Afterword

The Germ Theory of Management

by Myron Tribus*

Introduction

In a recent review of the Deming Theory of Management, William B. Gartner and M. James Naughton wrote:

> Medicine had been 'successfully' practiced without the knowledge of germs. In a pregerm theory paradigm, some patients got better, some got worse and some stayed the same; in each case, some rationale could be used to explain the outcome.

Doctors administer to the needs of their patients according to what they learn in school and in their training. They also learn by experience. They can only apply what they know and believe. They have no choice. They cannot apply what they do not know or what they disbelieve. What they do is always interpreted in terms of what they understand is "the way things work." As professionals they find it difficult to stray too far from the common knowledge and understanding. They are under pressure to follow "accepted practice." In this regard, doctors are no better and no worse than the rest of us. We are all prisoners of our upbringing, our culture and the state of knowledge of our teachers, mentors and fellow practitioners.

Today we smile when we read that after sewing up a wound with silken thread, the surgeons of 150 years ago recommended to leave a length of the thread outside the wound. This was done to draw off the pus that was sure to follow the insertion of unsterilized thread by unwashed hands using an unsterilized needle.

The doctors had a theory of how malaria was spread. They called it "mal-aria" to emphasize that it was the bad air, the unhealthy vapors in the night, that caused the disease. Their theory of medicine caused them to look in the wrong places for wrong answers to the solutions to their most pressing problems.

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Today our managers do the same. When they are up against tough international competition they look to changes in economic policy, in tax structure, in trade policy—everywhere except in their own understanding of what makes a company competitive. They question everything except their own theory of management.

Changing People's Beliefs is Not Easy

Try to imagine that it is now the year 1869. Pasteur has only recently demonstrated that fermentation is caused by organisms which are carried in the air. Only a few months ago Lister tried out the first antiseptic, carbolic acid, and found that it worked to prevent inflammation and pus after surgery.

120 years ago the spread of medical information was much slower than today. Imagine you are a young researcher in a medical school in the USA. The Civil War has just been finished and you are trying to develop your own career after army service. You are a serious young doctor who tries to learn the latest developments in your profession. Suppose that you have just learned about Pasteur's and Lister's work and that you have been invited to speak before a group of distinguished physicians, many of them having come to fame for their heroic service as surgeons during the American Civil War. What you now understand from your readings is that these famous physicians are actually killing their patients. Your responsibility is to explain to them, if you can, that because they do not wash their hands or sterilize their instruments, they sew death into every wound. Your assignment is to persuade them to forget most of what they have been taught, to abandon much of the wisdom they have accumulated over distinguished careers and to rebuild their understanding of the practice of medicine around the new theory of germs. Do you think you could do it? Do you think you could convince them? Do you believe they would be glad to hear you?

Suppose instead of being a speaker, you are a member of the audience. You are one of the good doctors who have earned respect and prestige in your village. You have a nice house on the hill, a pretty wife, a nice carriage, some fine horses and a few servants. You are part of the elite of your society. How will you feel if someone starts spreading the word that your treatments are a menace, that the theories you hold are bunk, and that your habit of moving from one patient to another, laying unwashed hands on each, guarantees the spread of disease to all who are so unfortunate as to become your patients? What do you think will happen to your practice if this kind of word gets bandied about? How would you be likely to greet the messenger?

This is not 1870—it is the end of the 20th Century. You are not doctors. You are all respected professionals. For most of you, managing is a part of your professional responsibility. You approach managing according to what you have been taught and what you have learned during your careers. I have worked among people like you and I know that no matter what happens, you always have a good explanation. I should be shocked and amazed if you were to explain your latest failure in this way: "You know, I really don't understand what I am doing and think that most of what I know is wrong."

You are no different than I was when I was an executive in industry a little over a dozen years ago. You don't get to a position of responsibility if you are continuously in doubt about the validity of what you believe. And you certainly don't get there if you broadcast your doubts about what you know and can do.

My task is similar to that of the young doctor trying to introduce the germ theory of medicine. There is a new theory of management, as different from what most of you now believe as the germ theory was from what the doctors believed. For reasons which will become clear shortly, I call this different approach the "germ theory of management."

Not everything the doctors did was wrong; just most things. Before the germ theory doctors interviewed patients, took medical and personal histories, prescribed changes in diet and lifestyle and were present at the arrival of babies. They developed a sense of social responsibility. They were sincere in their efforts to do the right things. Read, for example, the Oath of Hippocrates, which preceded the germ theory by many centuries. The earliest doctors did the best they could with what they knew at the time.

