WHERE TO FOCUS TO ACHIEVE LEADERSHIP IN QUALITY

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SUMMARY

Corporations around the world are investing more money and resources to improve *delivered quality* than they are investing to improve *produced quality*, and much of it is wasted investment.

The two fundamental reasons for this disparity in resource allocation are customer demand which has accelerated the world quality race and the fact that it is easier to appear that you are winning this race by improving *delivered quality* rather than by improving *produced quality.*

For example, let us suppose that out of 100 engines produced by the Wizard Company, 90 are acceptable and 10 are rejected. It is quite easy to create a system that removes the 10 bad ones from the lot of 100 engines, rather than determine the root causes for these failures and correct the problem. Wizard's manufacturing and quality control engineers will naturally choose the first route and design a production system which removes the rejects and ships the 90 acceptable engines. This, in turn, keeps their customers happy because they only measure quality by what is *delivered* to them, not by what is *produced* at the Wizard Company. Since the customer is happy, so is top management at Wizard.

However, these customers do not know that they often pay part or all of the cost of 10 bad ones, especially where competition for their business is not very strong. In markets where competition is stiff, the company must eat more of this cost — a fact that top management often dismisses as a normal part of doing business.

The difference between *produced quality* (90%) and *delivered quality* (100%), therefore, is a hidden, significant extra cost that companies like Wizard try to charge to their customers and to society, in general. In some countries, like India for instance, 90% of these engines typically would be labeled as meeting *Export Level Quality*; the remaining 10% (substandard engines) would be sold for local consumption. In other words, someone somewhere has to pay the cost for the bad engines. It's a fundamental rule of business.

Achieving excellence in *delivered quality* requires the presence of a sound quality system and consistency in its application accompanied by mechanized 100% sorting technology. This is easy to do. To improve *produced quality*, on the other hand, requires well-blended subject-matter competence, use of statistical science, and use of social science and team-building, accompanied by appropriate hardware and software technology. This takes time, money, effort, and commitment. To implement a quality system obviously is much easier to do.

Growing emphasis on *delivered quality* has significantly increased over the last decade as evidenced by the record number of companies registered under ISO 9000. It is entirely appropriate to applaud and celebrate those countries and companies which have worked very hard to achieve this milestone. However, let us not mistake the difference between appearing to win the race for quality and actually winning it.

As we celebrate the accomplishments of the 50-year battle to improve *delivered quality*, an even brighter future lies ahead to improve *produced quality*. Closing the gap between these two levels of quality will ultimately determine who the real quality leader is. All of the tools needed to improve *produced quality* exist and are readily available. However, the skill to combine them into a coherent, executable action plan is severely lacking. This is true, not because these tools are too difficult to understand or use, but because *produced quality* proponents have been crowded out of the limelight by advocates of *delivered quality.*

A brief historical review will illustrate why gains in *delivered quality* traditionally have been emphasized over gains in *produced quality*. More importantly, this review will describe the strategies which will enable companies to achieve dramatic gains in *produced quality,* satisfy more customers, and make a higher return on investment by implementing these powerful, creative tools.

True quality leadership will be bestowed upon those companies and countries which are the first to close the gap between *delivered quality* and *produced quality.* Until there is a clear demonstration somewhere that this is actually happening, much of the resources now being spent on achieving so-called world quality leadership is actually a waste of time, manpower, and money.

KEY WORDS

quality, strategy, future quality

INTRODUCTION

Delivered quality has improved dramatically during the last 2 decades, but *produced quality* — the key measurement of true quality improvement — has not. The evidence is all around us. The J.D. Powers' survey for automobiles is a prime example. These numbers — so highly prized and touted by vehicle manufacturers —are indicators of *delivered quality*, not *produced quality.*

Examine any engine or transmission assembly line, however, and you will observe that between 10-15% rejects occur daily - a glaring indicator *of produced quality*, or the lack of it! These units are either repaired or scrapped, which means that customers will never know that they were rejects. How about a case of 30% rejects on the die casting line? These units will be remelted and customers will never know about them either. And what about the case of 35% rejects on the gear line? These units, too, will be reworked or thrown away. We can go on and on. The stories about the lack of *produced quality* are endless.

In many instances, not only are customers unaware of the problem, but company management is in the dark as well. For example, a customer was routinely investigating a couple of failed field units supplied by the Widget Company (True incident, fictitious name). The complaint was that units were cracking. A visit to the plant revealed that 60% crack rejects was considered normal production! The plant's quality system was designed to inspect out and repair the cracked units which it did quite effectively. The two field failures had inadvertently escaped detection. Since Widget supplied this customer 20,000 units per month, the *delivered quality* report read the problem level at 2/20,000 or .01 percent. The less visible, yet more accurate, *produced quality* report should have read 12,000/20,000 or a 60% problem level.

