

Improvement of Quality and Productivity through Action by Management

Management can increase productivity by improving quality. Dr. Deming's fourteen points show the way.

*Optional ?
Relate to another article.*

W. Edwards Deming

Why productivity increases with improvement of quality

Some simple examples will show how productivity increases with improvement of quality. Other benefits are lower costs, better competitive position, and happier people on the job. It is important to note that a gain in productivity is also a gain in capacity of a production-line.

Best efforts are not sufficient

"By everyone doing his best."

This is the answer that someone in a meeting volunteered in response to my question, "And how do you go about it to improve quality and productivity?"

It is interesting to note that this answer was wrong—wrong in the sense that best efforts are not sufficient. Best efforts are essential, but unfortunately, best efforts alone will not accomplish the purpose. Everyone is already doing his best. Efforts, to be effective, must move in the right direction. Without guidance, best efforts result in a random walk.

Some folklore. Folklore has it in America that quality and production are incompatible: that you can not have both. It is either or. Insist on quality, and you will fall behind in production. Push production and you will find that your quality has suffered.

The fact is that quality is achieved by improvement of the process. Improvement of the process increases uniformity of output of product, reduces mistakes, and reduces waste of manpower, machine-time, and materials.

Management can effect a change in the system, helping people to work smarter, not harder.

Reduction of waste transfers man-hours and machine-hours from the manufacture of defectives into the manufacture of additional good product. In effect, the capacity of a production-line is increased. The benefits of better quality through improvement of the process are thus not just better quality, and the long-range improvement of market-position that goes along with it, but greater productivity and much better profit as well. Improved morale of this work force is another gain: they now see that the management is making some effort themselves, and not blaming all faults on the production-workers.

A clear statement of the relationship between quality and productivity comes from my friend Dr. Yoshikasu Tsuda of Rikkyo University in Tokyo, who wrote to me as follows, dated 23 March 1980.

I have just spent a year in the northern hemisphere, in twenty-three countries, in which I visited many industrial plants, and talked with many industrialists.

In Europe and in America, people are now more interested in cost of quality and in systems of quality-audit. But in Japan, we are keeping very strong interest to improve quality by using statistical methods which you started in your very first visit to Japan.

... When we improve quality we also improve productivity, just as you told us in 1950 would happen.

A simple example. Some simple figures taken from recent experience will illustrate what happens. Defective output of a certain production-line was running along at 11 percent (news to the management). A run-chart of proportion defective day by day over the previous six weeks showed good statistical control of the line as a whole. The main cause of the problem could accordingly only be ascribed to the system. This was also news to the management. The statisticians made the suggestion that possibly the people on the job, and inspectors also, did not understand well enough what kind of work is ac-

ceptable and what is not. The manager of the production-line and two supervisors went to work on the matter, and with trial and error came up in seven weeks with better definitions, with examples posted for everyone to see. A new set of data showed the proportion defective to be 5 percent. Cost, zero. Results:

Table 1
Illustrating Gain in Productivity with Improved Quality

Item	Before Improvement 11% Defective	After Improvement 5% Defective
Total cost	100	100
Spent to make good units	89	95
Spent to make defective units	11	5
Average number of good units per unit cost	.89	.95
Proportion of total cost spent to make defectives	.11	.05

Quality up

Productivity up 6%

Costs down

Profit greatly improved

Capacity of the production line increased 6%

Customer happier

Everybody happier

This gain was immediate (seven weeks); cost, zero: same work force, same burden, no investment in new machinery.

This is an example of gain in productivity accomplished by a change in the system, effected by the management, helping people to work smarter, not harder.

Reduction in cost

Taken from a speech delivered in Rio de Janeiro, March 1981, by William E. Conway, president of the Nashua Corporation.

At Nashua, the first big success took place

in March 1980: improvement of quality and reduction of cost in the manufacture of carbonless paper.

Water-based coating that contains various chemicals is applied to a moving web of paper. If the amount of coating is right, the customer will be pleased with a good consistent mark when he uses the paper some months later. The coating-head applied approximately three pounds of dry coating to 3000 square feet of paper at a speed of approximately 1400 linear feet/minute on a web 6-8 feet wide. Technicians took samples of paper and made tests to determine the intensity of the mark. These tests were made on the sample both as it came off the coater and after it was aged in an oven to simulate use by the customer. When tests showed the intensity of the mark to be too low or too high, the operator made adjustments that would increase or decrease the amount of coating material. Frequent stops for new settings were a way of life. These stops were costly.