So do you.

What the doctors were taught was not good enough. Some things they did were downright dangerous and harmful. They learned. So can you.

But just as medical practice has been changed by the germ theory of disease, so managerial practice is about to be changed. The changes are already being adopted in different lands and in different organizations, more vital and more alive. In this fiercely competitive world, the unhealthy enterprises are going to die. The enterprises which continue to be managed the old way are going to disappear.

This is not some new fad which you shall be free to follow or not as you please. What I am talking about is your survival. Your jobs will depend upon whether you are willing to learn a new kind of behavior. I do not expect all of you to like it; the doctors didn't like it then, either. But that's the way it was; that's the way it is.

The Required Changes in Management are Profound

As I said in the start of this talk, in 1865 Pasteur was sent to the south of France to investigate what was killing the silkworms in the silk industry of France. There he isolated the bacilli of two distinct diseases and developed a method of prevent contagion. Lord Lister applied the same ideas in medicine in the same year.

In the 1920s Walter Shewhart at the Bell Laboratories was given an assignment to see what to do to increase the reliability of telephone amplifiers used to strengthen the signal in long distance communication. These amplifiers were required to be about a mile apart and were to be part of a transmission system in which the cables were underground. Unlike the doctors, the Bell System wanted to be sure the amplifiers were healthy so they could bury them! If they died, they would have to be dug up. The amplifiers contained vacuum tubes which were known to have an uncertain life. Shewhart's assignment was to find out what could be done to guarantee the life of the amplifiers, to keep them from getting sick, so to

speak. In the process he discovered the virus of variability. Shewhart discovered what, in retrospect, ought to have been clear to everyone. When you assemble a vacuum tube, if every component that goes into the vacuum tube is the same as in every other vacuum tube and if each tube is put together precisely the same way and each is free of contamination, and if each is subjected to exactly the same load conditions, then each will live the same life. The problem is that not all vacuum tubes can be made the same. There are small variations in the chemical composition of the materials. There are small variations in the assembly process. There is always a small amount of dirt that falls by chance in different places. In short, there is always variability and this leads to uncertainty in how long the vacuum tube will last. If the process of assembly is sufficiently variable, it is almost certain that some of the vacuum tubes will have very short lives. The tubes are victims of the virus of variability. This was Shewhart's discovery.

Shewhart's investigations lead to the concepts of statistical quality control and in terms of our analogy, his work, like Pasteur's has laid the foundations for the "germ theory of management."

Few people understand what unpredictable variation does to the cost of doing business. Fewer still understand what can be done about it and what is management's role.

Just as Lister understood the broader significance of Pasteur's work in the field of medicine, so it was that Dr. W. Edwards Deming understood the significance of Shewhart's work to the general theory of management. He realized that the key to better management was the study of the *processes whereby things get done*. If you remove the sources of variability from any process, you make it more predictable. You can schedule activities closer together and eliminate waste and delay.

The key idea is the elimination of the virus of variability which results in the improvement of process capability. This idea was taught widely during World War II and was important to the successful development of America's mighty war machine. By 1956 a few people in the Bell System understood this idea well enough to write in the introduction to the Western Electric *Statistical Quality Control Handbook* the following comment:

> …it is possible to make process capability studies in connection with practically any type of Engineering, Operating, Inspection, or Management problem.

Unfortunately, most of our managers, in the period after WWII were so busy making quick money they forgot about the virus of variability and the theory disappeared from the American scene. None of our business schools picked it up. In fact, the few times I have tried to introduce these ideas to the prestigious business schools of America I have been listened to with polite amusement, if listened to at all.

Germs are invisible. That's what makes them so dangerous and so difficult to track down. You know about their presence only because of the symptoms. The same is true of the viruses of variability. They are invisible. You have to know where to look and how to look. Just as the doctor often has to use special instruments and may even have to culture a sample, so must the manager learn to take data and analyze it in a special way. Dr. Deming

says it takes "profound knowledge" to understand.

An experienced doctor looks into your throat and says, "I believe you have an infection there—or have you just been eating some red candy?" The doctor feels for lumps in your glands and listens to the sounds of your lungs as you breathe. If the doctor does not understand the germ theory of disease, he cannot interpret the symptoms.

In the same way a manager skilled in dealing with the virus of variability can judge the health of an enterprise by looking at data, by observing behavior, by asking questions and judging the answers, and by listening to what goes on in meetings. If the manager understands how the virus of variability works, he or she will understand what is seen and heard. If not, they will be as helpless as the doctors of long ago, prescribing different vapors to counter "mal-aria."

