This is not a concern for the training department, alone, but is an imperative concern and responsibility for all line and staff functions.

Drawing upon what we have learned so far, I would give the following response to the question of what we believe the schools should teach. I speak only of content, and would not presume to suggest what process educators might choose to convey this knowledge.

First would be a dedication to quality.

I define quality as "economical achievement of moral purposes."

I recognize the sensitivity of the word "moral" in this definition. I have my own idea of what the word should connote, but use it only to suggest that without a set of values, the word quality is meaningless, and that some degree of agreement on a value system is essential to both teaching and pursuing quality.

Additional instruction topics that might help to overcome some of the handicaps I mentioned earlier would include:

> Recognition that all human activity can be resolved into processes.
>
> Understanding of the concept of variability as applied to systems, processes and human behavior.
>
> Practical application of statistical concepts to management, as well as to the sciences.
>
> Appreciation of the psychological principles that support superior performance.
>
> Understanding of how teamwork and cooperation permit groups of people to magnify their collective efforts, while at the same time affording individuals greater joy and satisfaction in their work.

To close, I would suggest that what we are doing at Martin Marietta is a small model of the task to be performed on a national level. One result I hope might come out of this symposium would be a cooperative effort by academia, government and industry to define the knowledge that we collectively believe is a sound basis for continuous performance improvement.

If industry and government can state their TQM education and training needs, the academic community can address its role in satisfying these requirements.

If we can agree on the content of the education of the literate manager, we can more clearly allocate responsibilities. In particular, we all would benefit from a better understanding of what it is reasonable to expect from the academic institutions, and what government and industry must provide for themselves.

It has been suggested by Dean C. Warren Neel of the University of Tennessee that from the time of the Industrial Revolution, industry and the schools have followed parallel but independent paths of obsolescence, as they separately became more fragmented and specialized, and lost their ability to perform in a cross-functional, cross-discipline mode in this increasingly complex world. I believe his view is that it is time to develop an effective partnership that to date has not materialized. A complete partnership must also of course include government, and be a "win-win-win" relationship for all three parties.

Perhaps this symposium can be a step along the path to a common understanding and a working partnership among industry, academia and government in their individual and collective tasks of education and application of TQM principles to reinvigorate the American system.

No text available for John Evans.

Remarks

by
G.T. Wiezbicki
Provost and Deputy Commandant
Defense Systems Management College

First, we must recognize the imperative that implementing TQM at our universities ought to be higher priority than merely teaching it as a subject. If the universities properly implement the fundamentals of total quality management, then the extent to which it is a subject will be influenced by the customer demands.

Secondly, we must recognize that the customers of the university include not only the students, but their parents and their prospective employers. As such, these customers have a responsibility to shape the demands placed on the university. If customers are to expect institutions of higher learning to become "World Class," then it seems reasonable they (the customers) must be prepared to become "World Class" in their expectations. Industrial customers must be willing to make their expectations known to the university leaders and faculty, and willing to take their recruiting teams elsewhere if not satisfied.

Finally, we must recognize that TQM is a rather straightforward and fundamental approach to management. Admittedly, it would be a mistake to overlook its inherent need for cultural adjustment, but the practice of TQM does not require advanced degrees in rocket science. Excusing delays in its implementation by reference to its inherent complexity or sophistication is a lie with which effectively led enterprises do not conclude.

Section V

Team Reports

The aggregation of the 26 team activities produced the following key actions/recommendations:

- Promote total quality management (TQM) throughout the nation and its communities.
- Define the needs of the customers to academia, business, and government.
- Define the core competencies required to successfully practice as well as to teach TQM.
- Develop national leadership for TQM and involve national leadership in TQM promotion and development.
- Develop incentives and rewards for using TQM, for developing courses, and for teaching TQM.
- Be aware of and utilize the changing dynamics of the global marketplace to implement and promote TQM.
- Develop a structure for an academic, business, and government partnership to develop TQM as a process to improve national competitiveness.
- Investigate and develop resources to implement and develop TQM.
- Investigate and resolve TQM curriculum and accreditation issues.
- Develop measurements to assess the effectiveness of TQM in the work place, in academia, and in government.
- Investigate and resolve issues and problems regarding the quality of education and the use of TQM in grades Kindergarten through 12th grade in the U.S. education system.
- Internalize the use of TQM in universities.

The details of team membership and their activities follows:

Team 1

Team Leader: Herbert S. Abrams (I)*
Team Member: Gene Cole (A), Thomas E. Buzas (A), Michael Williamson (A), Joseph A. Caroli (G), Diane S. Ritter (I), Joe L. Carroll (I)

ISSUE:
Internalizing TQM at the University

* Establish student co-ops in TQM with industry
* Faculty co-ops using TQM trained faculty
* Create industry/academic advisory boards (multi-functional + multi-level, i.e. business + engineering)
  Charge board to develop a TQM implementation Plan
  To include instruction in the classroom
* Have an executive level industry/government/academic symposium with success stories.
  No delegate
* Number priority

* I-Industry, A-Academia, G-Government

Team 2

Team Leader: Jack West (I)
Team Member: G. Harlan Carothers (A), John Ettlie (A), Glen Taylor (A), William F. Wagner (I), Leslie Benmark (I), Theodore H. Criswell (G), Robert W. Rominger (G)

ISSUE:
Creating the will to change:

* Promote a mandate
* Motivate change in: (1) interuniversity; (2) external.

Team 3

Team Leader: Maureen Glassman (I)
Team Member: Lisbeth Claus (A), Edward Downing (A), J. Eldon Steelman (A), Albert J. Blesi (I), Louis P. Clark (G), Kathleen A. Eremic (G)

ISSUE:

* Bridging gap between TQM needs of industry/government and the teaching/research products of academia.
* Influencing national government funding process to emphasize TQM in research.
* Creating TQM subcommittee to draft position statement.
* Identifying key TQM supporters (CEOs, others).
* Educating & lobbying the Congress for change in research emphasis.

Team 4

Team Leader: Richard DiLorenzo (A)
Team Member: Milton Chen (A), Robert A. Thorne (A), John H. Bitzer (I), Colleen Denslow (G), Charlene Abshire (I)

ISSUE:

* There is no leadership coalition of academia, government, and industry to develop, implement, and continually improve a nationwide process to achieve world-class competitiveness through TQM.
* Establish a president's council chaired by DDFS or VP.
* Develop policy and strategy.
* Set benchmark standards - progress and achievements feedback and recognition.

REPORT:

1. We used four of the MPP tools to facilitate our examination of the issue of America's lack of leadership in global competitiveness. First, we generated an affinity diagram. We learned that there were six clusters of ideas, whose themes (headers) and sub-themes were as follows:

a) Preparing the faculty: faculty education, goal of academia, the need for change in academia.

b) Department implementation plan: organizing for action, modifying existing curricula, developing new curricula, specialized courses.

c) Nationally led actions: national standards, national level academic leadership; national industry leadership; national government leadership; role of NSF, Dept. of Education, NIST; accrediting agency participation.

d) Subject content: philosophy of management, TQM tools, recognition and rewards.

e) Motivating the faculty: consulting opportunities, what's in it for academia; federal grants; catalyst for reaction by academia; sources of funding.

f) Customer influence: voices from industry; media participation; influence of the gurus; identify the customer and other steps in quality planning; customers' perceptions of quality.

2. We then generated an interrelationship digraph. We learned that the two biggest drivers are: customer influences and nationally led actions (f and c above).

3. We also produced a tree diagram, from which we learned that the customer influence is primarily heard from the voice of industry, government, and the not-for-profit segments. Also, that government and industry primarily want educated graduates and research; and that the not-for-profit segment primarily wants research from academia.

4. Finally, we produced a matrix diagram to study the strengths of the demands from industry, government and the not-for-profit segment on academia. It showed that:

a) Industry has a high demand for educated graduates and for funded education and a medium demand for research from academia;

b) Government has a high demand for both funded education and research, and a medium demand for educated graduates;

c) Not-for-profit segment has a high demand for research; and a low demand for educated graduates and for funded education.

5. In summary, our team found that the biggest drivers in determining the role of academia in national competitiveness and total quality management are nationally led actions and customer influences. As it turned out, these were the same two primary drivers that the team leaders determined in Thursday night's meeting.

6. Our team's recommendations are:

a) The President of the U.S.A. chair a council of government, industry and academia leaders to develop strategy and

policies for the competitiveness initiative.

b) This council should establish benchmark standards to measure national progress and achievement levels.

Team 5

Team Leader: George A. Cucore (A)
Team Member: Walton Hancock (A), Alice E. Heist (A), Wilbur Meier (I), Michael E. Frye (G), Robert S. Green (G)

ISSUE:
Cross-functional Collaboration:

* Build trust through regular meetings of joint government, industry, and academia panels.
* Commit to share resources through an exchange program (people and/or facilities).
* Organize, produce, and provide training forum on TQM.

REPORT:
Establishing T.Q.M. Priorities and Critical Issues

The group was provided an overview of the TQM. seven M.P. "tool" method that would be employed during the teams study activity.

In the time allotted the team was able to complete the Affinity Diagram, the Interrelationship Digraph, the Tree Diagram and the Matrix Diagram.