The engineers knew that the average weight of the coating material was too high, but did not know how to lower it without risk of putting on insufficient coating. A new coating-head, to cost \$700,000, was under consideration. There would be, besides the cost of \$700,000, time lost for installation, and the risk that the new head might not achieve uniformity of coating much better than the equipment in use.

In August 1979, the plant manager decided to utilize the statistical control of quality to study the operation. It was thereby found that the coating-head, if left untouched, was actually in pretty good statistical control at the desired level of 3.0 dry pounds of coating on the paper, plus or minus .4.

Elimination of various special causes, highlighted by points of control, reduced the amount of coating and still maintained good consistent quality.

The coater had by April 1980 settled down to an average of 2.8 pounds per 3000 square feet, varying from 2.4 to 3.2, thereby saving 0.2 pounds per 3000 square feet, or \$800,000 per year at present volume and cost levels.

What the operator of the coating-head had

been doing, before statistical control was introduced and achieved, was to over-adjust his machine, to put on more coating, or less, reacting to tests of the paper. In doing his best, in accordance with the training and instructions given to him, he was actually doubling the variance of the coating. The control-charts, once in operation, helped him to do a much better job, with less effort. He is happy. His job is easier and more important.

All this was accomplished without making the proposed capital investment of \$700,000, which might or might not have improved the process and the quality of the coated paper.

Engineering innovation. Statistical control opened the way to engineering innovation. Without statistical control, the process was in unstable chaos, the noise of which would mask the effect of any attempt to bring improvement. Step by step they achieved:

- Improvement of the chemical content of the material used for coating, to use less and less coating.
- Improvement of the coating-head (without purchase of a new one) to achieve greater and greater uniformity of coating.

Today, only 1.0 pounds of improved coating is used per 3000 square feet of paper. This level is safe, as the variation lies only between .9 and 1.1. Reduction of a tenth of a pound means an annual reduction of \$400,000 in the cost of coating.

The reader can do his own arithmetic to compute the annual reduction in cost from the starting point, namely, 3.0 pounds.

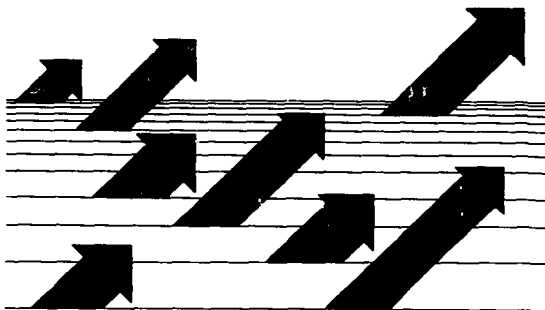
Before statistical control was achieved, the engineers had not entertained thought of improvement of coating-head. Once statistical control was achieved, it was easy to measure the effect of small changes in the chemistry of the coating and in the coating-head. The next step then became obvious—try to improve the coating and the coating-head, to use less coating with greater and greater uniformity.

Defects are not free. Somebody makes them, and gets paid for making them.

Low quality means high cost

A plant was plagued with a huge amount of defective product. "How many people have you on this line for rework of defects made in previous operations?" I asked the manager. He went to the blackboard and put down three people here, four there, etc.—in total, 21 percent of the work force on that line.

Defects are not free. Somebody makes them, and gets paid for making them. On the supposition that it costs as much to correct a defect as to make it in the first place, then 21 percent of his payroll and burden was being spent on rework. In practice, it usually costs more to correct a defect than to make it, so the figure 21 percent is a minimum.



Once the manager saw the magnitude of the problem, and came to the realization that he was paying out good money to make defects as well as to correct them, he found ways to help the people on the line to understand better how to do the job. The cost of rework went down from 21 percent to 9 percent in a space of two months.

Next step: reduce the proportion defective from 9 percent to 0.

From 15 percent to 40 percent of the manufacturer's costs of almost any American product that you buy today is for waste embedded in it—waste of human effort, waste of machine-time, loss of accompanying burden. No wonder that many American products are hard to sell at home or abroad.