Variability—the Virus of Systems

The first thing that Doctors had to learn was that germs, although invisible, could be transmitted by various means from one patient to another. They had to believe that these germs mattered. They had to learn about sterilization and antiseptics. They had to believe it was important to wash their hands. They had to learn about germ cultures and the causes of infection. They had to form new images of the world.

So will you. Let us consider an example.

Imagine a company which purchases castings from a foundry (or even has a foundry of its own) and passes these castings through a sequence of machining processes, carried out on different machines. The different machined parts are assembled into a product in which the parts move, deflect, and rotate, and are supposed to do so with some precision.

We suppose that the materials purchased by the foundry are not perfectly uniform. There is always some variability in the composition and the treatment of the materials. The processes in the foundry itself are not always the same. *We may say that the processes are infected with variability.* They yield castings which vary in composition, dimension, hardness, and porosity. The variations occur from point-to-point and part-to-part.

When these castings arrive at a machine tool to be scraped and cut by various tools, their variability infects the machine tools. The variation in hardness causes nonuniform tool wear. It also makes it difficult for the machinist to know at what speeds and feeds to set the controls. The tool wear is not predictable. Machine maintenance is not predictable, either. Thus the infection spreads to the tool room, where a larger inventory is carried than would be needed if the life of tools could be predicted accurately. Inventories are now subject to wider variations. The inability to predict the requirements for maintenance increases the number of people who need to be hired for maintenance and complicates the maintenance process.

With so many people to hire and train, the training system becomes overloaded and not everyone receives the same training. Thus the maintenance system is infected with variability. When a machine is "fixed" it may break down sooner than expected because the maintenance is not always done the same way. People with inadequate training do not follow stan-

dards of maintenance. The virus of variability spreads from the maintenance department to the personnel department where the records suggest there are large differences in the behavior of workers, when, in fact, the workers are subjected to uncontrolled variation. They are victims of a lottery, but they and the personnel department do not understand it. The virus of variability infects every department it touches.

Imagine a company making beer cans. The company purchases rolls of sheet aluminum from a supplier. As the sheet of aluminum passes through the can making machine it is cut into various shapes by dies and then drawn into beer cans and beer can tops. The aluminum varies in thickness from roll to roll. When a new roll is fed to the machine, it may jam and the controls will have to be reset. The output of the machines is now unpredictable. The variability virus has spread from the aluminum supplier to the machines. After a while some of the operators learn special tricks to apply when the aluminum rolls have to be changed. Because the management rates the operators individually and competitively, those who learn new tricks are not always willing to share them with their competitors. What the management then sees is a large variability in the performance of their operators. They think they are witnessing the capabilities of their operators. They think they are witnessing the results of the variability of people; they aim to fire the "bottom half." They do not know that the virus of variability is infecting their processes. They act on what they know. They have an explanation for everything and are confident in what they do. In the process they ruin the lives of some of their workers. They are a menace to the health of their companies, but because neither they nor their workers understand about the virus of variability, they are unaware. They know not what they do. And they do not like to be told.

When a product is assembled the variability in components causes variability in performance from one product to another. The variability of finished products may be so great that only a fraction of them can be used without being reworked. Some are so bad they have to be scrapped—or at best taken apart and reassembled using other parts, which may be similarly infected. What to do with the sick parts becomes an important policy issue for the company. These problems cause many management meetings, making the life of the managers hectic and unpredictable. The variability in the incoming materials has been allowed to infect all systems, including the managerial system. The symptom is managerial stress; the cause variability virus.

These infections of variability, which have spread from machine to machine, to the personnel, and even to the personnel records, are largely undetected by managers who do not understand the "germ theory." They have their own theories of how things work. The cures they apply may, in fact, make the infections more virulent.

The examples I have given are from the factory floor, but they occur in the office as well. In deference to my past experience as an executive in the Xerox Corporation, I shall not dwell on how variability in maintenance of copiers can cause variability in their performance and thereby infect the performance of an entire office.

Suppose you live in a small town served by a feeder airline. Suppose that the airline schedule is not reliable; that is, you cannot be sure when your airplane will take off. This variability of performance causes you to make your appointments at a distant city with con-

siderable slack in your schedule. Sometimes, just to be safe, you travel the day before and must pay for a hotel room for one night. You dare not count on the morning flight to get you there and the evening flight to get you back. Consider the total effect on the other businesses in the community and you have a recipe for the decline of the local economy—the added expense may just be enough to drive your company out of business. Too many people think of these delays and missed schedules as "normal." They do not know what it means to be well. A few of them go to countries where the trains run on time, the mail gets delivered promptly, the phone system works without delays, the taxis are clean and the streets are free of debris. They marvel at the sense of good health.

