Figure 11.12. PROCESS IMPROVEMENT STRATEGIES: The Role of Statisticians

EM8501: The American Statistician 39(#3), August, 1985, pages 224-227

The Key Role of Statisticians in the Transformation of North American Industry

BRIAN L. JOINER*

There is much to be done if North American industry is to survive in the new economic age. We statisticians have a vital role to play in the transformation that is needed to make our industry competitive in the world economy. As statisticians, we are faced with a major challenge – and a major opportunity – unlike anything we have ever experienced before. This article describes this opportunity and seeks to interest others in joining forces to help our industry meet its challenges. The discussion will move from the goal – improvements in quality and productivity – to the nuts and bolts of how statisticians can prepare for a new role in industry.

We begin with a reminder that major improvements in quality and productivity are indeed necessary if our industry is to regain a competitive position in world markets. The second point is also a reminder: statistics and statisticians are important in generating these improvements. The third point is not yet so widely accepted: a new managerial climate is necessary before these gains can be sustained. Fourth, and even less well known, is that statisticians have a major role to play in creating this new climate. Finally, specific steps are recommended for those who wish to prepare for a new role in helping to create the right managerial climate for achieving major continuous improvements in quality and productivity.

THE NEED FOR IMPROVEMENTS IN QUALITY AND PRODUCTIVITY

Automobiles, cameras, stereos, colour TV's, food processors, microwave ovens, athletic equipment, computer chips, medical equipment, industrial robots, optical equipment, hand tools, electric motors – This is a portion of a list developed by Stanford Professor Steven Wheelwright; it was communicated to me by Alan Godfrey of AT&T Bell Laboratories. What do these products have in common? They are attractive, complex products of high technology, demanded in high volume – just the types of products for which a country would like to be a leader in design and manufacture. But these are products in which the U.S. worldwide market dropped by 50% during the 1970s. And this list is just the tip of the iceberg. Japan and, increasingly, other countries are beating our socks off, and they show no signs of letting up.

STATISTICS AND STATISTICIANS

Statistics and statisticians are already helping our industries make gains in quality and productivity. There are many excellent, dedicated statisticians in industry today. Nevertheless, those of us who work in and with industry know that our effectiveness is related to the managerial climate in which we work; we know we could accomplish much, much more in a more favorable climate. This brings me to my major point: the need for a managerial climate in which major gains in quality and productivity become the norm.

NEW MANAGERIAL CLIMATE

Managerial climate is the secret to Japan's success – not robots, not tax policies, not cultural differences. But what managerial climate is best, and why? An article in *The Wall Street Journal* (Calonius, 1983), illustrates what the "new climate" is all about. RCA built a TV plant in Memphis in 1966 but shut it down five years later after a series of wildcat strikes, union-authorized strikes, apparent product sabotage, and layoffs that reduced the payroll from 4,200 workers to 1,600. Then Sharp of Japan moved in to salvage the plant and the reputation of the Memphis work force. During the past four years, this Japanese-managed plant has rolled out a million colour TVs and a million microwave ovens. Productivity is high; defect levels are very low. Sharp accomplished this with American workers, American components, and a serious recession – and *without* layoffs or loss of profitability. What is their secret? It has three parts:

1. obsession with quality,
2. achieving a feeling among employees that they are one big family,
3. identifying and correcting problems by means of data, not opinion or emotion.

These principles are best illustrated by a triangle, which connotes integrity, wholeness, and a synergy among the parts (see Fig. 1).

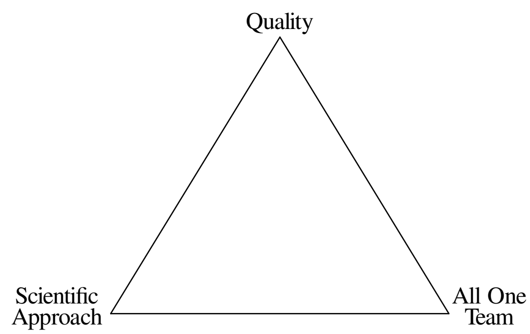

Figure 1. Necessary Ingredients for the Transformation of American Industry. These three ingredients, taken together, create the new managerial climate that is necessary to be world competitive.

