Quality is Elusive Without Vertical Systems

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1. ABSTRACT

The benefits of quality science and continuity in quality control, maintenance, and improvement are highly dependent on the presence and type of systems within the organization. In operational terms, there are basically two systems: 1) Horizontal systems, and 2) Vertical systems. Horizontal systems spread a single effective idea across the whole organization. Vertical systems use many proven tools in the most effective sequence to visualize and solve a specific problem. If investments in these two systems are not proportionate, the company can actually suffer heavy losses that could result in the closing of a business. In this paper, we explore horizontal and vertical systems to examine how they define the fate of any organization.

2. INTRODUCTION

There are many tools that can contribute to quality improvement. However, all tools are not necessary in addressing specific quality concerns that are present in daily operations. The use of control charting is a good example. There are at least two ways to institutionalize control charting: 1) Apply control charting throughout all operations -- because it is helpful for controlling processes. The implementation of across the board control charting is an example of a horizontal system. 2) Apply control charting to define the problem to be resolved -- because the control chart is a tool to convert problem symptoms into statistical problem conditions. Using control charting as one of the sub-steps in solving a problem is an example of a vertical system. Figure 1 illustrates the difference.

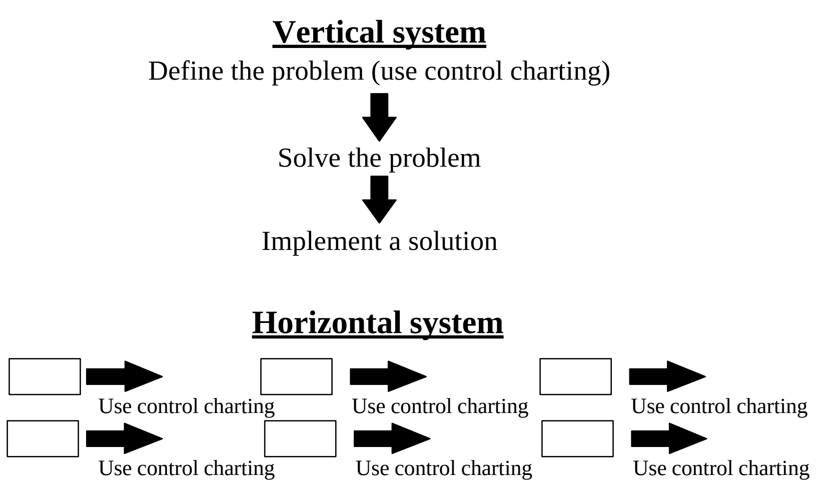

Figure 1 - Vertical system versus horizontal system

The success of the horizontal systems depends on its ability to stay current with and responsive to ongoing organizational and technological changes. In contrast, vertical systems are everlasting. They are robust with respect to all changes. Horizontal systems themselves cannot deliver complete solutions; they can only increase the efficiency of the vertical systems. In fact, usage of vertical systems frequently defines elements of horizontal systems that need to be strengthened, modified, or discarded. With horizontal systems, we reiterate known methodologies and encounter familiar solutions to familiar problems. With vertical systems, we are always discovering something unique. What knowledge we acquire through vertical efforts, can always be spread horizontally. Understanding a new concept brings us profit; executing effectively what we know allows us to keep the profit (Imai 1986). It is clear that we need both vertical and horizontal systems.

Examples of horizontal systems are ISO 9000, Gage Repeatability and Reproducibility Studies, SPC, TQM, Taguchi methods, TPM, 5s, massive method-focused training, etc. Examples of vertical systems are P-D-C-A (Shewhart 1986), 8D Problem-solving (Ford, 1987), Product development, Kepner-Tregoe method (Kepner and Tregoe, 1981), Statistical Problem Solving (Bajaria, 1991), Case studies, etc. Historically, there has been a great emphasis placed on developing horizontal systems. Most organizations severely lack vertical systems. As a result. they are extremely inefficient at executing vertical tasks. There is no doubt horizontal systems are necessary. However, they become quickly outdated and rarely bring return on investment. In fact, they are referred to as necessary evils. Most organizations have disproportionately invested in horizontal systems with practically no investment in effective or formal vertical systems. Horizontal systems are being used to provide for the needs of vertical systems rather than vertical systems driving the need for horizontal systems. Unless we understand the need to rearrange our focus on vertical and horizontal systems, we are not likely to shift our investments. As a result, we will leave our organizations vulnerable to vertical forces. If an organization is compared with fabric, the stronger one is defined as having a weave that will successfully resist vertical and horizontal forces. Figure 2 depicts strong and weak organizations.