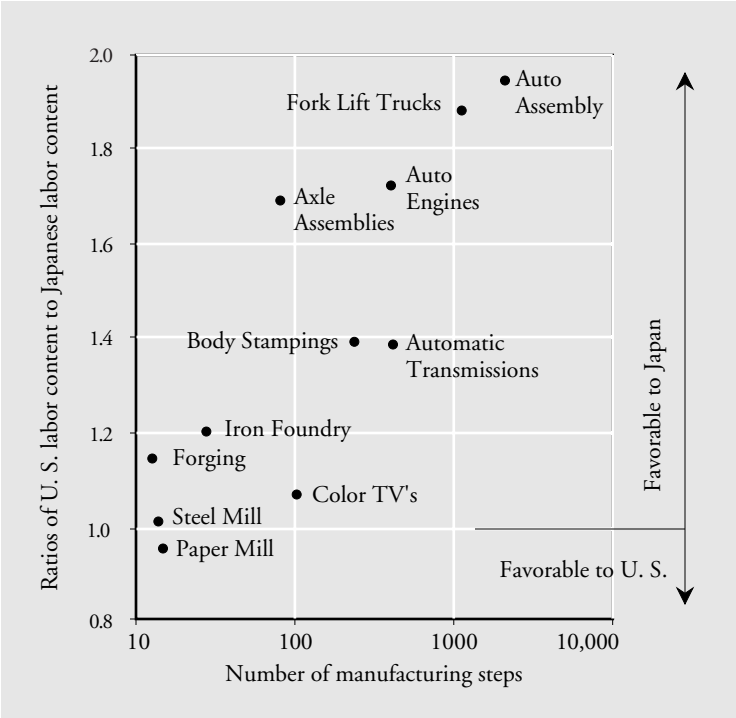

Figure 20.1: Ratios of U. S. labor content (number of manhours required per unit of product) to Japanese labor content for various operations. Ratios below 1.0 are favorable to the U.S. As the number of manufacturing steps increases the ratios become more unfavorable for the U. S. (Data from Boston Consulting Group)

How much could be saved if all processes had zero variability? Consider just this one example: In the early 1950s, to demonstrate just how quickly a house could be built, the Henry Beck company of Dallas, Texas, assembled a two bedroom, one floor house on a previously prepared concrete slab. As pictured in Life magazine, from the time they started to assemble the house until it was finished, painted, with one woman taking a hot bath in the bathroom and another cooking dinner on the kitchen stove was less than three hours. Think of that—three hours. The usual time is at least 30 days, often more. Why does it take more time? It is because the activities of all the people cannot be scheduled so closely. If the car-

penter starts to drive a nail 1 second after the board has been cut, instead of 15 minutes, the time scale increases by 900. Three hours stretches into 2700 hours. No one expects to be able to schedule all the people who are required to build a house so that each one does his or her job with only seconds to spare. We do not expect to see the precision of the Rockettes or the ballet. In an industrial setting, we cannot expect that kind of precision. But we can make each process more precise, and as we do so, errors, goofs, flaws, and delays all begin to disappear. As we reduce the virus of variability, we find savings in time and money we never knew were there, savings which our methods of accounting hide so cleverly that we think that waste is "normal."

We are not accustomed to thinking about achieving such precision of control that we can assemble a house in a few hours. Instead we expect to wait half a day just for an appointment at the bank! The inability to schedule things accurately means that for a complex activity, the total time required to do something is as much as 1000 times as long as it needs to be. This is the cost of the virus of variability.

All of the variability cannot be removed. No one knows, however, just how much can be done. Until the students of Homer Sarasohn, W. Edwards Deming and Joe Juran applied these ideas in Japan and the results were seen on a large scale, it was not appreciated that costs could be cut by as much as 50% in many instances. We are not just talking about hardware. The results in the service industries are sometimes even more dramatic.

Processes can have an Immune System Deficiency, Too

Until doctors accepted the existence of germs and began to analyze illnesses in terms of infections, they could not consider the existence of an immune system. It is common knowledge, today, that the mere infection of a person with germs is not enough to cause an illness. Much depends upon how the immune system of the body reacts to the virus.