As a result of the Affinity Diagram, the following major headings were developed:

* Cross Functional Deployment
* Paradigm Shift
* Customer Communications
* Customer Identification
* Customer vs. Benefits
* Technology
* Leadership
* Tools & Methods

Subsequently, the development of the Interrelationship Digraph resulted in the major identification of the Cross Functional Deployment and Leadership elements as the top priority issues.

Due to time constraints, the "Cross-Functional Deployment" issue was given top priority and the "Tree" diagram developed with the

following final outcomes:

"Cross Functional Deployment"

* Build trust through regular meeting of joint government, industry, and academia panels.

* Commit to share resources through an exchange program (people and/or facilities).

* Organize, produce, and provide training forums on TQM.

In summary, we respectfully suggest that the theme as presented in this first national symposium; "The Role of Academia in National Competitiveness and Total Quality Management", excellent as it is, it too restrictive. The word, "national" should be replaced by the word "global".

The team further supports the recommendation of a formal letter to the President as well as each state governor.

It is also paramount to establish sound time lines -- Plan our work and work out plan. This concept is well stated by Tom Peters "What gets measured gets done".

Team 6

Team Leader: Forrest C. Gale (G)
Team Member: Henry Jackson (A), Wilbur L. Weare (A), E. Fuchs (I), C. Gene Bond (I), Kurt Greene (G)

ISSUE:
Curriculum Issues: Needs, Content, Structure

* Define customer/needs
* Map needs to content
* Conceive, design, develop structure and resources
* Implement, monitor, improve.

REPORT:
Team #6 established three objectives which it agreed to pursue during the workshop portion of the Conference. These objectives were: (1) identify critical issues/problems; (2) develop and recommend actions to address identified problems; and (3) develop a rudimentary plan (who, what, when, where, how) to accomplish recommended actions, if time were available to accomplish this latter objective. There followed an amazing 6 hour session in which 44 linear feet of work was produced by the team.

The team quickly identified five major problem or "opportunity" areas which are fertile ground for academic quality improvement action. These problem areas (in order of perceived importance) are: (1) curriculum structure; (2) curriculum needs; (3) change acceleration; (4) implementation challenges; and (5) barriers to transformation. Recommendations for action were then developed and placed in one of these five problem areas.

Recommendations in problem area one (Curriculum Structure) included: interaction with accreditation groups, curriculum evaluations; customer and customer need identification; development of instructional materials and methodologies; development of effectiveness measures and criteria; priority of existing curriculum; development of competencies and learning objectives; pilot program and customer feedback mechanisms; internship and pilot quality programs, etc.

Recommendations in problem area two (Curriculum Needs) included: skills surveys; national customer surveys; business focus group

establishments; regional/local government/industry meetings; academia-industry conferences sponsored by governments (state, local, federal); survey data processing and priority establishment; faculty skill determination, university-industry interaction; awareness and benefit campaigns; government financial support; facility-faculty requirements identification; faculty TQM training programs; plan generation for faculty training and recruitment; etc. etc.

Problem area three (Change Acceleration) recommendations included: accreditation System assessment; accreditation system process review; adding TQM requirements; resistance strategy development; support development campaigns; identification of what is wrong today; faculty training and orientation; leading academic's support; industry and government leaders support; publicity for Total Quality (TQ) needs and progress; college-industry dialogue process improvement; regional/national steering group establishment; fund source development; government support and pressure development; government quality education policy deployment, etc.

Problem area four (Challenges) recommendations included: studies of winner/losers and group behavior; government fiscal policy return re: education; tax incentives for industry: finding available grants--survey; grants for faculty training; industry intern program for universities; industry interns to schools to train; industry retirees to schools to train; faculty-staff orientation (formal), etc.

Problem area five (Barriers) recommendations included: college curriculum TQ goal setting; joint college-industry curricula planning process; system for faculty input to industry; educator training program; change environment creation; faculty- staff orientation; faculty reward system emphasizing customer satisfaction; new reward system/process; accreditation process improvement and customer identification; industry membership increase on accreditation boards, etc.

Having recommended actions, the team worked on causal relationships among problem areas, determining that curriculum needs and change acceleration were the two problem areas exerting the greatest causal influence. The greatest effected problem areas were determined to be new curriculum structure and challenges. As a result of these digraph -- determined cause-effect priorities, "tree-

outs" of what specifically needs to be addressed in curriculum structure (content and delivery), curriculum needs (customer generated needs, customer networking, facilities, faculty, training funding) and change acceleration were developed. Scarcity of space precludes listing the many specific addressments generated by the group.

In this brief summary, I am unable to capture the richness of product, process and experience of this team, and thus can only list some of the products/product ideas developed by them. This work group, made up of talented representatives from industry, academia, and government (who had never met before the conference or ever before worked together) was indeed a high-performance work team.

Team 7

Team Leader: Wafik Iskander (A), Susanna B. Staas (A)
Team Member: Watts S. Humphrey (A), James E. Gardner (G), Robert J. Hager (G), Ashok Srinivasan (A)

ISSUE:

National Leadership:

* Form Committee
* Recruit Leader
* Obtain Charter from President Bush

National Agenda for TQM in industry, academia, and government by developing our vision: Our goal is to be the world leader in teaching our work force the concepts and practices of TQM by continuously improving the quality, timeliness and total cost of TQM education through a partnership with academia, government, and business, our students, our community, and our environment.

REPORT:

Team 7 began task of addressing national agenda for TQM in industry, academia, and government by developing our vision.

VISION

Our goal is to be the world leader in teaching our work force the concepts and practices of TQM by continuously improving the quality, timeliness and total cost of TQM education through a partnership with academia, government, and business, our students, our community and our environment.

To operate the vision, we developed 5 major strategies by means of the affinity diagram. The digraph led us to emphasize forming partnerships for TQM among academia, government and industry on the national, state and local levels.

To spearhead the formation of these partnerships, we determined that leadership on a national level is essential. Accordingly, Team 7 recommends:

A committee be formed from volunteers among attendees at symposium to do the following:

1. Recruit a leader of national stature to galvanize the formation of effective partnerships for TQM among academia, government and industry.

2. Ensure that this national leader receive his charter from the President of the United States, George Bush.

3. Work with the leader to develop a national advisory committee and charter to spearhead formation of the partnerships.

Team 8

Team Leader: Dan Robinson (A)
Team Member: Ronald L. Heilmann (A), Joe Jablonski (A), Philip Wolfe (A), Bonnie L. Gold (G), Ruth A. Haines (G)

ISSUE:
Define Total Quality Core Competencies:

* Identified 9 competency areas.
* Complete detailed definitions.
* Publish & report.

REPORT:
Team 8 defined their task for the working group sessions to be that of defining the core competencies that make up excellence in understanding and implementing total quality management. The group's rationale for choosing that topic was that if we didn't know what it was that academia was to teach and that industry was to implement, then why bother spending a lot of time working on ideas and strategies for getting national attention. If we can't define what it is, why do it?

In completing its task, Team 8 used specific tools from the 7 Management and Planning Tools marketed by GOAL/QPC. The team used the affinity diagram, tree chart and matrix diagram to define and begin to prioritize the competencies. We must stress that this process has just begun and the members of the team will continue to function in a modified Delphi process to flesh out the competencies and their characteristics.

The results of the affinity diagram were the identification of nine total quality competencies. Those competencies are:

LEARNING
MEASUREMENT
MANAGEMENT
CUSTOMER FOCUS
IMPROVEMENT
DESIGN
PROCESS ORIENTATION
HUMAN INTERACTION
STATISTICAL

This tentative list was then examined to determine which of the competencies to carry out to the next step and break down into their component parts. We selected the customer focus and human interaction competencies for which to construct tree charts. Customer focus was chosen because the team felt that was the bedrock on which the issue of total quality rested. Human interaction was chosen because that was the competency that really linked all the others together. Without coordination there is no action and nothing gets accomplished. That is congruent with Dr. Deming's insistence that the psychological aspect must be considered when thinking or implementing total quality activities.

The customer focus competency was seen to consist of five components. These components were further broken down to the third level of indenture, but for purposes of this paper we will only address the second level. That is:

ADOPTION OF PHILOSOPHY
CUSTOMER IDENTIFICATION
CUSTOMER EXPECTATIONS
CUSTOMER SATISFACTION
CUSTOMER INTERFACE

Adoption of philosophy was included in this competency because unless one is willing and able to accept and adopt the premise that it is the customer who defines quality, the others either will not be used, or if they are used, they may not be used effectively.

The issue of customer interface was included because it frequently is not sufficient to just find out what it is that customers want, but may need to help them understand what is is that you are able to provide them. The ability to manage a two-way conversation with customers was considered to be vital. The other issues speak for themselves.

The human interaction competency was seen to include the following second-level elements:

INDIVIDUAL DYNAMICS
INTERPERSONAL SKILLS
GROUP DYNAMICS AND SKILLS
ORGANIZATIONAL DYNAMICS AND SKILLS

These elements show a hierarchy of skills and understanding that lead to the effective coordination of action. They range from

knowing one's own strengths and weaknesses of how one thinks and acts to understanding and operating effectively in the complex dynamic environment of large organizations.