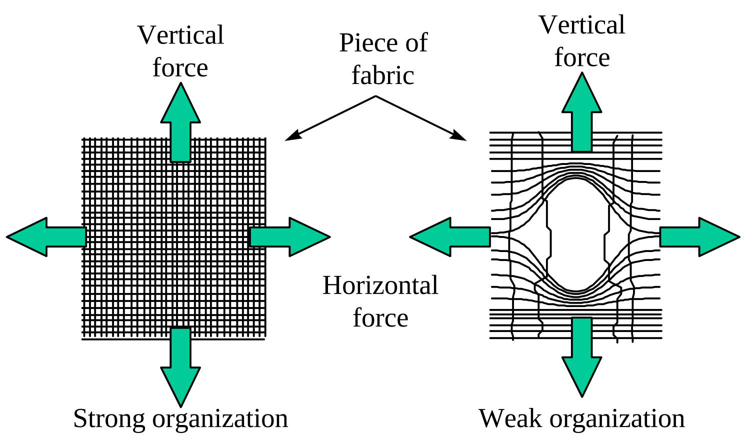

Figure 2 - Strong versus weak organizations

3. OUR NEED FOR VERTICAL SYSTEMS

The creation of any organization occurs through a vertical system. That implies that, an establishment is created around beginning, intermediate, and end steps of any product or service to be marketed. When we talk about planning, controlling, or improving quality, we also have beginning, intermediate and end steps. For example, suppose we want to improve the quality of a product line where we are experiencing 15% defective parts on the average. The first step is to define the statistical problem condition to be resolved, the intermediate step is to determine responsible variables for this condition, and the last step is to implement the control over key variables. Thus, we need a vertical system to execute these three steps in an efficient manner. None of these three steps when viewed individually can translate into a complete solution. Some companies will look into their horizontal systems to see if they can find instantaneous answers required to take these three steps. For example, they might look into their SPC system to see if they can take the first step -- define the problem condition to be resolved. The SPC systems as they are implemented today are grossly inadequate to define the problem condition. The gross inadequacy results from the emphasis of SPC as a procedural matter rather than a scientific tool. Most of the problem-solving meetings do not have authentic SPC charts available as hard evidence for pinpointing the problem. Personnel in charge of problem-solving meetings prefer to be descriptive rather than use SPC charts as a visual aid for problem definition. Often times, a description is not specific enough to define the statistical problem condition. The intermediate and the last steps are equally elusive when they are a part of the horizontal system. We definitely need a vertical system to complete quality improvement loops.

4. BUSINESS CAN COLLAPSE WITHOUT A VERTICAL SYSTEM

What happens when there are no well-defined vertical systems? Organizations are not equipped to face the ever-changing external circumstances. I will label external circumstances as vertical forces. It is possible that a company may fold if it does not have the strength to tackle vertical forces.

A recent example is a die-casting company which was enjoying a relative success of its products until external circumstances impeded its progress. Its major customer was experiencing very high rejects due to porous castings and was falling behind production schedule on a very successful product line. The die-cast company had no vertical system in place to efficiently deal with the problem and ultimately ended up declaring bankruptcy. Interestingly enough, the die-casting company had heavily invested in horizontal systems such as ISO 9000, SPC, etc. Unfortunately, these systems had not come to the rescue.

5. WASTE BECOMES INHERENT

We can fight waste only so long without a vertical system. Ultimately, we begin to accept waste as something inherent.