Dr. Genichi Taguchi in Japan has pioneered the concept of a robust design, one which does not amplify variability but rather tends to attenuate it and provide good performance even in the face of large variability.

Engineers and managers who are ignorant of elementary statistics simply cannot begin to think about how to design healthier products but spend dollars needlessly in attempting to control processes. When managers spend large amounts of money to get around the effects of variability, instead of learning how to reduce it, we call their approach a "technology fix." If you learn how to control variability and to make your processes immune to it, while your competitor spends millions of dollars on a completely automated process with complex controls designed to control variation, it is clear you will be able to undercut your competitor's prices. This line of reasoning explains why the NUMMI plant, operated by Toyota for General Motors, is the highest quality plant in the GM system although it has the least automation.

The Doctor or Manager as Detective

A common failure among doctors is misdiagnosis. Faced with a set of symptoms, the doctor is supposed to figure out what is wrong with the patient. A good doctor knows how to ask useful questions. The doctor has to be like a good detective. Indeed, it is not an accident that Sir Arthur Conan Doyle was a physician before he became a successful writer and that his model for Sherlock Holmes was the professor of clinical medicine who taught him that careful observation of a patient could reveal many things about lifestyle and habit.

Let me try you out as observers. Figure 2 shows data for [the flaws produced by] eight workers making the same product, all working at about the same rate, for 12 weeks. Good doctor, what do make of these data? What would you prescribe?

	Week												
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	**Sums**
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 20.2: Flaws by Worker by Week

How do you prescribe? If you were the supervisor of these workers, what would you do? How would you go about improving things?

I have presented this table to audiences across the USA, in Mexico, in Canada, in Australia, in the UK and I always get the same reaction. People always suggest a good talk with Eva. They propose putting Eva alongside Mary or asking Mary to help her. They propose to fire Eva. They propose to give Eva more training.

An astute statistician at a meeting of the Royal Statistical Society in London even went so far as to observe that there was a 30-day periodicity in Eva's output and that might have something to do with things.

After the audience suggests different cures based on the common wisdom, I explain to them that the numbers in the tables were actually generated by the random number generator in my computer. The flaws were generated and assigned to memory cells, to which I attached people's names. In other words, the faults were generated entirely by the system.

In only two or three instances, out of thousands of people, did anyone suggest that perhaps the problem was in the system itself—that the system had been infected with the virus of variability and it was not the fault of the workers. In the last four years, only three people have suggested that we analyze the data in the table to see if we could compute whether Eva's results should be expected in the light of the variability exhibited by the system.

The fact is the process itself is infected with the virus of variability. If you don't set about sterilizing the process, that is, reducing its variability, it will certainly infect the workers. Not only will it infect the workers, it will infect your judgment.

People change their views very slowly. I shall never forget the one manager who said afterwards, "Look, I know that the numbers were generated by a computer, but nevertheless, I would still talk to Eva!"

The output of these workers has been infected by the variability of the process over which they had no control. Suppose that the supervisor, with the objective of urging the workers to better performance decided to post Figure 2 on the bulletin board. Of course we do not expect the workers to understand the germ theory of management. They may think that the results are their fault and they will try to do better. Do you not see how the virus of variability of the system will infect their interpersonal relations and perhaps even the home lives of the workers? If the supervisor does not understand the theory, do you not see how the systems of supervision will become infected? Suppose there is an annual rating system for supervisors and the data in the above table are available to the upper management? Suppose the upper management does not understand the variability virus and therefore thinks the supervisor should have done something drastic about Eva. Suppose the supervisor, however, does know about variability and does understand it is the system that needs to be fixed. Given this disparity in understanding, how do you think the manager will rate the supervisor?

I am not describing a far fetched scenario. I am describing what goes on daily in factories and offices all around the world.

The variability in product performance also infects the purchasing process—the number of spare parts required is increased, making the purchasing and supply systems unhealthy.

We have seen, therefore, how this virus of variability can spread from the foundry to the personnel office to the top ranks of management.

The point I want to make is simple: Variability is a virus. It can infect every process it touches.

Juran has captured the essence of this spread of infection in what has become known as "Juran's Rule:"

Whenever there is a problem
85% of the time it will be in the system, and
15% of the time it will be the worker.

The instinctive reaction of most managers I meet is to blame the person. Sometimes I find a manager who, when confronted with a problem will even say it is his own fault, he should have done something else. As a consultant I often find it difficult to persuade him that in fact it is the *system* which is at fault. Many managers will persist in thinking that they need to change something in their personalities when in fact it is the system which needs to be changed.

