

Of course, there are many more answers, and you can probably list several others.

So we come down to the future of the United States, and your role in it. As you think about it and try to get involved, remember:

- We can not shield America, but we must adapt to new realities.
- Our solutions must involve social justice; workers, teachers, janitors — the “little guy” — must be respected.
- We need programs based on need, not greed.
- To attack the deficit, we must produce something of high quality that others want.
- We need flexible, often small, industries that can respond quickly in the global marketplace.
- A top priority is **building up human capital**.
- We must reform the educational system.
- Above all, we must be willing to adapt and change.

As statisticians and quality experts, we can help using our expertise. **Let's get involved; I'm begging again.** There is **HOPE WITH STATISTICS**.

Give it your best shot!
Bob

Editor's Note: Bob is the 1988 President of The American Statistical Association.

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STATISTICS, QUALITY AND THE BOTTOM LINE

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INTRODUCTION

“America can't compete. That perception has slowly and painfully crept up on us in recent years. Many Americans hoped that the falling dollar would solve our problems by making American goods cheaper, and therefore more salable abroad. But recent trade figures make it clear that the cheaper dollar is by no means a panacea.” Thus begins an article in the *New York Times* by Daniel A. Sharp on February 7, 1988.

In the *New York Times* article, Daniel Sharp is summarizing the report of the Seventy-fourth American Assembly held November 19-22, 1987. The report is titled, “Running Out of Time - Reversing America's Declining Competitiveness.” For three days, sixty-five leaders from business, labor, the media, academia, and government discussed some of the major issues concerning the ability of the United States to compete in the global marketplace.

Let me quote from this report.

“Once leaders in the world, American companies have lost command of markets to international competitors. Though macroeconomic factors like the exchange rate and trade policies have harmed our ability to compete, a strong case was made that these problems were chiefly the result of ineffective management practices as well as the cause of other problems. There are businesses and markets in which U.S. companies no longer compete at all. Those who try to compete find that working harder is

not enough, that fundamental changes are necessary.”

What are these fundamental changes?

We can devalue the dollar, in effect make each American work for half of what he or she was working for a few years ago. Cheap American labor should make our products and services more attractive to foreigners. But according to the *International Herald Tribune*, “You can now buy two Buicks in Belgium for the price of a single BMW, but the Belgians still prefer the BMW.” With the recent devaluations of the dollar, American workers now earn only 83% of the average Japanese wages, and 6% less than the West Germans. Even before the recent dollar devaluations, companies like Sony were coming to the United States because of the low-priced labor. In the Sony California television plant, American workers were earning 15% below their Japanese counterparts and winning Sony's awards for the best quality televisions made in the world.

We can sell some of the wealth we have stacked up in more prosperous times. We are a very wealthy nation. We have enormous resources in land, personal property and raw materials - even in junk. Two of our most profitable exports are scrap metal and recycled paper. We are selling art works, one Van Gogh recently brought \$40M. We are selling our land, 47% of commercial real estate in Los Angeles is now owned by foreigners. Buildings and

land in Manhattan are bringing record prices paid by people in other countries with strong currencies, and huge trade surpluses. Time magazine had an interesting article the week of April 3, 1988. In the last two years Japanese have purchased \$3,000,000,000 worth of Hawaii. More than the total foreign investment there in the previous 20 years.

We can sell other parts of our future. We can sell American-owned companies and businesses. We are already doing this in record numbers. For the first time in history foreigners are investing more in American than Americans are investing abroad. Foreign direct investment in the United States rose to an annual rate of \$53.4 billion in the second quarter of this year. (International Herald Tribune, 8-9 October 1988) Every day we read of familiar American brand names being sold off to raise cash. Bloomingdale's is now a Canadian company, RCA consumer electronics and televisions are now French, Quasar and Firestone are Japanese, Westinghouse light bulbs are now Dutch, many major appliances are now Swedish. Investment houses, banks and service industries are being gobbled up by bargain hunters from all over the world. In the first six months of 1988 British companies bought over 200 American companies. Even the Pillsbury dough boy will soon have a British accent.