A final activity by the team was to construct a matrix diagram to study the interaction between the second and third levels of the customer focus and human interaction competencies. This led to the fairly obvious conclusion that the most useful human interaction skill was that of listening, and that was most vital for the customer expectation and customer interface skills in the customer focus competency.

The consensus of the Team 8 members was that the use of the tools available to them was extremely powerful and effective in helping to define, examine and understand the issue of competencies for effective Total Quality understanding and implementation. This led to very useful information for understanding the areas of instruction and training in which both academia and industry need to focus their efforts.

As mentioned earlier, this effort is not complete and the Team 8 members will continue to explore this area and expand the results. A report on their efforts will be available for the 1991 conference.

Team 9

Team Leader: Tony Kondrotis(I)
Team Member: D. L. Kimbler (A), K. D. Lam (A), Terry D. Marion (A), Sam Stephenson (A), W. David Jones (I), Ned Hamson (I), James M. Horner (G)

ISSUE:
How to develop the academic, industry, government TQM partnership at state government level.

1. Key players must be identified and involved at earliest stages of partnership development.
2. Each partner needs to define and communicate their customers to other partners upon completion, the group must identify common customers.
3. The triad group must define common bonds and major barriers, this process will lead to a working structure.

REPORT:
INTRODUCTION

The focus of Group 9's work was to define a clear cut approach/method/process to develop an academic, industry, and government partnership. Due to group interest and the level of complexity of a nation wide system, we decided to concentrate on a system at the community/regional level. As with all groups, dynamics played a key part. The group was well versed on the subject, and most had experience utilizing the seven management and planning tools or similar techniques for brainstorming and problem solving. The next few pages illustrate the groups work of the issue and in addition, supplies definition of terms. Some suggestions for the development of the triad partnership are included.

HOW TO DEVELOP THE ACADEMIC, INDUSTRY, AND GOVERNMENT TQM PARTNERSHIP AT THE COMMUNITY/REGIONAL LEVEL.

KEY DEVELOPMENT STEPS:

* Key players must be identified and involved at the earliest stages of partnership development.

* Each partnership needs to define and communicate their customers to other partners; upon completion of the latter the group must identify common customers.

* The trial group must define common bonds and major barriers; this process will lead to a solid working structure.

HOW TO DEVELOP THE ACADEMIA, INDUSTRY, AND GOVERNMENT PARTNERSHIP AT THE COMMUNITY/REGIONAL LEVEL

Affinity

Identify key players
* Key personnel
* Identify drivers (movers and shakers)
* Identify key players

Marketing TQM Concept and Partnership

* Media involvement
* Selling tools
* Newsletters to partners
* Communication vehicles
* Visibility of process and goals
* Forum for communication

INVOLVEMENT & INPUT OF OTHER STAKEHOLDERS
* Medium for other institutions
* Involvement of religious community
* Involvement of K-12 community
* Others (non triad)

CUSTOMER RELATIONSHIPS

* Identify constituents of each
* What are the interests of the partners?
* Identify customers of the relationships
* Identify int/ext customers of academia
* Identify int/ext customers of government
* Identify int/ext customers of industry

IDENTIFY MOTIVATORS
* Common bond

* Perception of crisis
* Identification of key barriers
* What's in it for me/us?

DIRECTION OF PARTNERSHIP

* Develop common vision
* Vision of need
* Local/regional focus
* Who is the visionary to start?

STRUCTURES & PROCESSES

* Identify processes within partnership
* Inputs/outputs
* Execution of projects
* Resources
* Allow dyad partnerships

DEFINITIONS OF AFFINITY HEADER CARDS:

IDENTIFICATION OF KEY PLAYERS: Methods and processes of bringing key people into the system of TQM, this is imperative and crucial relative to forming a partnership among academia, industry, and government.

MARKETING TQM CONCEPT AND PARTNERSHIP: This is one of the first items in the process, it publicizes the activity and brings in additional players while building enthusiasm.

INVOLVEMENT AND INPUT OF OTHER STAKEHOLDERS: The act of involvement which expands the partnership and in addition, adds scope to its activities.

CUSTOMER RELATIONSHIPS: Identification of customers, their requirements, and relationships in order to satisfy any needs before changes or recommendations are made which will not increase customer perception or satisfaction.

DIRECTION OF PARTNERSHIP: All partners need to contribute to a vision/mission to increase TQM awareness and contribute ideas and philosophies to increase the community competitive position.

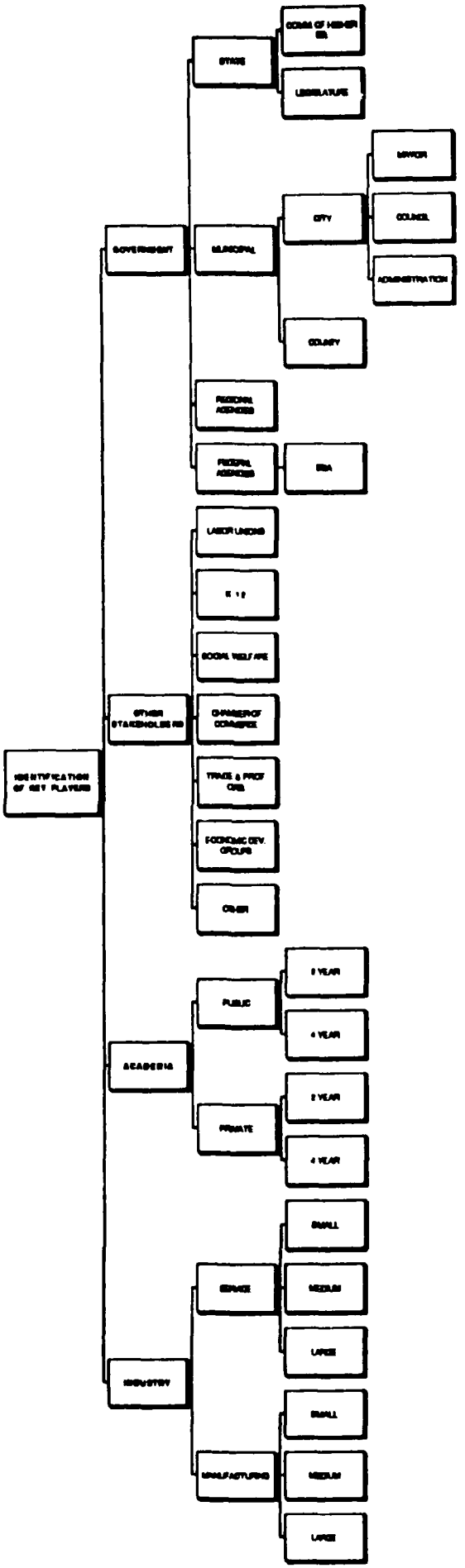
STRUCTURE AND PROCESSES: Identify required resources and develop process structures necessary to support/serve the partnership initiatives.

IDENTIFY MOTIVATORS: The identification of key motivators that are common to all parties to initiate the nucleus to forward TQM efforts.

PROPOSED ORDER OF EVENTS:

1. Identify motivators
2. Identification of key players
3. Customer relationships
4. Direction of partnerships
5. Structure and processes
6. Marketing TQM concept and partnership
7. Involvement and input of other stakeholders.

TREE DIAGRAM
(Not Complete)



Team 10

Team Leader: Robert Krone (A)
Team Member: Mahdi Kaighobadi (A), Mark S. Lang (A), Mark Treleven (A), Michael J. Kelley (I), Jeannette E. Hatton (I), Christine Kopocis (G), Margaret Wallace (G), Ray Bruce (A),Elizabeth Power (I)

ISSUE:
Resistance to change is the most powerful barrier to implementing TQM.

1. Practice quality process within education.
2. Government promotion of quality process as national agenda.
3. Industry be a proactive customer.

REPORT:
GOVERNMENT/ACADEMIA/INDUSTRY
1991 UNIVERSITY OF SOUTHERN CALIFORNIA (USC)

The 1991 National Quality Partnership Symposium at USC

How to build on these beginnings
Provide your recommendations
Think of any aspect from planning to follow-up
Write each idea on a separate slip
Long way, clean language, many slips

THE CULTURE OF QUALITY: AN IMPERATIVE FOR EDUCATION

Morgantown Product
"Toward a National Quality Program"

Customers:
Leadership in
Academia
Government
Industry

Issue 1. TQM PHILOSOPHY AND DEFINITIONS:
How to know the right thing to do.

The dominant business/engineering management paradigm is in conflict with many principles of the emerging quality management paradigm. There is also a great deal of noise in this emerging quality management paradigm.

Action Steps Recommended:

1. Sponsor cross-discipline research or the management of Quality in education and the work place.
2. Conduct symposium, conferences and workshops to evaluate research results.
3. Professionalize quality management methods.

Issue 2. MEASURING NATIONAL QUALITY:
How to know where we are in the process

- Criteria
- Standards
- Database
- Networking
- Benchmarking
- Opportunity Costs:
  - Academia
  - Industry
  - Government.

Issue 3. BARRIERS AND OBSTACLES TO CHANGE:
How to overcome pitfalls and setbacks.