Who should be responsible to clean up these processes, to *sterilize* them, so to speak?

Just as germs are everywhere, so are the causes of variability. To sterilize a process will require someone to study what causes the variability and to remove the causes one by one. Managers are the only people authorized to tamper with the system. If you, personally, do not do this, it will not get done. Your entire operation will become sick. As a manager, you cannot delegate to someone else the responsibility for the health of the processes for which you are responsible. If you can delegate this responsibility, why do we need you?

Some Managerial Myths

In promoting this different approach to management Don Petersen of Ford Motor Company put it to his subordinates this way: "I hate to be the one to tell you this, but some of you were promoted a time or two for the wrong reasons."

I have collected a few managerial myths which I believe need to be eliminated. I am aware that many of you will feel deeply resentful. That's to be expected. You will either get over it or be pushed aside by those who do understand.

The Perversity Principle

If you try to improve the performance of a system of people, machines, and procedures, by setting numerical goals for the improvement of individual parts of the system, the system will defeat you and you will pay a price where you least expected to do so.

This idea goes down hard for people who like to think that the organization chart defines how things get done. They like to issue crisp orders to subordinates. They think they can divide the system into parts, along the lines of an organization chart. They have a generic organization chart in their heads.

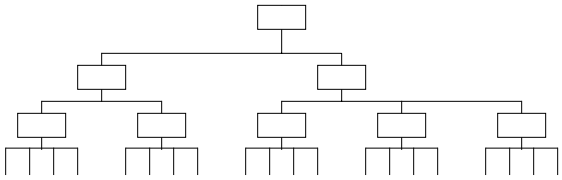

Figure 20.3: A Generic Organizational Chart

Their managerial strategy is "divide and conquer." They see the organization the way some friends of mine in Holland see it.

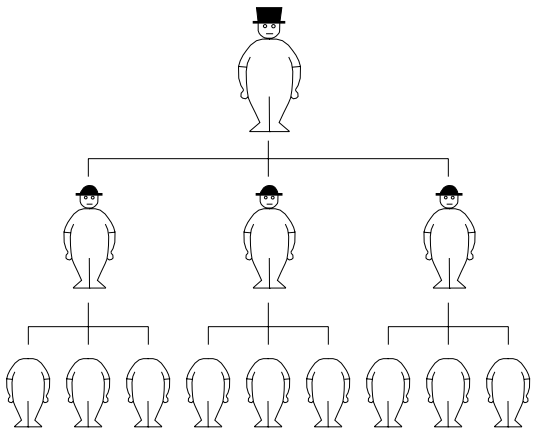

Figure 20.4: The hidden assumption of many managers—the people at the bottom have no heads.

(Courtesy of MANS Organization, The Netherlands)

The conceptual framework of many managers is impoverished. They forget that the work flows *across* the organizational chart, more or less perpendicular to the lines of authority. They are unaware that the different steps in the process infect one another. They ignore that they are dealing with a system as a whole. They are determined to judge each person and each division on its own accomplishments.

They do not know how to recognize and define a system of processes. They do not understand what is meant by a process. They do not know how to recognize when processes which flow across an organization chart are unpredictable. They persist in thinking that organization charts describe how things get done when in fact things get done in spite of the organization chart.

In some organizations this method of management leads one department to regard the other as the enemy. They would rather defeat the other department than the competition.

The problem of thinking only in terms of the organization chart, apart from the failure to harness the intelligence of the majority of the workforce, is that the work flows *across* the organization. Suppose you set a target for the people in one department, telling them they are to process a certain number of orders per month. Then you give another target to your sales force. It certainly matters to the factory whether the orders arrive bunched up or spread out. It matters if they arrive in a predictable fashion. In other words, even if each person does the required amount of work on average, the variability in performance will cause extra expense and waste in other departments.

Consider for example the loading of a ship. The cargo arrives at the dock in trucks and is unloaded by hand. Then cargo is picked up by a stevedore and taken to a crane. Bundles of cargo are picked up and deposited on the deck where another stevedore loads it into a fork lift truck and moves it into the hold. A colleague of mine observed that this was the way it

was done for the Nina, the Pinta, and the Santa Maria. If you watch this activity for awhile you will see that the variability of cargo sizes, the variability of movement of cargo and the variability of the performance of the individual performers does not speed up the process. It slows it down as each performer tries to look good at the expense of others.

The same difficulty arises whenever people have to work in sequence, whether it is in accounting, sales, maintenance and repair or in customer service. The work flows across the enterprise and attempting to treat it piecemeal, as independent operations, results in waste and expense.