We can borrow money from all over the world to pay for our trade imbalance and huge government deficits. We are now the largest debtor nation in the world. Our foreign debt soared 37% last year to \$368.2 billion. The US debt load is now greater than the combined total of Brazil, Argentina and Mexico. We were the largest creditor nation in the world as recently as 1982.

The Wall Street Journal on February 29, 1988 had a very strong opinion, "Reagan's Legacy: America for Sale."

"The steady rise of foreign investment in U.S. businesses and real estate may turn out to be the most controversial legacy of Reaganomics. Already, the 'selling of America' has become a hot topic among politicians and the press. And the sale has barely begun. The economic policies of the last seven years ensure that the foreign appetite for American investments will continue to grow in the coming decade.

"The end result will be a dramatic

reversal of the U.S. role in the world economy. For more than 30 years after World War II, U.S. multinationals spread their capital around the globe. Now, the nation finds itself on the receiving end. 'The American Challenge' to the world, as Jean-Jacques Servan-Schreiber described it two decades ago, has become the world's challenge to America.

"Even the most optimistic economic analysts see U.S. trade deficits continuing for at least the next decade. Data Resources Inc. of Lexington, Mass., projects trade deficits through the end of the century. That means foreigners would continue to have surplus dollars to invest in America.

"The trend startles many Americans, who grew up in a nation that dominated global investment flows. Throughout the 1950s and 1960s, the giant U.S. multinationals invested \$4 or \$5 abroad for every \$1 that foreigners invested here."

Or we can revamp our industrial base. We can once again become the world's leading developer and manufacturer of products. We can once again produce more than we consume. We can once again export the highest quality, lowest cost products in the world. We can once again read books on American engineering, American management, and American ingenuity and creativity. We can once again read books on the American threat, how American know-how and technology are going to take over the world.

It is this last option I would like to explore today. The other options are already being tried by our friends in Washington, by the most poorly managed companies in America, by many Americans who have given up, by Americans who feel we can no longer compete.

STARTING SMALL

What can we do? What can we do as individuals? How can statistics and quality really make a difference to the bottom line? How can statistics and quality control help companies compete in the world's markets?

I would like to start by redefining statistical efficiency. With apologies to Churchill Eisenhart and Bruce Hoadley, I would like to start with Churchill's definition of statistical efficiency and Bruce's later modification. In considering the con-

tribution of statistics and quality control to the bottom line we should look at the return on our work, the return on our investment

if we define,

RETURN = VALUE OF THE PROBLEM

TO BE SOLVED/UNIT OF TIME

X PROBABILITY PROBLEM IS SOLVED

X PROBABILITY SOLUTION IS IMPLEMENTED

X LENGTH OF TIME GAIN IS HELD

then our task is to maximize the return on our work.

Let's examine the return piece by piece.

THE VALUE OF THE PROBLEM TO BE SOLVED

The first question we must consider is whether we are working on the right problem, or at least a problem that is worth our effort to solve. To select work that will have a major impact on the company, we must have a way to measure this impact.

We can measure this impact in many ways: market share, time, total sales, gross revenues, profit, waste, parts per million. We often find that the language of management is money. If we can translate the value of the work to dollars we have an easy way to evaluate its impact on the bottom line.

This is frequently done by examining the cost of quality, or as some like to call it, the cost of poor quality. Here is where many of us go astray. The cost of quality in most companies is an unknown. The accounting systems are totally inadequate to deal with costs that cross departmental and divisional boundaries. Only in the past few years have companies begun to tackle cost accounting systems by product or product line. Usually, we have the costs by function: R&D, manufacturing, marketing and sales, distribution, and service.

To tackle costs of quality in a meaningful way we must remember four basic rules:

- Costs must be measured horizontally across the company, product by product or service by service. Implementing design reviews may cost R&D money but the costs will be recovered many times over in manufacturing and service.

- Quality costs must be a subset of total product costs. Paying one dollar each for a higher quality component so we can eliminate a 10¢ incoming inspection may lower our COQ by today's definitions, but

it won't lower the total cost of the product.

- Quality costs are dynamic. Today we may save money by starting 100% automated inspection of a troublesome component. Tomorrow we save even more by having the supplier implement the same test. Next week the supplier finds the problem cause, eliminates it, and saves even more money by eliminating the 100% test.