- Fear
- Values:
  - Tribal
  - Power
  - Status quo
  - short term
- Ignorance
- Inaction
- Rewards/Recognition
- Paradigms
- Invisibility of benefits
- Build champions/converts
- Model TQM in administration
- Forge G/1/A partnerships
- Teach personal change management skills
- Implement TQM at personal level.

Issue 4. ACADEMIA'S ROLE:
How educators should infuse quality

1) Teach by example, not words (culture of quality) cross functional presentations, problem solving, evaluate to improve not judge
2) Apply TQM methods to process of educating retraining, new reward system, evaluation of system
3) New research
   Measurement methods
   Incentives/group dynamics
   Information management tools.

Issue 5. INDUSTRY'S ROLE:
How to capitalize on private sector gains

Communicate Needs
Sponsor Research
Effect Proactive Relationship
Share Validated Training Materials
Award.

Issue 6. GOVERNMENT'S ROLE:
How to assist in the partnership

Government participation from President Bush to local agencies
Facilitate change process in education
Project literacy programs
Cooperative programs
Staff sharing
Recruitment
Legislation
Increase interplay between government and academia in TQM.

Team 11

Team Leader: Edward H. Konik (I)
Team Member: L. Ken Keys (A), Philip S. Kronenberg (A), Fred McFadden (A), Kenneth G. Haug (I), Stephen D. Napier (I)

ISSUE:

Internalize TQM at University:

* Establish academic respectability for TQM.
* Convince University to adopt "customer orientation".
* Empower faculty/staff to revitalize the collegial structure.

Team 12

Team Leader: Jack McGovern (A)
Team Member: Mark J. Kiemele (A), Lance Kurke (A), Carl E. Locke (A), Garry Maddux (A), R. Steve Kuykendall (I), William W. Jenks(I), Steve Ungvari (I)

ISSUE:

Establish National Advisory Council and Regional Committees:

1. TQM promotion and networking.
2. Training, teaming, and curriculum input.
3. Resources.

REPORT:

The area of concentration was to generate a strategy that would perpetuate the theme of the conference; i.e., Academia's role in TQM, so that a future solution can be realized. To this end, and with the use of the new management and planning tools, affinity and interrelationship diagrams, etc., the following strategy was recommended.

Establish a National Advisory Council (government, industry and academia) and Regional Committees. The mission of the Council and Committee are:

1. TQM promotion and implementation of a national networking system.
2. Training and Teaming to determine curriculum input requirements.
3. Assessment of the resources required to accomplish number 1 and 2, above.

Team 13

Team Leader: Billy E. Richardson (I)
Team Member: Kim McManus (A), James Perine (A), John D. Rohrbough (A), H. Andrew Scott (A), Bob Phillips (I), Douglas P. Lansing (I), Gregory Wierzbicki (G), C. Harold Brown (I)

ISSUE:

* Define customer needs.
* Create leadership council of academia/industry/government.
* Revisit standards of excellence for quality in education based on "customer" demands.
* Survey industry and recent graduates to determine needs and requirements.

Team 14

Team Leader: Marta Mooney (A)
Team Member: Steven Miller (A), Dale O. Richards (A), Myron J. Schmenk (A), Yechiel Shulman (A), Dean F. Poeth (I), Carol Tierney (I), Mike Trescak (G), Fleming M. Fox (I)

ISSUE:
National TQM Council:

* Certification: ABET type, Baldrige basis
* Membership: professional societies government, etc..
* Funding: primarily industry and government, academia space and time.

Team 15

Team Leader: James F. Guzzi (G)
Team Member: Edward F. Mykytka (A), Harry V. Roberts (A), Charles H. Samson (A), R. K. Powell (I), Lawrence B. Molner (I), William A. Schneider (I)

ISSUE:

TQM Leadership: To create a national alliance of industry, government, and academia to provide a leadership role in:

* Encouraging the adoption of TQM in academic administration
* Incorporating TQM in the academic, research, and service functions of colleges and universities
* Encouraging the creation of a national policy related to TQM and education at all levels.

Team 16

Team Leader: Richard Foley (I)
Team Member: Robert L. Milam (A), William J. Petak (A), Dan Sipper (A), Paul L. Shaffer (A), Robert D. Morrow (I), Allan R. Schubert (I), William McDaniel (G)

ISSUE:

K THRU 12

* Quality
* Quantity

Assessment Systems are required:

* To compare customer expectations with current graduates
* To quantify value added by the educational process
* For instructional performance.

REPORT:

1. In order to achieve continuous process improvement, it is imperative that academia have an assessment system for use by higher education that incorporates customer expectations relative to current university graduates.

2. In order to achieve a continuous process improvement, academia needs to have an assessment system to quantify the value-added by the educational process.

3. In order to achieve a continuous process improvement, academia needs an assessment system for instructional performance.

4. Inadequate supply of students from K-12.

Team 17

Team Leader: Emil Steinhardt (A)
Team Member: Philip Wolfe (A), Allan L. Soyster (A), Elana Stern (A), Richard J. Vitry (I), Normand Therlault (I), Robert Stovall (I)

ISSUE:

* Define customer needs
* Structure for partnership
* Our key issue which relates "Industrial customer not satisfied!" -- a reason for this is that university has lost sight of its role.

Industry's Role:

* To train love of creativity and satisfaction
* To use talent and education properly.

University's Role:

* To educate student: to know how to learn; to desire to learn; work ethic; communicate effectively, internally government /industry/academia, internationally (government drowns us in paper work).
* Exposure to industry: faculty and students.
* Proposal: increased emphasis on intern -- apprentice programs while in school, good for students and added pressure on faculty.

REPORT:

The team took as its focus:
"What Issues Are Associated With Academia Supplying The Right Product?"

While developing an affinity diagram, the team identified the following issues:

1. Who is the customer
2. Exploding technology
3. What practical tools should students acquire
4. Internal resistance to change by faculty
5. Long-term or short-term definition of right product
6. Feeling of perpetual existence by schools
7. Teaching effective communication
8. Departments cooperating across the curricula

9. Is there a plan for change
10. Schools not connected to product
11. Teachers not convinced
12. University bound to past tradition
13. Universities do not know customers
14. Industry needs to treat the university as a strategic partner
15. Elitist Attitude Culture
16. Universities believes professors better than staff of students
17. Who pays for all of this
18. No way to measure "right" product
19. Right product when (now or 20 years)
20. Broad base of industrial users
21. TQM Course or degree
22. Statistics should be required
23. Role of government
24. Industrial customer not satisfied
25. What to teach
26. Process of curriculum change
27. Fear of change
28. What tools to give students

By constructing an affinity diagram and then an interrelational digraph, the team identified that the key issue among the many issues was:

"The Industrial Customer Is Not Satisfied!"

The team believed that the reason for this is that:

"The University Has Lost Sight Of Its Role."

The team believed that the following perspective should be viewed as its contribution to the leaders of the symposium. With the current emphasis on total quality management, these comments provide a perspective as to the roles of industry and the university. Each has an obligation.

"The role of industry is to train, to foster in its employees a love of creativity, and to use the talent and education of its employees properly.

The role of the university is to educate the student -- to know how to learn, to desire to learn [love of learning], to have a work ethic, and to communicate effectively. Communicating effective includes: internally, government-industry-academia Relations, and internationally. [A comment was made that government drowns us in paper work]."

The team made the following proposal:

At the university, increased emphasis should be placed on Intern Apprentice Programs with industry. The programs would benefit the student and make them more qualified before they graduate. The programs would also pressure the faculty to do better. As the students learn more in industry, they will bring more questions and insight to the classroom. This would create a much more demanding set of students for the professor.

Team 18

The members in this team joined other teams.

Team 19

Team Leader: Ron Powell (I)
Team Member: M. Dayne Aldridge (A), H. A. Germer (A), Baxter D. Wellmon (I), P. R. Esposito (A), Walter Gonzalez (I), William McDaniel (G), Biman Ghosh (A)

ISSUE:
Awareness-Motivation and Reward in all three sectors:

* Address lack of understanding of need to change by instilling the urgency in each individual.
* Drive high expectations for all levels: self, customers, suppliers, and all organizational levels.
* Restructure system to reward: teams, efforts, prevention, and risk taking.

REPORT:
The problem chosen by the team was to identify critical attributes for implementing TQM in the three sectors. Three target areas were selected from the Affinity Diagram and the following summary was derived from further analysis using the Tree Diagram (see attached). The three key areas proved to be 1) Planning and Implementation, 2) Awareness, Motivation and Reward, and 3) Cooperation Between Participants.

Planning and Implementation. This is a key ingredient that will determine our success to a large measure. Time spent here will hopefully result in a time-phased focused effort that will gain momentum. A time-phased Master Plan that presents the schedule for goals and milestones in each sector should be developed and then statues once or twice each year through a network of contacts. This bed-sheet plan would graphically portray all the parallel thrusts that are taking place at any given time. A narrative describing the How-to Plan of Implementation should be a companion document to the Time-Phased Master Plan. A Mission Definition Statement is required and one that would also identify "who are our customers." Customer supplier relationships could then begin. How to teach TQM in the different disciplines is another issue facing academia, as is including K-12 through graduate level. This would require total involvement at the various levels in the planning process.

