Applying SPC in a Service Environment

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Abstract

Statistical Process Control (SPC) has long been used to monitor and control the performance of manufacturing processes. Its benefits in this arena are well known. By comparison, little attention has been paid to the use of quantitative tools for monitoring and controlling service processes, other than accounting data in financial reports and the use (and abuse) of numerical ratings in personnel evaluations. This monograph discusses the need for establishing objective measures to monitor and control service processes—especially at the point where taking action can result in maximum benefit. It also describes the use of SPC to accomplish this intent, including the practical realities and considerations for doing so. It is assumed that the reader has at least a cursory knowledge of the concepts of SPC.

Opportunity Knocks

Perhaps as a legacy of the industrial era, which began in the late 19th Century, it seems that most of the emphasis to distinguish ourselves in the global marketplace continues to be placed on product superiority. Don't get me wrong, I am a firm believer in striving for product superiority—but this should not be held up as a "red herring" to avoid facing the reality that:

- 80% of the U.S. economy is linked to jobs in the service sector
- Customers are five times more likely to take their business elsewhere due to poor service as opposed to poor products[1]
- Even in a manufacturing environment, only some 40% of the cycle time required to fill an order is, on average, attributable to the manufacturing component—the bulk is consumed by so-called "white collar" processes

When speaking on the subject of this report at conferences and other public events I sometimes remark, perhaps a bit irreverently, that many of us see ourselves as being in the "widget business" when in fact we are (or should be) in the *total customer solution business*. Seldom, if ever, do customers in today's world buy a product without at least a tacit expectation that there is some degree of customer support to back it up. If this is true for so-called "off-the-shelf" products it applies at least tenfold to products where *after market support* is inextricably linked to the product itself. It applies even more so to products where the customer is intimately involved in specifying and designing—or in other words, *customizing*—the product itself.

Considering the importance of service processes, coupled with the relative opportunity margin, it is somewhat of a mystery that so little *science* has been applied to the design and management of such processes. Some would argue that service processes are heavily reliant on the "human factor" and therefore not compatible with the ideals of scientific management. Those who take this position in the extreme are apt to say that management (specifically management of so-called "white collar" processes) is an *art*, not a *science*. I am convinced, however, that it is not an issue of one or the other, but both. The challenge is how to keep one point-of-view from overriding the other. Unfortunately, managers often align themselves toward one extreme or the other. Some would insist, for instance, "If you can't measure it, you can't manage it." Those on the other extreme would argue that when it comes to services, "The most important factors can't be measured." Since there an element of truth to both positions, one of the challenges in applying SPC to a service environment is to prevent one point of view from totally dominating the other.

The issue of *balance* is a prevalent theme in the discussion that follows. In any case, we should not allow philosophical differences to mask the fact that there is tremendous opportunity to improve the performance of our service processes—assuming we don't knowingly abuse or unknowingly misuse the tools (including SPC) that might allow us to do so.

Hear No Evil, See No Evil

Despite the fact that service processes are the mainstay of today's economy, we still have an inclination to let these processes fend for themselves. I submit this is largely due to the fact that the work-product as well as the work-in-process (WIP) of such processes is intangible, and therefore difficult to measure and monitor. It is difficult, for example, to objectively determine how much progress is being made toward the completion of such tasks as "gathering information" or "coordinating resources"—especially when the end-point and/or the success from doing so in each case is not clearly defined. Consequently, upper management seems to be content with the attitude, "If it's difficult to measure, why bother?" This condition is compounded by the fact that many managers are *uncomfortable* dealing with "people issues"—self-contradictory though this may be.

But, I firmly believe it is for this very reason that the opposite attitude should prevail. Because it is difficult to build accountability into our service processes we should be ever more vigilant to do so. Taking the opposite stance eventually leads to fostering highly inefficient processes that are destined to this end, if for no other reason because the external environment—including customer wants, needs, and values—are continually changing.