An Obsession With Quality

Let me tell a story to illustrate what I mean by an obsession with quality. One company I work with acquired a very large number of a part (434,000, to be exact) from a supplier before experiencing their first failure with it. It was a "minor" part, costing only 11¢. They notified the supplier, and the supplier came to inspect the failed part and the circumstances of the failure. The part proved to be defective, so the supplier changed their process. They subsequently purchased more than 3,000,000 of these parts with only one more failure. Now I ask you, do you think this supplier was under American or Japanese management? Another company experienced an 8.5% failure rate with another part. The supplier of *that* part wanted to know why the company was complaining: the 8.5% failure rate was better than the industry average. You guessed. That supplier was American managed!

Scientific Approach: Focus on Processes

The key to improved quality is improved processes. Quality is improved through improvement in processes, not by inspection. This recalls the 85/15 rule of Juran and Deming, which says that at least

*Brian L. Joiner is President, Joiner Associates Inc., P. O. Box 5445, Madison, WI 53705. This article was presented as the Youden Memorial Address at the ASA-ASQC Fall Technical Conference in London, Ontario, October 25, 1984.

(*continued overleaf*)

85% of problems are system problems and less than 15% are due to workers. (Deming now says that more than 94% of problems appear to be system related.)

Processes make things work. Thousands of processes need improvement, including things not ordinarily thought of as processes, such as the hiring and training of workers. We must study these processes and find out how to improve them. The scientific approach, data-based decisions, and teamwork are key to improving all of these processes. This emphasis on processes is one of the principal things Japanese managers have achieved, but American managers typically have not.

All One Team

This is absolutely necessary. Lacking team spirit, employees can, through passive resistance, impede the best efforts at quality improvement. With it, everyone seeks improvement, everyone gains from improvement, and teamwork becomes pervasive.

Here is an example of how one American-managed company improved its productivity and, at the same time, fostered the team spirit among its workers. This company employed 20 workers in a metal finishing area. These workers, their managers, and technical support people set to work to improve productivity. As a result, the number of workers required dropped first to 11 and then to 7. Now the usual response of American management would be to lay off the "surplus" workers. This company, however, taught them new skills, moved them into new jobs, and recognized their contributions to the company. What would have happened if they had been laid off instead?

Another success story (Serrin, 1983) is about a Warwick TV plant that moved from the Midwest to the Sun Belt to be competitive. But that did not work either and, after a few years, the plant was sold to Sanyo, a Japanese company. Sanyo kept the same workforce and now turns out excellent TV sets at a high level of productivity. The secret? A new managerial climate, with authoritarianism de-emphasized. A 12-year worker says: "We are a family."

The triumph of Japanese management is being repeated all over North America. The companies are not perfect, but they are highly successful. The February 2, 1984, issue of *USA Today* ("Japan's Goods Roll In," 1984) reported that 476 Japanese-owned companies now employ 82,900 American workers in the manufacture of everything from balloons to automobiles. It can be done in North America. It *is* being done.

The triangle, which has quality, teamwork, and the scientific approach at its apices, summarizes the major requirements of the new managerial climate needed for our industry to regain its competitive position in world markets. You may recognize that this triangle is also a condensed form of Deming's "14 Points for Management." Now I acknowledge that not everyone agrees with Deming. I must tell you, though, that after several years of focused study and hard work in this area, I have become increasingly convinced that, while Crosby, Juran, and others have many good ideas, Deming goes much further in understanding the deep underlying problems facing North American industry.

Some statisticians think Deming has gone too far and is too confrontational with top management. I will not argue about the packaging of his message; it might be improved. But I believe the message itself is right on target, and I ask you to suspend judgement on Deming and open your mind to the possibility that he may be right. Let us review his "14 Points for Management," which apply to organizations of all types and all sizes – not only to entire companies but to their parts:

1. Create constancy of purpose toward improvement of product and service.
2. Adopt the new philosophy – we are in a new economic age.
3. Cease dependence on inspection to achieve quality.
4. End the practice of awarding business on the basis of initial cost.
5. Improve constantly and forever every activity.
6. Institute training and education on the job, including management.
7. Institute supervision.
8. Drive out fear.
9. Break down barriers between departments.
10. Eliminate slogans and exhortations.
11. Eliminate work standards that prescribe numerical quotas.
12. Remove barriers that rob workers of their right to pride of workmanship.
13. Institute a vigorous program of education and retraining.
14. Put everybody in the company to work in teams to accomplish the transformation.