Educating for a lifetime and training vs. education are other issues

that require analysis and definition. Identification and integration of all TQM tools available should be developed and distributed. The Planning and Implementation phase should proceed with "sell by example."

Awareness, Motivation and Reward. Awareness within the three sectors as well as general public understanding are specific challenges we face. Effective methods to reach them require careful study for maximum impact. Six issues were identified under this subject; 1) lack of understanding of need to change is an issue in all three sectors - possibly more, so in academia due to their limited involvement in TQM thus far. There is a need for an industry consensus to help change academia and government. It is felt that the 'time' urgency should be conveyed to all individuals in the three areas and develop/distribute a definition of quality that is applicable to all 3. 2) Existing high-standard of living makes us lazy and, in a general sense, puts the public out of touch with reality and value system. 3) General public unawareness should be addressed through proven methods to address TQM and the reality of where we are. 4) Lack of motivation to excel is generally manifested by low expectations at the beginning. These expectations need to be raised by customers, management and workers in all sectors. 5) Rewards needed to overcome barriers would include the rewarding of teams, 'efforts' even though they may fall short of goal, prevention, and risk-taking. 6) There is a need for personal goal setting, in all three sectors that should be encouraged as well as the alignment of these goals collectively with continuous improvement.

Cooperation between Participants. Five areas were identified to be addressed to enhance cooperation at all levels between the sectors: 1) TQM should be universally emphasized in all sectors with a local, regional and national network established. Empowerment at all levels is necessary to effect cooperation. 2.) A closer partnership between the sectors should be encouraged including interchange often, providing enabling power to effect decisions and with demonstrated government support of industry/academia endeavors. 3) Government procurement policy is not aligned with TQM and requires congressional and public awareness of the issue. 4) A cross-fertilization between industry management and academia is suggested with an exchange program increased and broadened to include academia in industry TQM classes. 5) More cooperation is needed to better define customer/supplier relationships and roles across the three sectors. Groups of industry contacts with academia

is required (representing small bus/small disadvantaged business). The same is required for government.

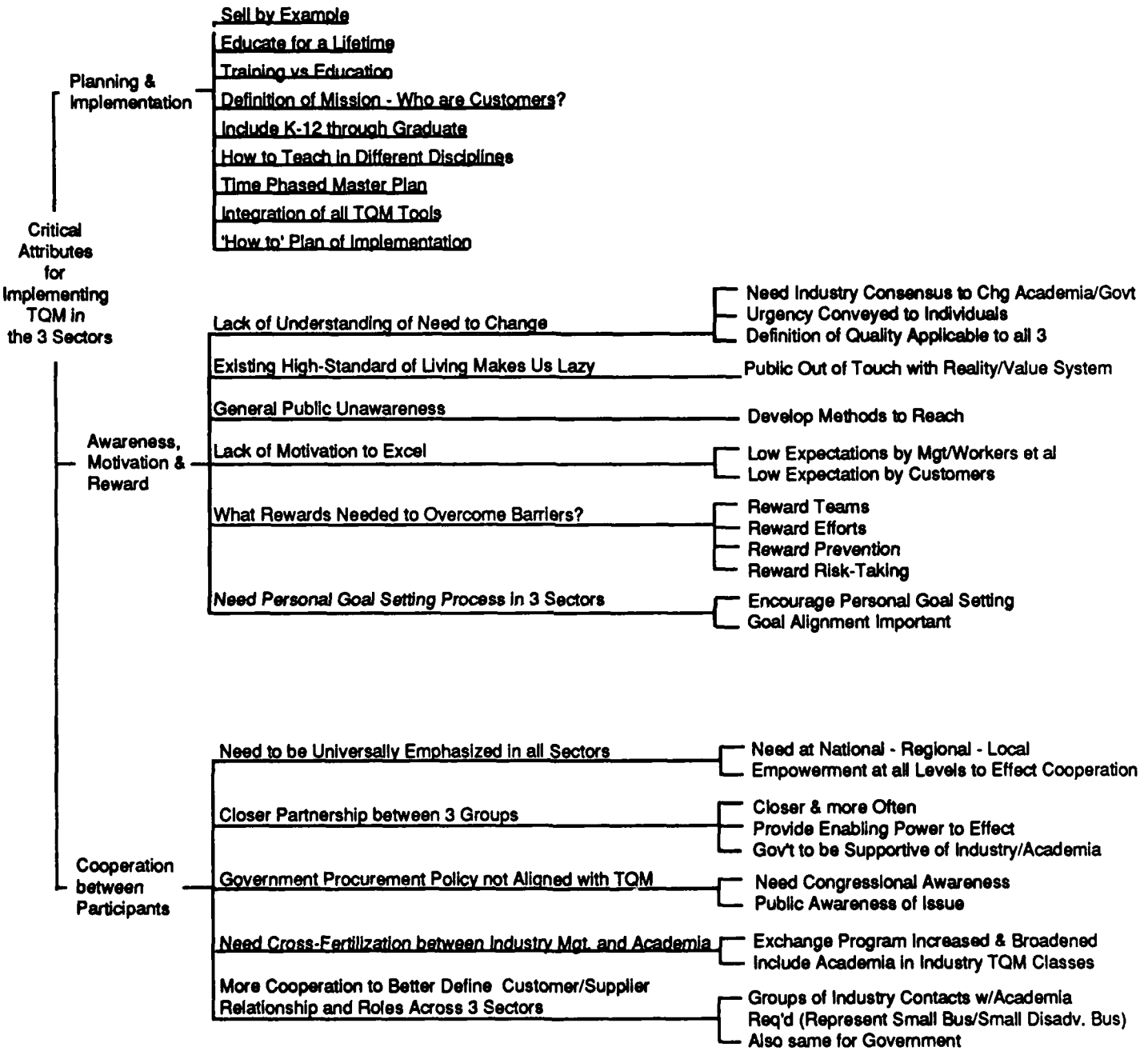
The team concluded that the near-term action with the highest payback would be as follows:

Awareness-motivation and reward in all three sectors:

- Address lack of understanding of need to change by instilling the urgency in each individual.
- Drive high expectations for all levels: self, customers, suppliers, and all organizational levels.
- Restructure system to reward: teams, efforts, prevention, and risk taking.

TREE DIAGRAM

CRITICAL ATTRIBUTES FOR IMPLEMENTING TQM IN THE 3 SECTORS



Team 20

Team Leader: Clifford J. Kronauer (G)
Team Member: Pieter A. Frick (A), Abbie Griffin (A), Thomas West (A), S. Dwight Wheeler (I), Alan Chapple (I), Robert Brennenstuhl (G), Carolyn McKinley (A), Michael J. Kruger (G)

ISSUE:
What Do Employers Really Want from Academia with Respect to TQM? Removing barriers to the dialog.

* Definition: tripartite work group definition, TQM journal.
* Promotion: presidential commission media exposure.
* Rewards: government grants faculty incentives.

Team 21

Team Leader: Bill Alexander (A)
Team Member: Leland Blank (A), Robert A. Sprague (A), Samuel L. Wiley (A), Richard DiLorenzo (A), James B. Ardis (I), Ralph T. Wood (A)

ISSUE:
Value Systems: the incentive and reward structure that includes dimensions of measurement, reward and satisfaction.

1. Build TQM into measurement criteria and instruments.
2. Modify reward systems to foster continuous improvement.
3. Emphasize personal motivators to encourage empowerment, influence, security and self worth.

REPORT:
The team members selected the following statement as a topic for analysis for using the seven management - planning tools. This topic was considered part of the Symposium general theme.

"We need to resolve cultural issues between, among and within industry, academia and government before academia can play an effective role in national competitiveness."

The team completed an Affinity Diagram which produced eight major issues. See attached summary of Diagram.

An Interrelationship Digraph was completed to ascertain the primary casual issues and those which are primary influenced issues. The table below shows those eight issues in rank order based upon the number of outgoing and incoming arrows.

Issue	Causing Change (arrows going out)	Being Influenced (arrows coming in)
Value systems (incentives & rewards)	6	0
Academic customer/stakeholder confusion	2	1
Lack of understanding of customer expectations	2	2
Entrenched vertical thinking	1	1
Conflict between expressed goals and behavior	1	2
Resistance to change	1	2
Quality, an input issue rather than institutional goal	1	3
Term of focus (long- or short-range goals)	0	1

The team selected the value systems issue and developed a Tree Diagram. Value systems reflect the incentive and reward structure that includes dimensions of measurement, rewards and satisfaction. The results are shown below:

Value Systems
1. Measurement
    - Frequency
    - Criteria
    - Standards
    - Process
2. Rewards
    - Financial
    - Responsibility
    - Recognition
    - Independence
3. Satisfaction
    - Sense of worth
    - Security
    - Influence
    - Empowerment

Next, a Matrix Diagram was begun using the twelve elements produced from the Tree Diagram as the "x" axis and the remaining seven issues developed in the Affinity Diagram as the "y" axis.

Selecting the Y axis criteria was difficult for the group since there were so many different possibilities for ascertaining multiple data. As a result, we completed approximately three columns in this matrix before time ran out.