For example, an assembly line is producing 15% defective products. To solve this problem, we need to apply the appropriate tools in the correct sequence. First we need to define the problem. In a vertical system, we would use a control chart for a short duration to accomplish this. In a horizontal system, we will tap into ongoing control charting. However, the problem definition does not result in an obvious solution. Next step is to solve the problem. In a vertical system, we will search for appropriate tools to discover the solution. In a horizontal system, we will feel frustrated because we have not defined a problem-solving horizontal system. If we cannot solve this problem, the organization will soon begin to make budget allowances for such losses. The phenomena continues to the point where we no longer label 15% loss a problem; instead, we refer to it as the nature of the beast. We accept it. Thus, the development of horizontal systems such as control charting spreads across the whole organization, whereas the development of the vertical system would have only used control charting on an ad hoc basis.

In another example, an engine plant performs 100% test at final assembly and rejects 10% on the average as a daily routine. The computerized data base at this plant keeps track of proportion rejects, the reasons for rejects, Pareto charts, etc. The system can tell you want happens hourly, daily, weekly, monthly, etc., with respect to failures. The 10% failure rate has not changed for a few years, an obvious indication that nobody is working on the problems. It is not that nobody wants to work on the problem. There is no system in place to work on it. Occasionally, there will be a meeting to review Pareto charts, but nothing significant will result. The Pareto chart at the next review meeting will reveal yet another problem. The emphasis will continue to shift from one problem category to another. The company has invested a great amount of money in developing a horizontal system that keeps almost instantaneous records of failures and makes them available on a real-time basis but has not invested much in permanently solving what the system reveals. Most people in the plant consider 10% rejects part of a normal day.

6. WE DO INCOMPLETE THINGS SYSTEMATICALLY

When we ask a series of questions for resolving a given situation in the form of “What happens next?” until we are satisfied, we conclude that a vertical system exists. When such a series of questions does not allow us to visualize the end result, we conclude that we have an incomplete vertical system. At that point, we must consider investing our resources in completing the vertical systems.

Let us examine what happens with an incomplete vertical system. A company has developed a very elaborate system to receive customer complaint parts from the field. Customer complaints are recorded by the dealer, parts arrive at the returned parts depot, defects are entered into the system, parts are disassembled, measured, reassembled, and finally, they are performance tested. In 80% of the cases, the reassembled parts perform as good as new. Nobody on the analysis team seem to understand why complaints exist? Ultimately, such situations get resolved in a business fashion – the expense is split 50/50 between the supplier and OEMs. The company, once again, has invested a lot of money, in gathering and analyzing parts for taking corrective actions. However, the company has not invested much in developing a core competence in analyzing problems. A group of people continue to produce "as good as new" parts almost daily, and yet, nobody is asking the question, "what happens next?"

7. WE DEFEND INCOMPETENCE

Our zeal for developing horizontal systems does not allow us to examine the merit of new ideas in sufficient details. As a result, a grossly incorrect idea can become a part of the horizontal system. Good managers, like good citizens, defend such horizontal systems even when they are based on false assumptions and poor scientific foundations. We pay a heavy price for contributing to, following, and maintaining such systems.

Let us look at one such idea. C_{pk} was developed as a good idea for process characterization in the early 1980s. It has been pointed out that improving C_{pk} does not deliver desired results because it is a function of two independent variables: average ($\overline{X}$) and standard deviation (s). Most people believe that as C_{pk} increases, process $\overline{X}$ moves closer to the desired center. This is not true. A higher value of C_{pk} could also indicate that the value of s has decreased and $\overline{X}$ has not come any closer to center. An alternate index (C_p - C_{pk}) makes sense from both scientific and business perspectives. This index forces the process to be centered.