In today's competitive world, profit margins are such that few companies can ill-afford to sustain inefficient processes. As one metaphor suggests, we are now flying closer to the ground and therefore have less room for maneuvering, less margin for error. Sooner or later, companies that ignore this reality will—if we are allowed to stretch the metaphor—face the unpleasant prospect of experiencing "n" takeoffs and "n-1" landings.

Law of Unintended Consequences

Related to the “difficult to measure and monitor” issue is the issue of what I call the Law of Unintended Consequences. By this I refer to the fact that no matter how careful we may be in identifying objective indicators of how a service process is performing, there is frequently a downside to doing so. As it turns out, this "law" is especially relevant to service processes since the *human component* is vitally significant to services. In other words, when there is a breakdown in a service process, the problem can almost always be traced to human error or human inadequacy. By contrast, when a manufacturing process goes *out of control*, there is a good chance that the problem is due some mechanical failure.

As an example of the Law of Unintended Consequences in action, let's assume, that a certain company believes it is important to monitor and control the time-duration of the service calls taken by its Customer Service Representatives (CSRs). If *minimum time per call* is given top priority, those who establish this standard should recognize the high possibility that the CSRs will take excessive short cuts in handling customer problems. The outcome in this example would ultimately contradict the intent of having CSRs in the first place—that is, to demonstrate the company's genuine concern for its customers.

The previous example also highlights the fact that the Law of Unintended Consequences is exacerbated by misuse of the data. If CSRs are evaluated on the basis of *minimum time per call* or *number of calls handled*, it is unrealistic to expect them to spend time on a difficult problem that a customer wishes to resolve. Bound by these criteria, CSRs have been know to *defeat the system* by having the customer repeatedly call back rather than solve the problem initially.

To avoid falling prey to the Law of Unintended Consequences when planning your measurement system and interpreting the results, I suggest the following:

1. Carefully consider the downside any parameter you wish to monitor in your service processes. Anticipate possible ways that your "system of measurements" can be defeated, undermined, or rigged. Also anticipate outcomes that are directly opposed to what you wish to accomplish.

2. Take precautions to ensure your measurement system will be used to improve process performance and certainly not penalize employees for desired behavior.

Taxonomy of Service Processes

There are, perhaps, numerous ways to classify service processes. Table 1 describes at least one method of classifying such processes that I find to be beneficial from the standpoint of being able to clearly identify the *process boundaries* and the critical links to the customer as well as the system-at-large that a particular process supports.

Why should we concern ourselves with classifying services? Let me respond by way of example—in this case involving certain *training services*. Training could, for instance, be bundled with a new computer system or else be purchased as a stand-alone service through an independent, third party provider. In the first case the process boundaries may extend from the point of where the *system* is purchased to the point where the training is delivered. In the second case the process boundaries might extend from the point where the training is purchased to the point where the training is delivered. The intra-process interfaces, customer expectations, and system of controls are necessarily specific to the application and circumstances, regardless of any similarities in the expected outcomes in each case. This suggests that, when applying SPC in a service environment, among other considerations it is necessary to be crystal clear on whom the service will support and what the expectations are from point-to-point within the process.

Classification	**Description**	**Examples**
Pure Services	Services that are an end unto themselves. In essence, the service is the product.	• Overnight courier service • Lawn maintenance
Integrated Services	Services that are "bundled" with a certain product. In this case, the customer is interested in the overall package–typically involving a product and service combined.	• New automobile/ warranty service package • Software/telephone support package
Product-Support Services	Services provided to directly or indirectly support the design, development, delivery or sale of a certain product. These are often internal services.	• Engineering design • Product distribution

Table 1

In the strictest sense SPC also requires that we be able to identify and monitor certain characteristics of the process that are relatively stable. Here the expression "relatively stable" implies that the characteristic in question will, within certain limits, vary in a random fashion around some pre-determined *baseline* (or average) level. But, as we shall see, there are some important reasons why such a restriction is more than we can expect from most service processes. This does not necessarily invalidate the use of SPC in such processes—not, that is, if we are willing to ease up on the restrictions in how we traditionally define SPC. In other words, we need to agree in advance that we are interested in functional pragmatism rather than idealism.