News media sources, like J.D. Powers, in general, report the results of *delivered quality*. The *produced quality* reports are mostly for internal use and are not highly publicized for obvious reasons. In this example, ISO 9001 merely certified that Widget Company had designed a system which ensured that 60% of their production would not be shipped to the customers. This would boggle the minds of Widget stockholders, if they only knew. Even worse, however, was the discovery that there were no visible, on-going efforts at the Widget Company to reduce the 60% reject rate!

Nobody wants to be the bearer of bad news like this. But the fact is that, in the last decade, companies throughout the world have assured themselves through elaborate inspection methods that they are a high quality producer of products just like the Widget Company. These methods amount to between 100 to 200% inspection. In fact, there is hardly a company with an excellent quality reputation in the supplier community which does not use 100% automated inspection or 300% manual inspection as a principal tool of quality assurance. And yet none of these methods is perfect.

Whenever *produced quality* has improved, credit often is given to the availability of off-the-shelf technology rather than the use of quality science tools and methods. Let us examine the historical perspectives which have led us to the present quality assurance platform which emphasizes *delivered quality* and de-emphasizes or ignores the use of quality science.

TWO OPPOSITE SCHOOLS OF THOUGHT

Two quality implementation camps have existed ever since the concept of quality was transformed into a formal manufacturing discipline in the early 1940s. One camp has always favored implementing quality "systems". The other camp has focused its efforts on quality "improvements". The quality systems group believes that quality improvements are a natural outcome of following a well-conceived, comprehensive, and inclusive quality system. On the other hand, the quality improvement group believes that if you focus on developing solutions for quality-related problems, you will evolve a realistic quality system that embraces these solutions.

In 1959, Q9858 Quality Program Requirements emerged from the military standards created during the 1940s and 1950s as part of the war effort. At the time, a system was desperately needed to debunk the idea that the issues related to poor quality could be resolved by handshakes and gentlemen's agreements. Soon the idea of the quality system was adopted by many companies. They copied Q9858 and renamed it as their Quality Systems Manual.

Dr. A. V. Feigenbaum's monumental work on quality was published in 1951 under the title "Quality Control: Principles, Practice, and Administration". It was revised in 1961 and published under the title "Total Quality Control". It has remained an excellent compendium for the quality systems camp. Today's version of Q9858 is the ISO 9000 set of standards. Nothing much has changed since the writing of Q9858. Thus, the quality systems camp has basically thrived on one idea which it revises and re-labels every time renewed emphasis is placed on improving quality.

During the 1940s and 1950s, statistical ideas were also introduced as being essential tools for monitoring, controlling, and improving quality. Thus, the tents of the quality improvement camp were pitched along side those of the quality systems camp. Dr. W. E. Deming, Dr. W. A. Shewhart, H. F. Dodge, H. G. Romig, and Dr. J. M. Juran were active developers of quality improvement which was the central theme of their published works. These improvement tools never really established a stronghold in the United States because they were emphasized only during economic downturns. As soon as the US economy

showed an upswing, things returned to normal. Quality improvement was de-emphasized in favor of quality systems and mechanized inspection. Most of the quality improvement learning, therefore, has remained at the seminar stage during the past 50 years. Many countries around the world copied and closely followed the US approach to quality based on the economics of the business cycle, with the notable exception of Japan.

Many changes also have occurred in the science of quality control improvement since 1980s. Taguchi methods, Robust designs, Quality Function Deployment, Design of Experiments, Mistake-proofing and other methodologies are now being actively used today by the quality improvement camp when opportunities arise.

Both the quality system and quality improvement groups hold on to their beliefs with an almost religious fervor. In fact, when any new quality idea is brought forward for adoption, each group thinks of the idea in an entirely different manner. Take statistical process control (SPC) for example. The quality system group thinks of it as part of their system that must be practiced everyday, everywhere. You can observe this fact simply by reading the supplier quality manuals of Ford, GM, and Chrysler.

On the other hand, the quality improvement group thinks of SPC as an improvement tool. That is, this group uses SPC as a problem definition tool. Once the problem is defined using SPC tools, the improvement group does not see any reason for its continued presence.