Here is an example that revealed that the root cause of a noise problem was an unacceptably high value of (C_p - C_{pk}). One of the facts that surrounded the problem is that the company had changed production machinery to an entirely brand-new line. The noise problem had shifted to much more frequent occurrences simultaneous with the introduction of the new machinery. The critical characteristic that controlled the noise had a C_{pk} of 1 on the older line and a C_{pk} of 2 on the newer line. However, the number of units exhibiting unacceptable noisy conditions was opposite – more units were rejected for noise on the newer line than the older line. The problem-solving team was confused because a C_{pk} value of 2 is supposed to produce more desired results. Ultimately, when it was discovered that the C_p for new machinery was 5 and (C_p - C_{pk}) was 3, they realized that the target of the critical characteristic had experienced an unacceptable shift causing the noisy condition. This left no doubt that (C_p - C_{pk}) is a better index than C_{pk}. In a large number of manufacturing organizations, C_{pk} is still followed religiously.

Besides the inherent limitation of the C_{pk} index to characterize the process, there are other problems which cannot be described in terms of C_{pk}. For example, there exists the problem of product leaking. Engineering teams have spent considerable time searching for the solution but have not succeeded. This problem cannot be described in C_{pk} terms because product leakage information cannot be characterized in variable form. The problem is simply described as leaky. The cost associated with the problem is very high. Many companies have invested thousands of dollars in training and institutionalizing C_{pk} as an index of process characterization and yet C_{pk} only addresses a fraction of the total concern. This exemplifies how a horizontal systems continue to cause a lot of financial damage. Somehow we continue to defend this incompetence.

8. VERTICAL OR HORIZONTAL IS A MATTER OF STRATEGY

The concept of Statistical Process Control (SPC) was developed by Dr. Shewhart around the 1920s (Shewhart 1931). Scientifically it is just a concept that separates assignable cause-problems from common cause-problems. However, from a business perspective, this idea can be utilized in many different ways for many different purposes. The SPC idea allows us to look at a variety of problems as if they were quality problems. Problem solving requires basically three elements: 1) We define the problem and narrow the field of investigation from a symptom to a problem condition, 2) We solve the problem by listing, prioritizing, evaluating, and optimizing responsible variables, and 3) we implement the solution by acting upon the knowledge gained. If used in horizontal systems, SPC simply becomes a process monitoring tool. If used in vertical systems, it allows us to define problems. It becomes a matter of strategy to choose between the two.

Let us look at which strategy might work better. Table 1 shows the universal nature of the problem distribution. The numbers are based on the my experience. Dr. Deming quotes similar number in two broad categories: 94% system and 6% special (Deming 1982).

Table 1 - Universal problem distribution

Problem Category	Problem Orientation	Causes	Require	Percent of total
1	System oriented	Common	Vertical system to solve the problems	85
2	Exhibit investigative patterns	Assignable	Vertical system to investigate the problem	12
3	Known patterns cannot be acted upon without altering the system	Assignable	Vertical system to discover the technology to alter the system	2.4
4	Actions are known but they require human judgments	Assignable	Vertical system to develop error-proofing scheme	0.48
5	Direct human action are inadvertently missed	Assignable	Horizontal system to provide assurance	0.12

85% of all problems come from the system (variation and target oriented), 12% of problems exhibit patterns on the chart requiring an investigation, 2.4% are problems where SPC does make the causes obvious and cannot be acted upon due to a physically limiting factor with the system or the equipment, and 0.48% indicate cases where causes are obvious, yet social factors do not allow us to act upon the clues provided by SPC. This boils down to the fact that SPC effectiveness when executed through horizontal systems, resolves only 0.12% of all problem situations. In spite of such factual evidence, management has chosen to invest in SPC as a horizontal system. As a horizontal system, SPC is basically a black-hole investment. A better case can be made for the use of SPC within a vertical system, where we have an SPC chart allowing us to accurately define a problem condition. With the use of SPC, a problem symptom can be broken down into three problem conditions: 1) instability, 2) variation, and 3) off-target. Once, the symptom is broken down into three components, it is easy to deal with. The probability of solving a problem immediately increases. In a vertical system, we must recruit the additional power of other methods to resolve the problem condition. Why would companies invest money in a horizontal system that solves 0.12% of applications and ignore investments in a vertical system suitable to solve 99.88% of all the problems?