American industry (including service-organizations) can no longer tolerate mistakes and defective material at the start nor anywhere along the line, nor equipment out of order.

New machinery is not the answer

Lag in American productivity had been attributed in editorials and in letters in the newspapers to failure to install new machinery and the latest types of automation. Such suggestions make interesting reading and still more interesting writing for people that do not understand problems of production. There is a quicker and surer way, namely, better administration of man and whatever machinery is in use today. Then, after the present problems are conquered, talk about new machinery.

The following paragraph received from a friend in a large manufacturing company will serve as illustration.

This whole program (design and installation of new machines) has led to some unhappy experiences. All these wonderful machines performed their intended functions, on test, but when they were put into operation, they were out of business so much of the time for this and that kind of failure that our overall costs, instead of going down, went up. No one had evaluated the overall probable failure-rates and maintenance. As a result, we were continually caught with stoppages and with not enough spare parts, or with none at all; and no provision for alternate production-lines.

Comparison between American and Japanese production should take account of some important differences. Japanese manufacturers are already using their machinery to full advantage, not wasting materials, human effort, or machine-time. They have no unemployed people to draw upon for expansion. There are no unemployment agencies in Japan. The Monthly Report

on the Labor Force for the United States, in contrast, shows at this writing 7 million unemployed. American industry can expand by drawing upon a supply of labor, a large part of it skilled, experienced, able, and willing to work. The Japanese manufacturer, on the other hand, can expand his production only by use of better machinery or improvement in design. He can not hire more people: there are not any. The fact is that there is only a small amount of automation in Japan. They have been sensible about it.

If I were a banker, I would not lend money for new equipment unless the company that asked for the loan could demonstrate by statistical evidence that they are using their present equipment to full realizable capacity.

Quality control in service industries

Eventually, quality control will assist not only the production of goods and food (the birthplace of modern statistical theory was agriculture) but the service industries as well—hospitals, hotels, transportation, wholesale and retail establishments, perhaps even the U.S. mail. Statistical quality technology has for many years contributed to telecommunications, both in the manufacture of equipment and in service. Statistical quality technology is improving service and lowering costs in the banking business. In fact, one of the most successful applications of statistical methods on a huge scale, including sample-design and operations, is in the U.S. Census, not only in the decennial Census but in the regular monthly and quarterly surveys of people and of business, an example being the Monthly Report on the Labor Force.

It is interesting to note that some service-industries in Japan have been active in statistical methods from the start, e.g., the Japanese National Railways, Nippon Telegraph and Telephone Corporation, the Tobacco Monopoly of Japan, the Post Office. Department stores have taken up statistical quality control. Takenaka Komuten (architecture and construction) won recognition in 1979 for thoroughgoing improve-

ment of buildings of all types, and for decrease in cost, by studying the needs of the users (in offices, hospitals, factories, hotels) and by reducing the costs of rework in drawings and in the actual construction.

What top management must do

The purpose here is to explain to top management what their job is. No one in management need ask again, "What must we do?" This section serves two purposes: (1) It provides an outline of the obligations of top management. (2) It provides a yardstick by which anyone in the company may measure the performance of the management.

Paper profits, the yardstick by which stockholders and Boards of Directors often measure performance of the president, make no contribution to material living for people anywhere, not do they improve the competitive position of a company or of American industry. Paper profits do not make bread: improvement of quality and productivity do. They make a contribution to better material living for all people, here and everywhere.

Short-term profits are not indication of good management. Anybody can pay dividends by deferring maintenance, cutting out research, or acquiring another company.

Ways of doing business with vendors and with customers that were good enough in the past must now be revised to meet new requirements of quality and productivity. Drastic revision is required.

What must top management do? As I noted at the beginning of this article, it is not enough for everyone to do his best. Everyone is already doing his best. Efforts, to be effective, must move in the right direction.

It is not enough that top management commit themselves by affirmation for life to quality and productivity. They must know what it is that they are committed to—i.e., what they must do. These obligations can not be delegated. Mere approval is not enough, nor New Year's

"Let me emphasize that where top management does not . . . get personally involved, nothing will happen."

resolutions. Failure of top management to act on any one of the fourteen points listed ahead will impair efforts on the other thirteen. Quality is everybody's job, but no one else in the company can work effectively on quality and productivity unless it is obvious that the top people are working on their obligations.