What's So Special About Services?

Services are distinguished from products in several important ways, one of which has already been described: namely, that services are intangible while products are tangible. Another factor—*perishability*—is related to intangibility but distinctly accounts for the fact that services cannot be saved, accumulated, or inventoried.

Either of these factors—*perishability* or *intangibility*—could have bearing on the application of SPC to service processes. For instance, the relative intangibility of the work-product may limit us to monitoring only those factors that relate to process execution, since there is often no partially completed work-product available for examination while the process is underway. By contrast, in a manufacturing environment we typically have access to a broader array of variables and attributes that can be monitored, including those that relate to the actual work-in-process.

From an SPC point of view, the *perishability* factor is significant due to the fact that the customer "experiences" the service at the point of execution. In other words, there is often little, if any, delay between the time the service is produced and the time when the customer benefits from the service. The *real-time* nature of service processes suggests that, in contrast to product manufacturing, there may be little, if any, opportunity to correct deficiencies before the outcome of the process reaches the customer. Consequently, outcome-indicators, such as the *number of defectives*, often have limited worth in a service environment. In the same respect, I would challenge the notion that *customer retention* is a key measure of service quality, as some contend.[2] Customer retention, while perhaps the ultimate indicator of service quality, is a weak index for controlling service quality. By the time you are able to observe and measure customer retention you are past the point of improving it—much in the same way that product inspections are an after-the-fact proposition that offer limited utility from the standpoint of process control. This highlights the fact that if *in-process* indicators and controls are important in a manufacturing environment, they are even more so in a service environment. Loosing a customer is more consequential than rejecting a product.

There are a couple of other distinguishing characteristics of services that deserve special attention from the standpoint of applying SPC. Let's examine these in more detail.

High Human-Factors Component

Manufacturing processes are dependent on an array of devices and sub-processes that harness the laws of physics and chemistry. These may take the form of servos, actuators, sensors, gears, switches, or a host of other electro-mechanical devices, tools, or complex machines. To a large extent, process performance in a manufacturing environment is defined by the reliability and accuracy of the devices, tools, and machines themselves. In fact, as the dependence on automation increases, the so-called human factor diminishes in importance, at least in those portions of the manufacturing process that are so affected.

With service processes, on the other hand, the outcome and resulting quality of the outcome are highly dependent on the *human contribution*. Therefore it is important to recognize that service processes have a significant labor content—where the term "labor" is the prevalent way of distinguishing employees from capital equipment, even though knowledge and intellect have largely displaced manual labor in the contemporary service process. Be that as it may, we are somewhat conditioned to view all processes by the generic form represented in Figure 1. This is perhaps due to the fact that *process flow diagrams* have traditionally been used to represent manufacturing processes, which in turn produce products rather than services. In other words, Figure 1 depicts the process as a *transformational* entity, wherein inputs are translated into outputs through a series of well-defined steps or stages. Using the traditional form of representing a process, suggested by Figure 1, the process essentially consists of those things that happen within the box, while the rest is viewed as being peripherally related to the process itself.