In summary, the team was able to accomplish two things: (1) gain experience using four of the seven management planning tools, and (2) develop and analyze key issues which have impact on the implementation of TQM into academia. We were pleased to see that our issues were duplicates of or very closely related to the final twelve issues identified by the team summaries.

This was a very rewarding learning experience.

I should like to express my sincere appreciation to each of my team members who worked diligently through the periods of uncertainty,

confusion, frustration, analysis, synthesis and evaluation. Their patience and persistence was exceptional.

Copy of Report of Team 21 at Summary Session

Issues: Value Systems

Statement: The incentive and reward structure that includes dimensions of measurement, rewards and satisfaction.

Suggested Actions:

1. Build TQM elements into measurement criteria and instruments.

2. Modify reward systems to foster continuous improvement.

3. Emphasize personal motivators to encourage empowerment, influence, security and self worth.

ATTACHMENT

Results of Affinity Diagram

1. Lack of Understanding of Customer Expectations (no sub topics)

2. University: Quality An Input Issue Rather Than An Institutional Goal (no sub topics)

3. Customer VS Stakeholder Confusion
   a. Focus on process rather than outcomes
   b. Customer focus
   c. Funding imperatives

4. Vertical Thinking - Entrenchment
   a. Traditional thinking - (we don't do it that way).
   b. Background of professor as he/she was educated in past.
   c. Research syndrome - (I do research and don't have to worry about delivery and schedules).
   d. Higher education disciplines
   e. "Stovepiped" departments
   f. 100 percent academic - poor research model for industry.

g. Lack of perceived incentive to work with others in teams.

5. Term Focus - Goals
   a. Goal issues
   b. Industry vs. university: Short-term focus, long-term commitment.
   c. Education vs. training

6. Resistance to Change
   a. Lack of stimulus for change
   b. Reward system not conducive to change: "spikes of excellence"
   c. Accreditation barriers to change
   d. Mixture of faculties from different countries
   e. Lack of trust
   f. Opportunity for interaction
   g. Industry organization is unique -- first must train
   h. Fear of being wrong or different

7. Conflict Between Expressed Goals And Behavior
   a. Reorganize teamwork value
   b. Measurement -- reward system
   c. Recognition of need for TQM

8. Value Systems
   a. Peer inequities
   b. Industry pays for structure and value
   c. Academia provides personal freedom for low pay
   d. Government offers high structure, low freedom and compensation.

Team 22

Team Leader: Charles G. Yarnall (A)
Team Member: Uttarayan Bagchi (A), Frank Alt (A), Sheila Derdeyn Kalas (A), Tom Glass (I), Charles M. Parks (A)

ISSUE:
The Education of Quality Principles and Practices -- Addresses the need for an educational process that instills TQ concepts across all appropriate disciplines in higher education and in the secondary school curricula.

* appropriate incentive and rewards.
* Paradigm shifts/cultural change.
* Form industrial boards of advisors.

REPORT:
THEME

The interaction among industry, government and the academic community for total quality management.

The primary issues and concerns for infusing total quality into the academic community are seen by our team as follows:

I. Affinity Diagram

1. Accreditation and Administration Viewpoint - set and meet artificial numerical goals.
2. Paradigm Shifts - adopt the fact that a cultural change is required.
3. Management Must Learn to Understand Random Variation - statistical input and statistical thinking in our work.
4. Quality of Educational Process - total quality management must embrace K-12, undergraduate and graduate education.
5. Why Quality - productivity yesterday, quality today, what tomorrow?
6. The Customer Becomes Kami (King) - who are our customers and what are their needs?

7. International Competitiveness - bench mark where you are against the best of the best!

II. Interrelationship Chart

After charting the (7) issues, Quality of Educational Process (No. 4) was the key concern that surfaced as the root cause.

III. Tree Diagram

With the root cause being identified (Quality of Educational Process), we established four key supporting concerns.

1. Cross functional curriculum
2. Graduates that are being sought
3. ASQC Certified Engineers (CQE)
4. View academia as the supplier, responsible to customers - government and industry.

IV. Matrix Diagram

As a result of working our tree diagram to 3/4 levels, we found working thru the matrix process four definable and assignable areas are identified. They appear in their rank and weight values.

1. Establish University, College and accreditation body requirements. (53)
2. Create a passion for quality. (48)
3. Define lines of communication. (40)
4. Develop real life examples. (24)

Next are the immediate corresponding areas (tasks) needed to be redesigned to bring about continuous improvement. They appear in their rand weight value.

1. Customer first (37)
2. Cross functional curriculum (37)
3. Paradigm shifts (33)
4. Academic environment and barriers removed. (33)

SUMMARY

As the team discussed each issue several points continuously surfaced (these are represented in the sub-sub-areas) and should be focused on.

1. Redesign Reward and Recognition System - it was agreed this would be a primary motivation area.

2. Walk the Talk - here the concern was real and meaningful follow thru.

3. Fear/Trust - during each discussion a lack of support and trust was present.

Team 23

Team Leader: David A. Kelly (A)
Team Member: Ralph Bledsoe (A), Mason H. Somerville (A), John Grasso (A), Ralph Ponce DeLeon (I), Robert G. Batson (A)

ISSUE:
National Leadership Value: Paramount to effort success
Need: Federal & state mandates
Action: Letters

From: Symposium leadership
To : White House Chief/Staff; each state governors chief/staff.
RE : Outcome of symposium and need for top level leadership
For : Presidential imperative proclamation; governor's imperative proclamation.
Target: year 2000 Quality initiative for triad Identify all customers and products 100 percent goal: all outcomes

REPORT:
1. TO:
    1. White House Chief of Staff Summon (by name)
    2. Each states governor's chief of staff (by name)

RE:

Recommendation/request for a presidential initiative letter on quality (quality in educations, for product and services quality improvement, identification of customers and their expectations, and meeting those expectations).

ACTION:

a) Non-departmental responsibility.
b) Presidential initiative/imperative to all institutions and communities.
c) Immediate implementations.
d) #1 world-class good by year 2000.

CONSIDERATIONS/FUNDAMENTAL NECESSITIES:

a) We must change/improve our way of thinking about/treating each other (all deserve proper education/training, right to work if desired, continuous

education to adequacy, life-long learning environment, and insurance of quality in all aspects of life as we know it to be possible.

b) State governor initiatives to follow/support president's statement.

c) Quality training/funding support to follow.

2. A quality initiative to/by all education institutions-earliest.

Substance:
Management quality orientation/training for all college/university administrators, deans, and faculty members. Philosophies of leadership and management exposed, explained, drilled, and reinforced for above plus staffs and students.

Sample Areas for Improvement:

a) Self appraisal and development

b) Student graduation rate (expect/strive for all students admitted will graduate with 4.0 grade).

c) Tenure rate (accept only 100% success rate).

d) Grading/student evaluation process/procedure

e) Interest conflicts among the faculty are teacher vs "evaluation".

f) Continuing education for faculty, staff, and administration.

3. Reorientation of college/university identification of its customers and establishing alternatives to the "inspecting of quality into the product".

Problems:

a) Most undergraduate students come in contact with faculty -- faculty that often places importance of self, research and sponsors, T&P committees, and the institution (in that order) ahead of the student.

b) Institutions management/administrators do not always insist the the student is/should be the principal customer.

c) Universities do not identify and prioritize their customers and their expectations.

d) Universities still inspect quality into their product.

Changes/Improvement

a) University staffs and faculties must appreciate, accept, and accomplish self assessment and commitment to quality teaching, learning and student.

b) Faculty and staff must identify/meet expectations of each of their customers/products.
c) Ensure flexible schedule for student progress and assessment: Monotonic development.

1. Why are we here?

2. Who is the customer?

3. What is the customer's time frame?

1. We are here to:
   a) Examine academia's evolving role in the education of future engineers and managers (in philosophy and methods necessary to achieve world-class excellence).
   b) Promote a national planning process to be used by academia, industry, and government to significantly enhance America's global competitiveness.
   c) Lay the groundwork and set the agenda for the president's imperative that our math/science graduates by the year 2000 be the best in the world.
   d) Develop a national agenda to address TQM in business/engineering education, training, and research.
   e) Form a network for on going TQM collaborative efforts.
   f) Brain storm imperatives identify interrelationships (if any), and set initial objectives/time frames of each.
   g) Identify new/engineering models for corporation between industry, government, and academia to pursue mutually beneficial objectives.
   h) Define a model for academia's increased cooperation with industry and government.
   i) List the mutual objectives of the trials.

2. The customer is:
   a) The student (majority, minority, international)
   b) The college/university employee
   c) Industry (manufacture, services)
   d) Government (federal/public service, tax payers, nation's reputation
   e) Academia (administrators, faculty, curricula, national networks)
   f) Community
   g) American people.