"Let me emphasize that where top management does not understand and does not get personally involved, nothing will happen."
(From a speech made by William E. Conway, president of the Nashua Corporation.)

The 14 points for top management

Here are the obligations of top management. These obligations continue forever: none of them is ever completely fulfilled.

1. Create constancy of purpose in the company. The next quarterly dividend is not as important as existence of the company ten, twenty, or thirty years from now.

a. Innovate. Allocate resources for long-term planning. Plans for the future call for consideration of:

- Possible new materials, new service, adaptability, probable cost.
- Method of production; possible changes in equipment.
- New skills required, and in what number?
- Training and retraining of personnel
- Training of supervisors.
- Cost of production.
- Performance in the hands of the user.
- Satisfaction of the user.

One requirement for innovation is faith that there will be a future. Innovation, the foundation of the future, can not thrive unless the top management has declared unshakable policy of quality and productivity. Until this policy can be enthroned as an institution, middle management and everyone in the company will be skeptical about the effectiveness of their best efforts.

The consumer is the most important part

of the production-line. Japanese management took on a new turn in 1950 by putting the consumer first.

b. Put resources into

- research
- education

c. Put resources into maintenance of equipment, furniture, and fixtures, new aids to production in the office and in the plant.

It is a mistake to suppose that statistical quality technology applied to products and services offered at present can with certainty keep an organization solvent and ahead of competition. It is possible and in fact fairly easy for an organization to go broke making the wrong product or offering the wrong type of service, even though everyone in the organization performs with devotion, employing statistical methods and every other aid that can boost efficiency.

Innovation generates new and improved services. An example is new and different kinds of plans for savings in banks, financial service offered by credit agencies, Meals on Wheels, day care in out-patient clinics. Leasing of automobiles is an example of service that did not exist years ago. Express Mail is a new service of the U.S. post office (equivalent to what a postage stamp would accomplish in Japan or in Europe). Mailgram by Western Union is another. Intercity and intracity messenger service is a growth industry, thriving on the delinquency of the U.S. post office. Services can and do have problems of mistakes, costly correction of mistakes, and consequent impairment of productivity associated with mistakes.

2. Learn the new philosophy. We are in a new economic age. We can no longer live with commonly accepted levels of mistakes, defects, material not suited to the job, people on the job that do not know what the job is and are afraid to ask; handling damage; failure of management to understand the problems of the product in use; antiquated methods of training on the job; inadequate and ineffective supervision.

Acceptance of defective materials and poor workmanship as a way of life is one of the

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We are in a new economic age. We can no longer live with the commonly accepted levels of defects.

most effective roadblocks to better quality and productivity. The Japanese faced it in 1950. Unreliable and nonuniform were kind words for the usual quality of incoming materials. Japanese management took aim at the problem and in time reduced it to a level never before achieved. American industry today faces the same problem. The road that Japanese manufacturers paved would be a good one for American management to copy.

3. Require statistical evidence of process control along with incoming critical parts. There is no other way for your supplier nor for you to know the quality that he is delivering, and no other way to achieve best economy and productivity. Purchasing managers must learn the statistical control of quality. They must proceed under the new philosophy: the right quality characteristics must be built in, without dependence on inspection. Statistical control of the process provides the only way for the supplier to build quality in, and the only way to provide to the purchaser evidence of uniform repeatable quality and of cost of production. There is no other way for your supplier to predict his costs.

Most purchasing managers do not know at present which of their suppliers are qualified. One of the first steps for purchasing managers to take is to learn enough about the statistical control of quality to be able to assess the qualifications of a supplier, to talk to him in statistical language. Don't expect him to carry on the conversation in French if you don't know French.

Some suppliers are already qualified and are conforming to this recommendation. Some follow their product through the purchaser's production-lines to learn what problems turn up, and to take action, so far as possible, to avoid problems in the future.

One company may have influence over hundreds of suppliers and over many other purchasers.

Vendors sometimes furnish reams of figures, such as records of adjustment, input of materials (2 kg. chromium added at 1000 h). Figures like these are as worthless to the buyer as they are to the vendor.

The manager of an important plant, which

belongs to one of America's largest corporations, lamented to me that he spends most of his time defending good vendors. A typical problem runs like this. A vendor has not for years sent to him a defective item, and his price is right. Some other manufacturer underbids this vendor by a few cents and captures the business. The corporate purchasing department awards the business to him because of price. The plant manager can not take a chance, and must spend many hours and days arguing for the vendor that knows his business.