Many US supplier companies operate today under the duress of costly dual SPC systems. For example, the ABC Company (True incident, fictitious name) has one SPC system in place which it uses, in part, just to please their automotive customers. However, it also uses SPC in other, more productive ways as an improvement tool to solve difficult and costly quality problems. The ABC company would like to de-emphasize the use of SPC as a "showcase" system for its customers and invest its resources in the powerful problem-solving capabilities of SPC; but this option is simply not available due to their customers' requirements.

Since the 1940s, more investment and effort have been made in creating, refining, and implementing quality systems rather than in improving quality. Quality improvements, by comparison, are usually attributed to technology developments, as indicated earlier. These technology developments have focused primarily on improving productivity but have resulted in improved quality as a serendipitous side effect. For example, painting robots were developed to improve productivity. Better finish with less painting defects were fortunate side effects.

Painting robots are a good example also of the logic presently used to apply technology:

- examine process deficiencies
- implement available technology to correct the deficiencies
- prove that the technology actually worked

Unfortunately, there has been something missing from this logic, to our ultimate detriment, and it is this: we did not invest in practicing quality science in order to bring about these technology-based improvements. If we had, the use of quality science would have approached quality improvement in a vastly different manner than using plug-in technologies and system methods.

By comparison, the logic used for applying quality science is:

- examine or anticipate the results deficiencies
- investigate to determine the verifiable solutions
- seek technology that will hold the solutions in place

To execute this logic sequence, the quality science practitioner must first define or dissect the quality problem into three subproblems, namely:

- instability (operational disturbance)
- variation (a partial understanding of the system)
- off-target (system structure limitations)

Quality science, thus, will narrow the field of investigation by focusing on the subproblems to determine the root causes of these conditions. Subsequently, we then — and only then — seek an appropriate technology to either eliminate or control the root causes. If affordable technology is not around, it then becomes necessary to develop it. It is far better to define and seek out the needed technology than settle for something off-the shelf to patch a problem. This chain of events is absolutely imperative to achieve quality improvements that exceed the investment, and reduce the wasteful expenditures being made to improve *delivered quality* systems.

WHY DELIVERED QUALITY HAS IMPROVED

You cannot deny that *delivered quality* has improved. J.D. Power confirms that it has, for example, in the automobile business. Let's briefly look at the numerous factors at work which have contributed over the years to improvements in *delivered quality*. The most obvious factor is the high warranty cost and loss of good will when defective products are placed in the hands of customers. In those products where safety and quality are synonymous, legal pressures also have forced companies to achieve good quality control.

Delivered quality for most products has also improved because of the tremendous emphasis placed on improving supplier quality by the Big Three and the earning of quality awards as the minimum requirement for doing business. 'Ford Q1', 'Chrysler Pentastar', and 'GM Mark of Excellence' are the most coveted quality awards in the automotive supplier community.

Many companies throughout the world have set up similar award programs in their industries. Even though these awards are promoted as quality "improvement" awards, they are, in actuality, awards for excellence in *delivered quality*. Just look at the evidence. Most companies today require 300 parts to be approved as having met all design requirements prior to process sign off. The only way suppliers presently can meet these conditions is to make anywhere from 500 to 2,000 parts, sort out the best 300, and send them out for customer approval.

Once the supplier company gets the approval, it then has to deal with reality, which in the case of Widget is a 40% yield and a 60% reject rate. Suppliers like Widget hope that over time, and with the help of the learning curve, they can reach an acceptable yield level. In some instances they do; in other instances they must eat the bitter cost.

The only way for suppliers like this to maintain their sales, is to make sure that the *delivered quality* is kept up. Furthermore, these suppliers have to keep hoping that the costs associated with defects will not

bankrupt them. In our Widget case study, the company was able to obtain business in spite of 60% defective products. How was that possible with the tight quality controls which had been imposed on them by their customer?

The answer is that Widget was able to maintain their *delivered quality* at a high enough level to continue winning their customer's coveted quality award. Contrast this, with the fact that the Widget Company was actually losing money on every order and was actively downsizing just to stay afloat. The sad fact is that they did not know how to stop the financial hemorrhaging. Eventually, companies like Widget will slowly bleed to death and disappear, unless they change their approach to quality.

One more reason why *delivered quality* has improved is the infusion of automatic sorting technology. Manual inspection has proven to be less than 100% effective. Automatic inspection technology has changed all that by greatly reducing the chance of rejects escaping to the customers. This has resulted in higher levels of *delivered quality.*

ISO 9000 AND DELIVERED QUALITY

ISO 9000 standards have significantly improved *delivered quality* levels. Certifying parts and processes to these standards, however, requires proof that the quality system maintains high levels of *delivered quality,* not *produced quality*. Another example of this phenomena is the XYZ Company (Actual case, fictitious name) which received an ISO 9001 status with only a 20% yield in their powder processing operations. The remaining 80% of production was recycled or sold as scrap. Would you want to own, manage, or invest in a company like XYZ?