Some statisticians may say: "We can do well enough without the change in managerial climate." I do not believe it. Let me cite an example. One manager I know got really turned on when he learned about statistics. He studied processes and improved them. He used Pareto charts, control charts, and design of experiments. He isolated the causes of problems and eliminated them. His workers thought he was super, because he worked with them and helped them get rid of many of the hassles that had plagued them in their jobs.

Then he was relieved of his responsibility because his manager and other managers did not understand the 85/15 rule. When he pointed to problems outside his own area, the other managers felt he was pointing to *them* – when, in reality, he was pointing out the problems in the system.

You may encounter similar problems. Your work may often be stopped at departmental barriers. You may be asked to work on problems that you know are not the most important and urgent problems of the company. Do you work in a place where other employees, from top to bottom of your organization, actively seek your advice to help them improve quality and productivity? You are useful to your organization now, but you could be much, much more useful.

ROLE OF STATISTICIANS IN CREATING THE NEW MANAGERIAL CLIMATE

I have briefly described the new managerial climate and why it is important. I hope you agree with me that it is needed. The next question is: Is there anything we statisticians can do to help create the new climate? The surprising answer is: Yes, there *are* things we statisticians are among the best prepared to do. Deming told me that for three years before I believed him. He said: "Nothing less is required than the transformation of the American style of management – and you [statisticians] must show management how to create that climate."

I could not see it. I could not see why I or other statisticians should be involved in the creation of a new climate. I could see why statisticians would benefit from the change – that part was relatively easy. But what did I know that would help with the transformation of the American style of management? Only in the past year have I come to understand what Deming meant, and I would like to share with you my new understanding of his message. I do not expect to convince everyone to become involved in the transformation of management. That is not necessary. But some of us do need to be involved.

It will not be easy. The transformation of management is not a role for which we have been well prepared. It is a much broader and more ambitious role, requiring new skills that most of us have tended not to develop. Let us look at a few aspects of the new management philosophy and note what contributions statisticians can make toward their implementation.

Everyone Seeking Improvements in Quality and Productivity

Statisticians can help implement this by teaching managers how to focus on processes rather than on blaming individuals. American

(*continued*)

Figure 11.12. PROCESS IMPROVEMENT STRATEGIES: The Role of Statist..... (continued 1)

managers do not normally think in terms of processes, especially not processes like recruiting well-qualified employees, training first-line supervisors, and introducing new products. Teaching managers how to study and improve such processes helps them understand why everyone else should also be studying processes and seeking improvements. Many statisticians find it natural to think in terms of processes; we know how to gather and interpret data from processes to help improve them.

Statisticians can also help speed up improvements, and the success of these efforts tends to build confidence and *esprit de corps*. We tend to seek out causes, not jump to solutions. We ask: Why? How do you know? more times. As a result, projects to improve processes are usually completed much faster and with much better results when statisticians are involved.

For example, in one company a production line often went down. Why? Study found that the ink-jet labelling machine failed frequently. *Why*? The major cause turned out to be fluctuating pressure in the air lines. The machine failed whenever the pressure dropped below 66 psi. The study team recommended the purchase of local compressors to supply uniform pressure. But they should have asked *why* one more time: they should have asked why the pressure fluctuated, because it turned out that other machines also had problems when the pressure dropped. Statisticians tend to persist longer in asking why and thus tend to help teams achieve better results.

Trust of Management – Absence of Fear

Statisticians can help bring this about by demonstrating to managers that at least 85% of problems are related to the system, not the worker. As we urge, and help, managers to improve processes throughout the company, they come to understand the 85/15 rule. These process improvements in turn help convince workers that management really cares about the organization and thus cares about their collective survival.

We can also eliminate the practice of making demands that are inconsistent with process capabilities. We can help identify and eliminate inadequate materials or training. Workers will no longer take the brunt of the blame when processes fail. Thus, we may ultimately be able to convince management not to terminate workers when productivity gains are made or lay them off when the economy dips downward. We may also be able to help convince management and labour that gains in productivity lead to more jobs and greater job security, not to fewer jobs and less security.

Eliminating Barriers Between Departments

Statisticians can help quantify current process capabilities. Only when these capabilities are truly known will others be able to place realistic expectations on them. Unfortunately, management knows today that if they put enough pressure on one point, that group will generally come through. They often interpret this to mean that increased pressure is the best way to get results. They need to learn, however, how this pressure distorts the system and interferes with overall quality and productivity.