4. The requirement of statistical evidence of process control in the purchase of critical parts will mean in most companies drastic reduction in the number of vendors that they deal with.

Companies will have to consider the cost of having two or more vendors for the same item. A company will be lucky to find one vendor that can supply statistical evidence of quality. A second vendor, if he can not furnish statistical evidence of his quality, will have higher costs than the one that can furnish the evidence, or he will have to chisel on his quality, or go out of business. A man that does not know his costs nor whether he can repeat tomorrow today's distribution of quality is not a good business partner.

We can no longer leave quality and price to the forces of competition—not in today's requirements for uniformity and reliability. Price has no meaning without a measure of the quality being purchased. Without adequate measures of quality, business drifts to the lowest bidder, low quality and high cost being the inevitable result. American industry and the U.S. government are being rooked by rules that award business to the lowest bidder.

The purchasing managers of a company are not at fault for giving business to the lowest bidder, nor for seeking more bids in the hope of getting a still better price. This is their mandate. Only the top management can change their direction.

Purchasing managers have a new job. It will take five years for them to learn it.

Example. An American manufacturer of automobiles may today have 2500 vendors. A

Japanese automobile company may have 380. Rapid and determined reduction of the number of vendors in American manufacturing is already under way.

Made by Company A

1000 pieces
all meet
specifications

Made by Company B

1000 pieces
all meet
specifications

Problem 1. You wish to purchase 1000 pieces of xbae. You make calls to two companies A and B that offer the product, and you explain the specifications. Each company submits 1000 pieces of xbae—all good, so the companies claim. You satisfy yourself, by your own inspection, that indeed all 2000 pieces meet your specifications. Which lot would you buy? Toss a coin?

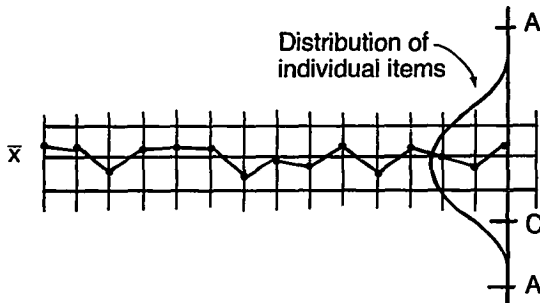
Before you make a snap judgment, it might be wise to consider the fact that your specifications may not tell the whole story. There may be characteristics that are important to have in the pieces that you will buy, but not covered in your specifications. There may be other characteristics that you would wish to avoid, and your specifications may not protect you. Company A has been in the business and provides continuing evidence of process control. There may be persuasive arguments in favor of Company A. One must remember that the distribution of the important quality-characteristics of the 1000 parts made by Company A will be more uniform than the distribution of those made by Company B. Uniformity is nearly always important. If the price offered by Company B is the lower of the two, it would be wise to inquire how this could be, as Company A's costs will be lower. Perhaps Company B can offer a bargain. He may have had a cancellation from another customer, and has the material on hand.

Problem 2. Now, we come to a totally different problem. You plan to purchase 1000 pieces of xbae every week. Your requirements in this problem point definitely to selection of Company

A. The distribution of the important quality-characteristic of the xbae is predictable. It will be steady week after week. If the distribution falls within your specifications, you can eliminate inspection of incoming parts except for routine observations and comparisons for identification. You will know from the control charts that came along with the product, far better than any amount of inspection can tell you, what the distribution of quality is and what it will be.

If a tail of the distribution falls beyond your specifications, you will require 100 percent inspection.

Company A



x-chart for a critical quality-characteristic. If the specifications are at A, A, the output of Company A requires no inspection. Problems will arise (see text) if a specification were at C.

Company B



About Company B we know nothing.

Another advantage of statistical control is a better price and better quality than Company B can give. If Company B offers you a better price, it is because he knows not what his costs are. He may chisel you on quality, or he may go out of business trying to meet the price that he quoted, and leave you stranded.

In free enterprise you have a right to make a wrong decision, and to get beat up for it.