Many businesses in the United States and around the world have suffered market share due to Japanese imports. The resulting market pressures, however, have turned out to be the best mechanism for renewed emphasis on quality as a key business variable that demands attention. The positive effect of the growing Japanese presence in world markets has also forced governments and companies to change lenient and sometimes fraudulent attitudes towards quality. The recent quick gains made in narrowing the gap between the Japanese and their competitors have been made possible by improving *delivered quality* levels. Yet even these gains are not enough — and will not be enough — to maintain quality competitiveness in the future. This brings us to the heart of the matter.

WHAT CAN WE DO TO IMPROVE PRODUCED QUALITY LEVELS?

In spite of all the preventive work that manufacturers can invest in quality planning, they must contend with the scientific fact that it is not possible to start production at 100% yield on day one. This fact, however, should not prevent them from aiming at achieving the highest level of quality possible. Through personal experience, I have seen starting production levels as low as 30% and as high as 99%.

There is a way, in fact, to ensure that, regardless of the product or processes involved, the production quality level can be close to 100% yield the very first day. What is it?

Step one: We need to acquire knowledge of, and control over, all the variables that affect the output conditions. These variables are associated with the operational environment as well as physical sciences.

Step two: We must organize and learn to blend together subject-matter knowledge, statistical science, and social science. Subject-matter knowledge is required because we must understand design parameters,

process parameters, and system parameters in order to close the gap between actual quality and expected quality. Furthermore, we need to use statistical science to acquire complete knowledge of all parameters, including their interactions, in a statistically controlled environment.

Step three: We need to apply social science to define and execute these quality improvement tasks in a team environment. The team environment is necessary for two reasons:

1. The produced quality level is influenced by several knowledge points.
2. These knowledge points require a multitude of actions and interactions by different people.

We also need superb leadership and facilitation to bring all these elements and people together and implement quality improvement tasks in a timely, efficient, and effective manner.

To achieve this goal, we must seriously consider some fundamental changes in our present approach to quality:

- First we must proportionately assign resources to quality improvement efforts as well as to quality system maintenance efforts
- Second, we must change the manner in which we focus on improvement efforts. We need to integrate quality improvement training programs and implementation processes together.
- Third, we must change from traditionally teaching generic concepts for improving quality to teaching specifics about quality-related situations in industrial settings. In addition to authorizing budgets for these activities, top management must champion this cause and demand to see actual improvements in quality.
- Fourth, we must increase the use of quality improvement methodologies such as QFD, SPC, DOE, Taguchi methods, TQM, and others.

We can label these methodologies as "soft" technologies because the care required to implement them is equivalent to that required to implement hard technologies. In many instances, however, these soft technologies have been offered as singular solutions to complicated quality problems. This has often cost companies huge sums of money and produced few or no lasting results because these technologies were misapplied.

Most of these technologies, however, do provide a structural approach to the quality efforts already being done by the companies. This structural approach requires some reorganization by the company, but it can bring significant benefits in return. Top management must take the lead in determining how these technologies are applied throughout the organization and how to measure the results.

Following is a brief description of these methodologies:

- QFD-Quality Function Deployment techniques measure customer satisfaction needs and translate them into executable organizational elements
- Statistical Process Control (SPC) methodologies refine operating actions and processes
- Design of Experiments (DOE) is a systematic approach to developing a complete knowledge of design, process and system requirements
- Taguchi methods are a collection of philosophies and methods to develop robust products and processes with minimum losses
- Total Quality Management (TQM) is a management discipline that defines, monitors, and improves the performance of all departments in achieving a common corporate goal.

A manufacturer of cardboard food packaging products recently used these quality improvement tools to reduce a 10% defect rate caused by poor adhesion and separation of the cardboard plys. The problem was the inability of their process to compensate for variations in the paper's moisture which ranged from 5-15%. DOE, TQM, and Taguchi tools provided the solution. The company installed technology to continuously measure the moisture content of the paper as it unrolled. It automatically adjusted the process temperature and speed controllers to maintain the optimum moisture level. The result was an increase in yield from 90% to 98%.

Coordinating and implementing these steps as part of the product development process from day one will ensure higher *produced quality* levels, fewer rejects, reduced warranty, greater good will, and even higher levels of *delivered quality.* Given all of these advantages, it makes you wonder why some companies are willing to settle for less than the best possible quality? Obviously, entrenched ideas are hard to change, and often require a paradigm shift in thinking.