Sometimes the variability is so inherent in the system there is no way to improve except to change the system itself. That is why container ships have been so successful. By pushing the inefficient packing problem onto someone else, they have eliminated the variability in the loading process. The turn around time for ships has been reduced to hours instead of days.

If you set targets for the people at the bottom of the system, or for the people in between, without regard for the *systems* aspect of the work, you are abdicating your responsibility. Remember what you tried to do to Eva. Don't do it to everyone.

The Manager's Job Has Changed

The people work **in** *a system.*
The job of a manager
is to work **on** *the system,*
to improve it,
with the help of the workers.

There are several key words in this statement:

1. "work *in* a system" If you believe this you then have to acknowledge that workers do not control what goes on in their work. Managing in such a way that you tell people you are holding them accountable for results flies in the face of what you really know. When you do this, you are inconsistent with yourself. "But," you are certain to protest, "If I don't hold them responsible, they won't do anything." First of all, that's not true. But more importantly, you should hold them accountable to help you to improve the system.

2. "the job of a manager" What did you think your job was?

3. "work *on* the system" Do you know how to define the system upon which you are supposed to work? Do you know *how* to work *on* a system? Do you know what you have to learn to do it? Do you know where to go to learn?

4. "to improve it" Do you still hold to the admonition—"If it ain't broke, don't fix it?" Do you know you are supposed to be active about a third of the time trying to improve the system under your care? Do you do it? Do you believe you should do it?

5. "with their help" Do you accept that your people should help you? Do you accept that you should teach them to help you? Do you want them to help you? Are you afraid? Do you know what you have to do to make it possible for them to help you?

The State of Health of An Enterprise

This audience, of course, is different. It is filled with enlightened people. Surely you would not behave as the doctors a century ago behaved when they were told they should see that their operating rooms were sterile. They fought it tooth and nail.

"What, stop to wash my hands? Don't be silly. I have important things to do."

It was a lot of work to change and it required them to admit they had a lot to learn. They were human. They resented the need to change and hoped in their heart of hearts that it would all blow over.

In the first place, changing the practices and procedures in the operating room was not something they could do alone. They needed nurses and orderlies to help them. They had to begin by first understanding the germ theory of disease themselves. It is one thing to learn a new theory when you are a young student in medical school; it is another when you are busy supporting your family through your practice of medicine. After they learned the theory themselves they had to teach the nurses and orderlies how to sterilize instruments and medical facilities. They could not just leave these things to chance. They had to institute practices and procedures and train people to follow them. They had to influence the training and education of nurses so that these nurses would do the right things without having to be told. Such changes could not come about over night. Many patients would have to die along the way as the changes slowly made their way through medical practice.

The history of medicine is full of examples of doctors who fought the changes and ridiculed the change agents. They buried their mistakes, and few people outside of medicine knew what was happening.

Today I meet managers who do not want to learn. They are busy with mergers and acquisitions and with plant closings. They are busy beseeching the government to do something to somebody else, all the while leaving them alone. With their false images of how an enterprise ought to be managed, they make demands on their workers and thereby provide job security only for labor leaders.

Even if you personally are convinced that a different theory of management ought to be adopted, you will quickly discover you cannot apply it alone. You are answerable to your boss and if the boss does not go along with the new ideas your job may be put at risk. You will have some hard choices to make. If you are low enough in the enterprise you will be entirely frustrated.

The question I am most frequently asked is "Will you please come and explain about quality to our top management?" I have a stock answer to such requests: "I'm sorry but I do not do that sort of thing. I have a colleague, however, who will accept such assignments. His name is Don Quixote."

We started this example with the factory floor, but the variability virus will infect any system it touches. This includes the managerial system itself. Doctors can get sick, too, you know. When you work in an enterprise that is sick, it gets to you. You don't enjoy the work. You have to work hard just to keep things going. If you stay in the job too long, you can burn out.

It is important that a manager learn how to diagnose the situation in an enterprise by observing what happens in meetings.

Since managers spend so much time in meetings, my colleague Professor Tsuda, of Rikkyo University in Tokyo, has prepared the following chart to help a manager make a diagnosis from the symptoms which will be exhibited in typical meetings.