You may decide, for protection, to give some of the business to Company B, just to have a second vendor to fall back on in case Company A suffers some hard luck. This is your privilege. You will have to pay the extra cost that Company B must charge you if he stays in business and delivers the quantity that you require, and you will have to inspect the material that comes from him. Whether it is wise to do business with Company B could be questioned, but you now have a rational basis for your decision.

In free enterprise you have a right to make a wrong decision, and to get beat up for it.

A request for bids usually contains a clause to say that quality may be considered along with price. That is, the award will not necessarily be given to the lowest bidder. Such a clause is meaningless without a yardstick by which to measure quality. The buyer and his purchasing manager usually lack such a yardstick. They are candidates for plunder by the lowest bidder.

A flagrant example is a request for professional help, to be awarded to the lowest bidder. Example (actual, from a government agency):

For delivery and evaluation of a course on management for quality control for supervisors . . .

An order will be issued on the basis of price.

5. Use statistical methods to find out, in any trouble spot, what are the sources of trouble. Which are local faults? Which faults belong to the system? Put responsibility where it belongs. Do not rely on judgment. Judgment always gives the wrong answer on the question of where the fault lies. Statistical methods make use of knowledge of the subject matter where it can be effective, but supplant it where it is a hazard.

Constantly improve the system. This obligation never ceases. Most people in management do not understand that the system (their responsibility) is everything not under the governance of a local group.

6. Institute modern aids to training on the job. Training must be totally reconstructed.

Statistical methods must be used to learn when training is finished, and when further training would be beneficial. A man once hired and trained, and in statistical control of his own work, whether it be satisfactory or not, can do no better. Further training can not help him. If his work is not satisfactory, move him to another job, and provide better training there.

7. Improve supervision. Supervision belongs to the system, and is the responsibility of management.

- Foremen must have more time to help people on the job.
- Statistical methods are vital as aid to the foreman and to the production manager to indicate where fault lies: is it local, or is it in the system?
- The usual procedure by which the foreman calls the worker's attention to every defect, or to half of them, may be wrong—is certainly wrong in most organizations—and defeats the purpose of supervision.
- Supervision in large segments of American industry is deplorable. For example, a common practice is to look at the production records of people on the job, supervisors, managers, and to deliberately take aim at the lowest 5 percent or the lowest 10 percent. Claims of results from this procedure are nothing but reinvention of the Hawthorne effect. The ultimate result is frustration and demoralization of the organization.

8. Drive out fear. Most people on a job, and even people in management positions, do not understand what the job is, nor what is right or wrong. Moreover, it is not clear to them how to find out. Many of them are afraid to ask questions or to report trouble. The economic loss from fear is appalling. It is necessary, for better quality and productivity, that people feel secure. *Se* comes from Latin, meaning without, *cure* means fear or care. Secure means without fear, not afraid to express ideas, not afraid to ask questions, not

Work standards are costing the country as much loss as poor materials and mistakes.

afraid to ask for further instructions, not afraid to report equipment out of order, nor material that is unsuited to the purpose, poor light, or other working conditions that impair quality and production.

Another related aspect of fear is inability to serve the best interests of the company through necessity to satisfy specified rules, or to satisfy a production quota, or to cut costs by some specified amount.

One common result of fear is seen in inspection. An inspector records incorrectly the result of an inspection for fear of overdrawing the quota of allowable defectives of the work force.

9 Break down barriers between departments.

People in research, design, purchase of materials, sales, receipt of incoming materials, must learn about the problems encountered with various materials and specifications in production and assembly. Otherwise, there will be losses in production from necessity for rework and from attempts to use materials unsuited to the purpose. Why not spend time in the factory, see the problems, and hear about them?

I only recently saw a losing game, 40 percent defective output, the basic cause of which was that the sales department and the design department had put their heads together and come through with a style whose tolerances were beyond the economic capability of the process. This lack of coordination helps a plant to become a nonprofit organization.

In another instance, the man in charge of procurement of materials, in attendance at the seminars, declared that he has no problems with procurement, as he accepts only perfect materials. (Chuckled I to myself, "That's the way to do it.") Next day, in one of his plants, a superintendent showed to me two pieces of an item from two different suppliers, same item number, both beautifully made, both met the specifications, yet they were sufficiently different for one to be usable, the other usable only with costly rework, a heavy loss to the plant. The superintendent was charged with 20,000 of each one.