WHY ARE WE CELEBRATING?

Given the advantages of quality science, quality improvement methods, and *produced quality* standards for the manufacturer, it is hard to understand why we continue to celebrate the worldwide acceptance of *delivered quality* as the only criteria for customer satisfaction. The world manufacturing community has accepted this idea almost as a permanent fact of life by requiring ISO 9000 standards registration as a part of the business contract. Even though this, in itself, is a tremendous, positive milestone, we will never achieve breakthrough quality gains in the future by depending on today's ISO 9000 standards.

Perhaps an allegory best illustrates this point. Many years ago, after I had arrived in the United States, I had to travel from Detroit to Los Angeles. All I knew was that Los Angeles was west of Detroit. It did not seem necessary to check out the distances or the best route to get there. After driving 40 miles, I arrived in Ann Arbor, Michigan, and somehow thought this was in Los Angeles. After all, Ann Arbor was west of Detroit and it was a sunny day. I exited the highway, pulled into a gas station and asked the attendant to confirm my conclusion. He stared at me with a puzzled look on his face. I realized that something was wrong but could not quite figure it out. The attendant politely said that this was not Los Angeles, but that I *was heading* in the right direction. I felt reassured because he gave me an impression that I was almost there. Of course, my ignorance and youthful naiveté became obvious to me after a few hundred miles. The journey towards higher quality over the past 50 years has been somewhat similar, although not as laughable as my youthful misadventures. In fact, it is much more sobering.

As we celebrate 50 years of hard-won victories in the battle for quality, we must recognize that we have arrived in Ann Arbor and not in Los Angeles. We have a long way to go. We should be justifiably glad that we have been heading in the right direction; but we cannot overlook the immense cost to everyone — suppliers, customers, and consumers — by continuing to ignore low *produced quality* levels and the tools readily available to help solve this problem.

WINNING THE BATTLE

How do we take up the fight against low *produced quality* levels? First we must come to terms with the fact that a serious problem exists — and will continue to exist — regardless of the quality awards companies display on their walls or fly on flag poles. The information reporting systems used by companies

today do not allow top management to understand this fact with any degree of clarity or comprehension. Only by writing technical papers like this can the message get out.

Once the media exposes this problem, hopefully it will create a sense of urgency among top management to take up the gauntlet and champion higher *produced quality* levels through education, training, and effective implementation. The essential elements management must use to increase *produced quality* are:

- Create a synthesis of subject-matter competence in the company and use statistical science in a teamwork environment to confront actual problems
- Make product engineering or design engineering responsible *for produced quality* until production yields have reached an optimum level
- Discontinue the wasteful use of SPC and free up people and resources to focus on real problems
- Discontinue methods focused solely on training and, instead, make problem solving the center of attention
- Require a checklist for top management review that enables those with profit and loss responsibility to correctly evaluate the effectiveness of *produced quality* improvement methods.

CONCLUSION

Even though 50 years of notable quality efforts have been achieved in the US, geographically speaking, we only left Detroit an hour ago and have just arrived in Ann Arbor. We should celebrate the fact that we are heading in the right direction, but we need to remind ourselves that our ultimate destination is Los Angeles. As we journey on, two distinct routes of travel lie before us. Those companies which have achieved ISO 9000 certification will travel on one route. These companies must depend on their quality system foundation and *delivered quality* for continued success. Those companies which are less impressed or influenced by ISO 9000 will travel on the other route. These companies will focus on improving their *produced quality* levels without being distracted by the system enthusiasts.

In the race for quality leadership, it is important for manufacturers to know which route will get them to Los Angeles as fast as possible for the least cost. My 20 years of personal experience suggest that the second route is the best way to go. I will close with the following proof.

Recently, during real-world problem-solving sessions at the Gizmo Company (fictitious name), I discovered that 85% of the field units returned by customers were classified as *No Trouble Found (NTF)*. The limitations of the quality systems route were immediately obvious because it is designed only to prevent delivery of detectable/inspectable plant problems, not diagnose the cause of field problems. On the other hand, the quality improvement route could have immediately focused on solving the problem using soft technologies specifically designed for this task.

As we continue our journey toward improving quality levels, those who move more rapidly towards quality leadership will learn how to narrow the gap between *produced quality* and *delivered quality*. Until these differences in quality measurement are clearly understood and acted upon by companies, the route leading to quality leadership will continue to be bumpy, unpleasant, and slow.