3. The customer's time frame is:
   a) Now (1990 - a sincere, critical appraisal/self-evaluation)
   b) One Year (1991 - the next symposium)
   c) Five Years (1995 - half-way progress evaluation)
   d) Ten Years (year 2000 - the President's imperative)

Questions

1) What will satisfy the customer(s)?
2) How to define the tried partnership?
3) What are the cross-disciplines in question?
   a - Which need change?
   b - How prioritize?
4) What exchange does academia need?
   a - From industry?
   b - From government?
5) What is academia's?
   a - Product?
   b - Service?
6) How best/when to begin the necessary?
   a - Collaboration?
   b - Coordination?
   c - Communication?
7) What is the action list for year one?
   a - Academia?
   b - Industry?
   c - Government?
8) How to best define the national planning process by participant, time frame, need, and output.
9) Can the Malcolm Baldrige award be applied to Academia (within year 1)?
10) How best to define a new approach to education by the nation/each institution?
11) What is the TQM involvement/mandate for the liberal/fine arts and natural sciences communities of the non-business student population?
12) How/when should the colleges/universities begin to alter/arrangement their faculties for TQM incorporation?
13) How best to identify, prepare for, and implement the increased role(s) for women, minority, and international students in TQM education/career functions?
14) How best to raise the national awareness of TQM and the

mandate for its implementation into/by academia?

15) Who should be responsible for the initial/ongoing curriculum reviews for TQM incorporation and redefinition?

16) How but to improve the product of academia, the student population for TQM implementation?
   a) Business
   b) Sciences
   c) Non-business

17) What other questions need definition (and possible answer) before the end of year 1?

18) What is definition of TQM?
   Thought revolutions is management.

19) How to measure quality in services organization?

Team 24

Team Leader: Mike Herrington (I)
Team Member: James V. Foran (A), David Haddad (A), Paul E. Givens (A), Kenneth Harling (A)

ISSUE:
Internalize TQM "Walk the Talk":

1. Practice/apply TQM in your department.
2. Promote and grow your successful example to other departments of your organization, for example, engineering college to business college.
3. Benchmark

Xerox/Motorola Facilities
University leaders are the benchmark team
Find, understand and promote academia "best practices"
Your leadership can break down the barriers to change.

REPORT:
1. CONCLUDING RECOMMENDATIONS

Group 24's recommendations for next steps are based on the definition of leadership discussed by Bob Galvin, CEO of Motorola. This is leadership as exhibited by role models. We believe that the attendees of the Symposium are themselves leaders of the respective constituencies in business, academia and government. We challenge the attendees to "walk the talk" by first practicing TQM and then advocating and demonstrating TQM to their larger organizations. Our specific recommendations are:

Practice/apply TQM in your department.

Promote and grow your successful example to other departments of your organization. For example Engineering College to Business College.

Our third recommendation is that the leadership of the Symposium organize a benchmarking project for academia to spread the examples of very good work of the few truly "world class" institutions to all colleges and universities.

* Ask Xerox/Motorola to supply people to facilitate the benchmarking process.

* The group doing the benchmarking will be made up of presidents and similar high leadership representatives of academia.
* The objective is to find, understand and promote academia "best practices."

YOUR LEADERSHIP CAN BREAK DOWN BARRIERS TO CHANGE

2. AFFINITY DIAGRAM

Group 24 developed an Affinity Diagram to identify major issues. As the basis for this diagram we listed the college graduates and hiring industries as the primary customers. We defined our objective as;

PRODUCE THE HIGHEST QUALITY GRADUATES TO CONTRIBUTE TO SOCIETY.

Based on this, we concluded that there were four key obstacles;

* External (to the university) issues and opportunities
* The cross discipline nature of TQM
* Academic culture and organization
* Knowledge of TQM and content.

Attached Figure I presents the numerous issues identified in the Group that were combined into the above key issues.

3. INTERRELATIONSHIP DIGRAPH

Group 24 evaluated the cause and effect relationship of the four key issues produced by the affinity process. This exercise concluded that the academic culture and organization was the key causal issue from the perspective of meeting the expectations of the graduates and hiring companies in "producing the highest quality graduates to contribute to society."

We further identified that within the culture and organization of academia, the resistance to change was the major factor to address.

4. RESISTANCE TO CHANGE TREE DIAGRAM

The resistance to change was divided in three areas - WHY CHANGE

(JUSTIFICATION), PERSONAL OBSTACLES TO CHANGE and SYSTEMIC OBSTACLES TO CHANGE. Under these areas, the group identified the following factors;

WHY CHANGE (JUSTIFICATION)

Lack of customer input
Lack of benchmarks (general knowledge of best practices)
Insufficiently high expectations

PERSONAL OBSTACLES

Fear of failure
Lack of peer support
Comfort with the known

SYSTEMIC OBSTACLES

Accreditation process
Reward system
What they give up to make room for TQM teaching
Need to create new course materials and content

5. RECOMMENDATION MATRIX - SYSTEMIC OBSTACLES

Reward System	Define current system	Establish Measurement System	Reward good teaching	Reward innovators	
What to give up to make room	Define current system	Establish Measurement System			reassess present
Obtain new materials	Define current system	Establish Measurement System		Reward innovators	Create a database of available materials
Accred-itation process	Define current system	Poll Customers (industry)			

6. RECOMMENDATION MATRIX - JUSTIFICATION

Benchmark	Identify institution that are world class		

raise expectations	measure expectations	Identify what perfection is	set targets
Customer input		poll industries that have grads	establish advisory councils from industry

Based on these matrices and the aggregation of thoughts of the entire attendees of the Symposium, Group I-24 formulated the concluding recommendations present in item 1 above.

AFFINITY DIAGRAM

FIGURE I

OBJECT: PRODUCE THE HIGHEST QUALITY GRADUATES TO CONTRIBUTE TO SOCIETY.

1. External (to the University) issue and opportunities

   * Linkage of University and Industry
   * Long Term Commitments from Industry
   * Accredited Process

2. The cross-discipline nature of TQM

   * TQM is process focused and process is not generally taught - Techniques become ends rather than issues
   * TQM is multi-disciplinary but University disciplinary focused
   * Produce highest quality graduates to contribute to society

3. Academic culture and organization

   * Differing Vision/Purpose of University
   * University System does not reward faculty for interdisciplinary work - Resistance to change

   *Stimulating faculty to "more" on TQM
   a) Faculty agenda is already full
   b) No reward system for TQM

4. Knowledge of TQM and content

   * Lack of material and faculty renewal (training) on TQM

* Key issues
* Lack of TQM knowledge
* Lack of training of faculty in TQM and teaching materials for classroom use

Team 25

Team Leader: John Hadjilogious (A)
Team Member: Jack Hamm (A), Gerald Jakubowski (A), Carl Gooding (A), Lawrence B. Molnar (A), Fay Carothers (A), Kenneth D. Riener (A)

ISSUE:

Internalization of TQM at a University:

* Establish Quality Council
* Training for All
* Incentives?

Team 26

Team Leader: Gerald J. Borie (I)
Team Member: Thomas Tuttle (A), David W. Weiss (A), Helen G. Varsallo (A), Peter Lee (A), Hank J. Todd (I), Myron F. Wilson (I), Jill Swift (A), Ronald M. Varney (I)

ISSUE:
Changing Dynamics:

* Three customer drive: conflict identification and resolution; customer service center; and surveys (graduates, industry).
* Research and teaching teams: individual/collective contributions; interdisciplinary activities; and vertical interaction.
* Rewards/incentives (individuals/teams): tenure/promotion - serving the big three; appropriate funding.

REPORT
Step I - Identifying top-level issues
Team 26 developed five initial issues for consideration. They were:

1. Rationale for TQM
2. Reward structure
3. Curriculum guidelines
4. Approaches to implementation
5. Customer expectations.

Step II - Understanding the selected issue
It becomes clear at this point in time that the customer was composed of three separate segments. They are:

1. The student
2. Industry
3. The school.

Step III - The interrelationship digraph, or cause and effect
The " cause" and "effect" relationship became resulted in two sub-issues. They were:

1. Existing structure (of the university/college)
2. Current Philosophy (of the university/college)

Step IV - The Tree
It was at this point that the team realized that at this level of detail the identify of the customer was transparent and that the barriers

were universal.

Step V - Recommendations for removing barriers to instituting the concept of customer satisfaction
Following are two sets of recommendations.

Recommendations for "existing structure"

Control:
In order to address the concerns of delegation/empowerment/layers of management/fear/trust, an effective way to introduce TQM within them is to use a "TQM center."

The TQM center serves in the capacity of "facilitator." This is an academic way to convert an organization to TQM. The TQM center's role is to coordinate across the departments/schools of the university and to the outside customers to provide reference to the TQM umbrella (shown on the chart).

TQM center would consist of three or four members (faculty and administrator) who are experts in its principles, technology and application.

A major question regarding a TQM center concerns its costs. Outside support from industry and government may be needed to expedite the formation of TQM center.

Issue:
Understanding and resolving the existing barriers to satisfying three Different Customers Simultaneously

- Student
- Industry
- School.

Barrier: Existing Structure
Sub-Barriers: (1) Tradition
(2) Unwillingness to accept change
We are treating both sub-barriers as same issue

Traditions Needing Modification
Rewarding individual faculty performance
Bring in research
Publish

Establishment of Accreditation Guidelines
Classical Organization Structure

Players who must be willing to consider change
Accreditation bodies
Trustee/state legislatures
University/presidents
Advisory committees
Deans
Department chairs
Faculty
Non-faculty administrators
Students

Recommendations to break down barriers

Create equivalent of customer service
Survey graduates
Survey industry } customers
Survey university staff

Encourage development of teams within the university to better
Enable the university to meet customer needs
Encourage faculty whose primary interests are research to faculty whose primary interests are teaching.
Resulting student/graduate (product) has balanced education in physical law and practical application which meets requirements of industry, student and school.