Both pieces satisfied the specifications. Both suppliers had fulfilled their contracts. The

explanation lay in specifications that were incomplete and unsuited to the requirements of manufacture, approved by the man that had no problems. There was no provision for a report on material used in desperation. It seems that difficulties like this bring forth solace in such remarks as:

This is the kind of problem that we see any day in this business.

or

Our competitors are having the same kind of problem.

What would some people do without their competitors? Surely one responsibility of management in production is to provide help in such difficulties, and not leave a plant manager in a state of such utter hopelessness.

Purchasing managers must learn that specifications of incoming materials do not tell the whole story. What problems does the material encounter in production? It is necessary to follow a sample of materials through the whole production process to learn about the problems encountered, and onward to the consumer's problems.

10 Eliminate numerical goals, slogans, pictures, posters, urging people to increase productivity, sign their work as an autograph, etc., so often plastered everywhere in the plant. ZERO DEFECTS is an example. Posters and slogans like these never helped anyone to do a better job. Numerical goals even have a negative effect through frustration. These devices are management's lazy way out. They indicate desperation and incompetence of management. There is a better way.

11 Look carefully at work-standards. Do they take account of quality, or only numbers? Do they help anyone to do a better job? Work standards are costing the country as much loss as poor materials and mistakes.

Any day in hundreds of factories, men stand around the last hour or two of the day, waiting for the whistle to blow. They have completed their quotas for the day; they may do no more work, and they can not go home. Is this good for the competitive position of American industry?

Ask these men. They are unhappy doing nothing. They would rather work.

12. Institute a massive training program for employees in simple but powerful statistical methods. Thousands of people must learn rudimentary statistical methods. One in 500 must spend the necessary ten years to become a statistician. This training will be a costly affair.

13. Institute a vigorous program for retraining people in new skills. The program should keep up with changes in model, style, materials, methods, and, if advantageous, new machinery.

14. Create a structure in top management that will push every day on the above thirteen points. Make maximum use of statistical knowledge and talent in your company. Top management will require guidance from an experienced consultant, but the consultant can not take on obligations that only the management can carry out.

Action required

The first step is for management to understand what their job is—the fourteen points. The next step is to get into motion on them. Quality and productivity are everybody's job, but top management must lead. Until and unless top management establish constancy of purpose and make it possible for everyone in the company to work without fear for the company and not just to please someone, efforts of other people in the company, however brilliant be the fires that they start, can only be transitory.

How soon? When? A long thorny road lies ahead in American industry—ten to thirty years—to settle down to an accepted competitive position. This position may be second place, maybe fourth. Small gains will be visible within a few weeks after a company mobilizes for quality, but sweeping improvement over the whole company will take a long time, and will continue forever. Unmistakable advances will be obvious within five years, more in ten. Management must learn the new economics: likewise government regulatory agencies, and they may require thirty

years. Meanwhile, American industry will continue to suffer under the supposition that competition is the secret to better quality and service, and to lower costs.

Products that have been the backbone of American industry may in time decline to secondary importance. New products and new technology may ascend to top place. Agriculture may move up further in foreign trade.

Tangible results from each of the fourteen points will not all be visible at the same time. Perhaps the best candidate for quickest results is to supplant work-standards (No. 11) with statistical aids to the worker and to supervision. No one knows what productivity can be achieved with statistical methods that help people to accomplish more by working smarter, not harder.

A close second for quick results would be to start to drive out fear (No. 8), to help people to feel secure to find out about the job and about the product, and unafraid to report trouble with equipment and with incoming materials. Once top management takes hold in earnest, this goal might be achieved with 50 percent success, and with powerful economic results, within two or three years. Continuation of effort will bring further success.

A close third, and a winner, would be to break down barriers between departments (No. 9).

Survival of the fittest. Companies that adopt constancy of purpose for quality and productivity, and go about it with intelligence, have a chance to survive. Others have not. Charles Darwin's law of survival of the fittest, and that the unfit do not survive, holds in free enterprise as well as in nature's selections.

the impact of research!

W. Edwards Deming has been for forty years a consultant in statistical studies, with practice worldwide. He is best known for his work in Japan, which commenced in 1950 and created a revolution in quality and economic production. He is the author of several books on statistical methods and over 150 papers. Dr. Deming is currently working on a book that will elaborate on the fourteen points discussed in this article.