We can show how understanding processes helps provide ways for data-based communication of departmental needs. We can help eliminate finger pointing and get down to the facts. "In God we trust. All others must bring data." Or: "Facts often kill a good argument."

HOW STATISTICIANS CAN PREPARE FOR THIS CHALLENGE

Statisticians have three types of special knowledge. We are uniquely well qualified to:

(a) help figure out what data to collect and how;

(b) interpret data in the face of variation;

(c) coach others in the proper use of the scientific approach.

The first and second types of knowledge, figuring out what data to collect and interpreting data in the face of variation, are obvious. But the third point may be surprising. We often think that other people approach problem solving and process improvement in the same way we do, even though most statistical consultants would admit that one of the most valuable contributions they make to an investigation is the use of a logical, data-oriented approach. As Cochran and Cox (1957) reminded us, perhaps the major contribution a statistician can make in the planning stages of an investigation does not involve statistical theory at all, but simply forcing the investigator to explain clearly why he is doing the study, why he chose the proposed method, and why he thinks the completed study will answer the questions it was intended to answer. Although we statisticians do not usually think of our role in this way, the role is a natural one because we, as a group, are most likely to ask: Why? How do you know? How *will* you know?

To be maximally useful in the transformation, however, we must further educate ourselves. We must learn the new philosophy in depth. We must thoroughly understand the Quality-Teamwork-Scientific triangle and the teachings of Deming, Juran, and others. We must understand current American management style, its strengths and weaknesses. Finally, we must prepare to venture far beyond our familiar statistical territory to learn new skills – interpersonal skills, team-building skills, how to plan for change, and how organizations work.

In conclusion, here are a few specific recommendations for action:

Locate one or more partners who specialize in the new skills and who complement your strengths.

Educate yourself and others concerning what must be done and why. Listen to and study Deming, Juran, and others. Attend both Deming's and Juran's seminars for management.

Seek to change roles. Think bigger, more strategically – more like the president of the company or the chairman of the board. Help get a team organized to work on a key project. Help obtain major, highly visible gains in quality and productivity. Get higher and higher level managers on board with respect to understanding the new philosophy.

When enough of us have done these things, we will be in a position to make major contributions toward the survival of North American industry.

SUMMARY

1. Major chances in management are needed if we are to become and remain competitive with the Japanese.
2. Statisticians have a vital role to play in the creation of the new managerial climate.
3. Some of us need to expand our view of what we can contribute to our organizations.
4. We need to develop new skills and new ways of thinking about our roles.
5. Then we will be ready to achieve and sustain major gains in quality and productivity.

ACKNOWLEDGEMENTS

It is especially appropriate in this Youden Memorial Address to acknowledge my personal debt to W.J. Youden. He was an early and important teacher and mentor when I first began statistical practice at the National Bureau of Standards in 1963. By example and advice, he taught me a great deal about how to write, speak, and consult.

(*continued overleaf*)

Other people who contributed directly and importantly to this paper include W. Edwards Deming, who is the originator of most of the ideas expressed here; Laurie Joiner, who worked long and hard with me on the expression of these ideas; Carol Steinhart, who was a major editorial collaborator; and a large number of colleagues who gave me support and strong challenges on several earlier drafts.

[Received December 1984]

REFERENCES

Calonius, L. E. (1983), "Factory Magic," *The Wall Street Journal*, April 29, 1. (See Figure 11.11a of these Course Materials.)

Cochran, W.G. and G.M. Cox (1957), *Experimental Designs*, (2nd ed.), New York, John Wiley.

"Japan's Goods Roll in: East Comes to the West" (1984), *USA Today*, Feb. 2.

Serrin, W. (1983), "Japanese Clearly Doing Something Right in U.S. Plant," *New York Times* (reprinted in San Diego *Mercury News*, Nov. 9).

A more recent longer publication is: Joiner, Brian L. *Fourth Generation Management*. Joiner Associates Inc. and McGraw-Hill, Inc., New York (1994).

The subtitle of this book is: The new business conciousness: how the evolution of management and the revolution in quality are converging, and what it means for business and the nation.

Another reference is: Scholtes, Peter R. *The Team Handbook. How to Use Teams to Improve Quality.* Joiner Associates Inc., 3800 Regent Street, P.O. Box 5445, Madison, WI 53705-0445, U.S.A. (1988).