Change reward system to encourage team effort recommended above
Reward teaching/research team, as a team, for meeting the requirements of the two primary customers (student & industry) in so doing, we think the third customer (school) will also be satisfied.

The implementation of this TQM-based philosophy must begin at the university president level.

Recommendations for "current philosophy"

To overcome resource barriers:
(a) Make a review of financial practices and organization structure to determine any excesses or possible reallocations.

(b) Document and make easily available various sources and methods of additional findings. Set up industrial affiliate programs in current areas of specific local industry need.

(c) Review current uses of resources to determine possible inefficiencies. Request industry's aid and/or professional societies in performing these audits.

(d) Review and determine actual usage of resources to determine if other organizations could benefit from any open availability.

(e) Review current policies or practices of individual concept of "ownership" of valuable resources to reduce redundant funding efforts and satisfy multiple needs.

To enhance the people policies and practices concerning individuals:

(a) Retain managers in techniques of communication and intercommunications (i.e., open-door policies for all levels, feedback) in order to facilitate multi-level understanding and increase individual productivity.

(b) Encourage higher levels of management to visit with their people in their own environment in order to increase the openness of communication.

(c) Institute a policy of interdisciplinary discussions to better understand personal biases in order to:
   (1) Enhance technical understanding to make the educational experience more synergistic
   (2) Treat everyone in a fair and consistent manner.

The basic issue is understanding and resolving the existing barriers to satisfying three different customers simultaneously.

The subset issue is the current philosophy of the institution.

This barrier of the current philosophy is due in large part to the reward system presently in effect in most upper-level institutions.

The paradigm assumes that the student is the customer of the faculty (and all other ancillary services). In addition, this material deals

with the delivery of these services to the customer in a total quality management philosophy.

Barrier: The university does not reward team play (an essential element of TQM) either in teaching or in research

Recommendations:

Reward team teachers/team projects

Canvas committee members for individual committee service

Interview alumni for professor evaluation

Barrier: The incentive system (e.g., tenure review) focuses on individual achievement.

Recommendations:

Tenure committee of each institution set up standards for customer service (student evaluation and alumni evaluation)

Make introduction of TQM concepts import issue in tenure process

Barrier: The university does not have quality as a goal.

Recommendations:

Since this is more likely a perception that a reality, deal with it as such introduce a TQM mentality at the very highest level of the administration.

Barrier: The incentive system (e.g., tenure) relies heavily on research and interferes with the delivery of services to the customer.

Recommendations:

Reassess importance of market niche; is this focus appropriate for us?

Who are we? (Define who we are)

Define our competition now and in the changing situation?

Since heavy research focus is being questioned in the media, hold open discussion meeting of faculty and administration on goal of research (funding, etc.) and mission of college.

Section VI

Appendices

Appendix A

TQM SYMPOSIUM SCHEDULE

Tuesday, July 17, 1990

5:00 - 9:00 p.m.	Pre-conference registration (Chestnut A Foyer)

Wednesday, July 18, 1990

7:00 - 4:00 p.m.	Registration (Chestnut A Foyer)
7:00 - 8:15 a.m.	Continental Breakfast (Chestnut A & B)
Chair Session I:	**Curtis J. Tompkins** Dean, College of Engineering West Virginia University
8:30 - 8:45 a.m.	Welcome (Governors Ballroom) **Neil S. Bucklew** President, West Virginia University
8:45 - 9:30 a.m.	Keynote Address (Governors Ballroom) **Thomas J. Murrin** Deputy Secretary U.S. Department of Commerce
9:30 - 10:00 a.m.	Congressional Perspective (Governors Ballroom) **Congressman Don Ritter** 15th Congressional District, Pennsylvania

10:00 - 10:30 a.m.	Industry Perspective (Governors Ballroom) **David T. Kearns** Chairman and CEO, Xerox Corp.
10:00 - 10:45 a.m.	Break (Governors Ballroom Foyer)
10:45 - 11:15 a.m.	Academia Perspective (Governors Ballroom) **John White** Assistant Director for Engineering National Science Foundation
11:15 - 11:30 a.m.	Business School Survey (Governors Ballroom) **John P. Evans** Professor, University of North Carolina
11:30 - 11:45 a.m.	Engineering School Survey (Governors Ballroom) **Rashpal S. Ahluwalia** Professor, West Virginia University
12:00 - 12:50 p.m.	Lunch (Chestnut A & B)
1:00 - 1:30 p.m.	Luncheon Speaker (Governors Ballroom) **John Betti** Under Secretary of Defense (Acquisition)
Chair Session II:	**Aris Melssaratos** VP and General Manager Design Engineering & Manufacturing Westinghouse Electric Corp.
1:30 - 2:00 p.m.	TQM Overview (Governors Ballroom) Curt Reimann Director Malcolm Baldrige National Quality Award

2:00 - 3:00 p.m.	Panel: Models of Cooperation (Governors Ballroom) Moderator: **Myron Tribus**
3:00 - 3:15 p.m.	Break (Governors Ballroom Foyer)
3:15 - 3:45 p.m.	Challenges/Opportunities (Governors Ballroom) **Myron Tribus** Chairman Community Quality Coalition
3:45 - 5:00 p.m.	Identification of Critical Issues and Teaming for Change (Governors Ballroom) **Jim Naughton** Goal/QPC
6:00 - 7:00 p.m.	Reception (Governors Ballroom Foyer)
7:00 - 7:30 p.m.	Banquet Speaker (Governors Ballroom) **Richard A. Linder** President Westinghouse Electronics Systems Group
7:30 - 9:00 p.m.	Banquet (Governors Ballroom)

Thursday, July 19, 1990

7:00 - 8:15 a.m.	Continental Breakfast (Chestnut A & B)
Chair Session III:	**Ralph Ponce de Leon** V.P. and Director of Production Operations Motorola
8:30 - 9:45 a.m.	Panel: Accreditation and Curriculum Issues Changing Needs and Requirements (Governors Ballroom) Moderator: **Arthur R. Taylor** Fordham University
9:45 - 10:30 a.m.	Selection of Critical Issues (Governors Ballroom) All Attendees
10:30 - 10:45 a.m.	Break (Governors Ballroom Foyer)
10:45 - Noon	Discussion of Critical Issues by Teams (Governors Ballroom)
12:00 - 12:50 p.m.	Lunch (Chestnut A & B)
1:00 - 1:30 p.m.	Luncheon Speaker (Governors Ballroom) **Robert W. Galvin** Chairman of the Board Motorola, Inc.
Chair Session IV:	**William J. Petak** Executive Director Institute of Safety & Systems Management University of Southern California
1:30 - 3:00 p.m.	Resolution of Issues by Teams (Governors Ballroom)

3:00 - 3:15 p.m.	Break (Governors Ballroom Foyer)
3:15 - 5:00 p.m.	Consolidation of Issues by Teams and Development of Recommendations by Issues (Governors Ballroom)
5:00 - 7:00 p.m.	Team Leaders Meeting (Oakroom)
7:00 - 9:00 p.m.	Pool Side BBQ (Outdoor Pool)

Friday, July 20, 1990

7:00 - 8:15 a.m.	Continental Breakfast (Chestnut A & B)
Chair Session V:	**Curtis J. Tompkins** Dean, College of Engineering West Virginia University
8:30 - 10:30 a.m.	Presentation of Recommendations by Team Leaders (Governors Ballroom)
10:30 - 10:45 a.m.	Break (Governors Ballroom Foyer)
10:45 - Noon	Discussion and Adoption of Recommendations, Future Actions (Governors Ballroom)
12:00 - 12:10 p.m.	Announcements (Governors Ballroom)
12:10 - 12:30 p.m.	Closing Remarks (Governors Ballroom) **Congressman Alan B. Mollohan** Congressional District, West Virginia

Exhibitors (Partial List)

Malcolm Baldridge National Quality Award
National Institute of Standards and Technology

Federal Quality Institute

Madison Area Quality Improvement Network

Philadelphia Area Council for Excellence (PACE)

Florida Institute of Technology/Rome Air Development Center

Concurrent Engineering Research Center (CERC)
West Virginia University

Center for Entrepreneurial Studies and Development (CESD)
West Virginia University

Association for Quality and Productivity

Appendix C

Program Committee

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Government Chairman:	**Curt W. Reimann** National Institute of Standards and Technology
Industry Chairman:	**Francis X. McKenna** Martin Marietta Astronautics Group
Program Committee:	**Charlene M. Abshire** US Department of Education **Gerald J. Borie** Litton Industries **Dale Butler** Martin Marierra Astronautics Group **Jan Gaudin** Boeing Helicopters **James Guzzi** Air Force System Command **John T. Jurewicz** West Virginia University **Clifford J. Kronauer** Martin Marierra Astronautics Group **Jack McGovern** Defense System Management College **Marta Mooney** Fordham University **Julie Parsons** University of Notre Dame **Ralph W. Plummer** West Virginia University **Jack West** Westinghouse

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