Professor Tsuda's Classification Scheme for Organizations

	Style of Meeting	Decision Making	Diagnosis	Status
1.	Discussions without data	Decisions are based on politics, emotion, turf, etc.	People do not want to see problems, so they deny their existence	Drugged or Comatose
2.	Data are discussed, but only if they are favorable	Decisions are based on raw data without analysis—options accepted on boss' hunch	People see problems but are habituated to their presence	Asleep
3.	Good and bad data are discussed and analyzed	Decisions are based on data, analysis, and options proposed by the presenters	People see problems but do not know what to do because problems are systemic	Alive
4.	Data are presented, analyzed statistically, and options are also analyzed, including the option of changing policies	Decisions are based on analyses and data—options and policies are questioned	People want to see their problems and are quick to seek out data—they want to solve problems	Alert Sensitive Alive

(courtesy of Professor Yoshikazu Tsuda, Rikkyo University, Tokyo)

Perhaps with the aid of the people in finance you have tried to divide your company into separate "profit centers," with ratings for the performance of each. Everyone in your enterprise has a well defined job and is held accountable for it. Well, whether you like it or not, the enterprise is one system. You can divide it up anyway you want to in your head; in reality it is what it is—a highly interactive complex system in which each unhealthy part infects the others. If you ignore this elementary fact, the system will never be healthy. It will not be able to compete against healthy systems. In due course, unless protected artificially against competition, it will die. Your job will go with it.

The Transition of a Culture

In my opinion, what this country now needs more than anything else is a better understanding of what it means to be a leader. Don Alstadt has described the situation in the USA by the phrase "Overmanaged and underled." We need to lead our enterprises into a new way to manage. We need to lead in the transition of our managerial cultures from one norm to another. This transition started in Japan in the late 1940s as a result of Homer Sarasohn's intervention after WWII. It accelerated when Deming and Juran went there in the 1950's and it has continued to accelerate ever since. In the early 1980s a few companies learned about the Deming Prize and the impact of quality management on Japanese industry. Now we have quite a few examples in many countries of the world of what it means to change the corporate culture.

What I can tell you about, from the experience of others, is the path you are most likely to follow in changing the company culture. There are seven stages, once you start to change. My own observations bear out the validity of the following table which was originally prepared by Professor Tsuda.

Stage 0

The management expresses concern only over market share, profits and return on investment.

Stage 1

The management is concerned about quality of the product because of its impact on warranty cost and customer complaints. Loss of market share becomes apparent. The action taken is to add more inspectors so that the "bad stuff doesn't get out."

Stage 2

Management recognizes that control of the production process will lead to less waste and a lower cost to obtain acceptable products. Manufacturing is supported in increasing QC activities.

Stage 3

The results of QC are limited by reactions of personnel so management begins to emphasize quality management. Manufacturing introduces methods of continual improvement (also known as SPC).

Stage 4

Management asks that SPC and quality management methods be applied to all departments which border on the production department (purchasing, transportation, warehousing, etc.)

Stage 5

Management attempts to persuade R&D, engineering and finance to consider quality management principles but these departments think they are not part of the problem. Gradually professionals learn that quality is their mission (a difficult stage).

Stage 6

Management begins to recognize that quality management principles will be useful if applied to all departments of the enterprise but doesn't know how to make it happen. It organizes actions all over the company to see what to do.

Stage 7

Management proclaims (and acts consistently with the proclamation) that "Company wide quality control is the company policy."

Specifically, this means:

Quality is first priority
Customer oriented decision criteria
Personnel policies respect humanity
All departments coordinated
All departments cooperative
All employees involved in improvement
Solid relations with suppliers
Good communications based on
    Factual data
    Statistical Process Control

A Checklist of Things Managers Need to Learn

Every manager should be competent in the basic techniques:

1. Process Flow Charting
2. Fishbone Diagrams
3. Run Charts
4. Histograms
5. Pareto Diagrams
6. Scatter Diagrams
7. Process Behavior Charts
8. Elementary Design of Experiment

Every manager should learn how to:

1. Recognize, define, describe, diagnose, and improve the systems for which he or she is responsible.
2. Diagnose the variability of a system and decide which variations are special, and require special action and which are common and will require a change in the system design and operation. The manager must be able to tell the difference between signals and noise.

3. Lead teams of people, having different educational levels, in problem identification, data gathering, data analysis, and generation of proposals for solution, implementation, and test.
4. Diagnose the behavior of humans and distinguish those difficulties which are due to the variations in human abilities (15%) and those which are caused by the system (85%) [Juran's Rule].

A leader's main obligation
is to secure the faith and respect of those under him.
A leader must himself be the finest example
of what he would like to see in his followers.

Homer Sarasohn in Japan, 1948