- True quality costs are unmeasurable. At best we can get a lower bound for a single point in time. We never know the true effect on market share for a less-than-perfect product — or its impact on sales of other products or services we offer.

The situation is not as bleak as it sounds. In most American companies opportunities for work with major impact abound. We do not need to wait for a restructuring of the corporate accounting system to identify areas for improvement, areas where we can obtain large returns for our efforts. There are numerous clues all over the place. The defective item reports, scrap reports, warranty reports, customer complaints and returns all point to possible areas of work. We can study competitive analyses, market share reports, sales figures and trends to find opportunities for major contributions. We can also analyze business processes to find major glitches or incredible instances of non-value-added work.

We only need rough estimates. The numbers are big enough that 10 or 20% errors in our estimates will not change the ranking or the importance of getting on with the work. Sometimes even an order of magnitude is good enough. When we look at the problems in this light, we often find that what we have been doing cannot possibly compete. How can creating a new method that may never be used compete with solving a real problem that has been plaguing the company for years.

PROBABILITY PROBLEM IS SOLVED

Just tackling important problems is not enough. We must also solve them. Much effort goes into discussions among statisticians about the right method to solve a particular problem. We seem to have endless discussions on the advantages and disadvantages of hundreds of different statistical techniques. But whether a problem in a company is solved or not is often not very dependent on the technique used. There are so many other things that are important, things that we usually do not consider.

The People Working On The Problem

The most important step to solving any problem in a company is the people selected to work in the problem. Getting the right people together on the team is crucial. Getting them time to work on the problem is the second most important step. This team must collectively have, or have access to, all the relevant information about the problem. They must be able to obtain the necessary data, do the required analyses and develop hypotheses about the cause or causes.

It is not enough for the team to possess the needed analytical skills, they must also be able to work together. They must understand the basic problem solving sequence. They must openly formulate theories, design experiments and test these theories, and draw conclusions based on fact-not opinion. They must be able to find the root cause and agree on the root cause.

But having found the cause is not enough! We must also find a way to remove the cause, a solution. This remedial journey is often very different from the diagnostic journey. Knowing what the cause is and knowing what to do about it are often two very different things.

PROBABILITY SOLUTION IS IMPLEMENTED

Of course, having the solution is no good at all if it isn't implemented. And the sad truth is that far more problems are solved than solutions are implemented. This is probably the hardest part of the whole process. We are now messing with the company's immune system. There are good reasons why things are like they are, someone designed them that way, someone has the responsibility to keep them that way. To change something, especially to remove a problem, we must often ask someone to do something differently. And this is seen by many people as asking them to admit that they have been doing something wrong.

The problem solving team (or the quality improvement team) plays a very important part in this step. We must make sure to have team members from all "suspect" parts of the company. The solution must have strong input from the department that will have to implement the solution, they must be part of developing the solution. We must also run a field trial to make sure that the solution can be implemented by the people who will actually have to do the

work. We must get complete buy in and ownership as part of the problem solving process.

LENGTH OF TIME GAIN IS HELD

The second hardest part of the entire problem solving process is keeping the solution implemented. Most changes are not irreversible, and if we do not change our control system the problem will reoccur over and over. One company told me recently that they were very good at problem solving. They said they should be, because they solve the same problems every year.

To maximize the return on our work we must maximize the time the solution is implemented and the problem stays solved. We must put in place systems and procedures that help control, monitor and adjust the process so that the problem does not occur again. We must also find ways to keep the problem from occurring again on the next product or process designed.

We must, in fact, develop a quality control system, a true quality control system in the best sense of what Shewhart and Juran meant when they wrote about quality control. Quality control is meant to be an operational system, a way to give complete control to the operating forces of key processes. For the operators to have this control they must have four things:

- Knowledge of what quality is for their process, a clear definition and target or standard
- A way to measure the quality of their process
- A way to compare the measurement with the target or standard and a way to interpret the difference
- A way to act on the difference when necessary, a way to adjust the process.

(Continued in next issue)

CONFUCIUS SAY

*Ladder of Success
Contain Splinters
But Not Realized
Until Sliding Down*