9. VERTICAL SYSTEMS REVEAL THE BASIS FOR CREATING HORIZONTAL SYSTEMS

We operate on the assumption that the horizontal system facilitates the vertical system. On the contrary, it is the vertical system that must drive the need to create horizontal systems. Vertical systems cannot be outdated with the advance of computer technology. One of the vertical systems developed by the author (Bajaria, 1991) is C-S-I-N shown in Figure 3.

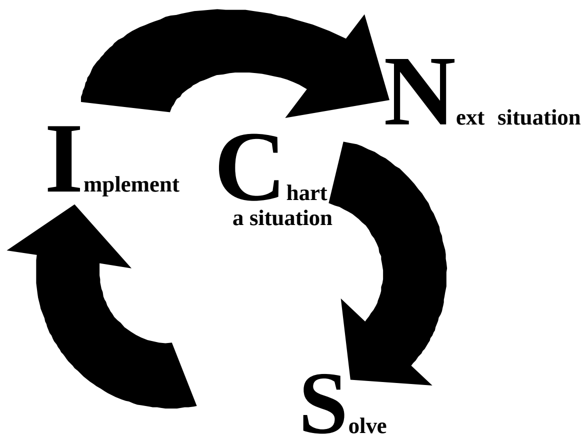

Figure 3 - C-S-I-N vertical system

The Chart(C)-Solve(S)-Implement(I)-Next(N) vertical system can be used to solve a wide variety of problems. With this system, several things can be accomplished simultaneously: training, synthesis of many tools, problem solving, and a handsome return on investment. A successfully solved problem through C-S-I-N provides a stimulus for developing horizontal system elements.

10. COMPARISON BETWEEN VERTICAL AND HORIZONTAL SYSTEMS

Even though we need both horizontal and vertical systems, we must let vertical systems be the horse, and horizontal systems be the cart. The comparison between the two systems shown in Table 2 should act as a continuous reminder of the dependent relationship between the two.

Table 2- Comparison between vertical and horizontal systems

Vertical system	Horizontal system
Robust with respect to time.	Changes with respect to time.
Has a well-defined beginning and a well-defined end requiring many steps.	Increases efficiency of one of the sub-steps required to execute a vertical system.
Reports results.	Reports activities.
Shorter ROI cycle.	Longer ROI cycle.
It cannot be canceled.	It can be delayed or canceled.
Increases competence.	Increases efficiency.
At no time are we away from a real problem.	We lose touch with real problems.
Flexible. We can expand or narrow based on the real need.	Inflexible. We have to view every situation as requiring the same degree of details.
We need to be organized to execute vertical systems.	We need to be organized to execute horizontal systems.

11. CONCLUSION

A. We are beyond the point of discussing product quality and service quality. We must broaden the applications of quality science to a wide variety of problems.

B. Vertical systems allow us to solve the problems. Horizontal systems accelerate the problem-solving process. We must comprehend and identify problems in all categories, and apply vertical systems to solve them. One such vertical system is Chart-Solve-Implement-Next.

C. We need vertical systems as well as horizontal systems. Together, they define the strength of our organization against vertical and horizontal forces. Vertical forces are those that threaten our presence in the market place. Horizontal forces are those that challenge our efficiency of execution. We must resist both these forces.

D. Vertical systems should be the drivers; horizontal systems should be driven. Horizontal systems cannot respond fast enough to ever-changing customer needs. Horizontal systems become increasingly outdated with the rapid advancements of information technologies. We must divert our investments into the efficient execution of vertical systems. Let vertical systems define the needs to develop horizontal systems; only then should we invest in flexible horizontal systems that are deemed necessary.

E. We are defining quality as a result of conforming to a collection of well-documented procedures. Therefore, we continue to emphasize horizontal systems. We fail to view quality as an outcome of practicing quality science. The quality science complements the physical sciences and business strategies. These two elements of the quality science must be applied through vertical systems. Historically, our funds and energies have been disproportionately invested in developing, maintaining, defending, and following the horizontal systems. We do not fully realize the negative impact they can have. In this paper, we have developed a case for reversing the pattern of investments.

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