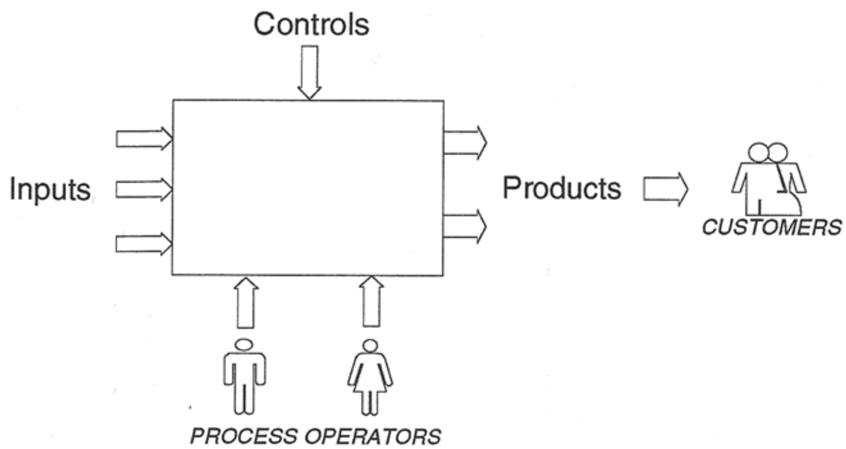


Figure 1

As far as service processes are concerned, I submit that Figure 2 provides a more accurate representation of reality than Figure 1. The point here is that the process and the people supporting the process cannot be isolated in most service processes. The distinction between the process representations in Figure 1 and Figure 2 is more than symbolic or semantic, it ultimately has bearing on the way we choose to monitor, control, and enhance the process.

SPC Implications: No two people are alike in terms of their psychological, emotional, social, or intellectual makeup. Consequently, given that service processes are heavily dependent on human performance, it is reasonable to expect that the baseline (or average) performance will shift when and if different individuals are brought into, or removed from, the process. Furthermore, even the same individual does not perform consistently from one instance to the next—thus adding to process variability. When planning a measurement and tracking system for the service process, it is important to be aware of any variance and/or any temporary shifts in process performance that are introduced as a result of individual performance. If data are collected in such a way that it aggregates or fails to account for the contribution of two or more individuals, it may be impossible to pinpoint and remediate problems on the basis of the available "facts." Collective indicators of team performance also tend to mask the impact of individual contributors—which may, in some situations, be the desired intent.

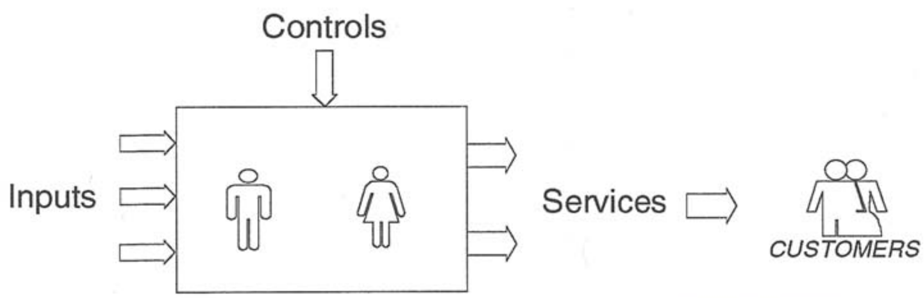


Figure 2

High Degree of Customer Involvement

As indicated in Figure 3, in a service environment, the customer is often intimately involved in the process that results in the service in question. In other words, the customer and the service-provider may work hand-in-hand. For instance, the person receiving a haircut from a certain barber is directly involved from start to finish in the process that leads to the outcome. By comparison, when it comes to products, the customer typically has little, if any, involvement in the internal manufacturing process that actually results in the product itself.

To appreciate the significance of what this means, it may help to compare the similarities of a process in which there is a high degree of customer involvement to that of a cafeteria serving line. In the case of the latter, the customer moves from point to point, selecting from the available salads, entrees, vegetables, breads, desserts, and beverages. Here each *process-point* may be as important as the next. In other words, regardless of the outcome at the end of the serving line, from the customer's point of view, the process is no better than its weakest link. If, for instance, the person serving the salad is inconsiderate or otherwise inattentive, the customer will most likely view the process as a whole as a failure. These, and analogous process-points in which the customer is intimately involved, are essentially what one author refers to as *moments of truth*.[3] It suggests that the customer is "tied into" various points in the process—not simply the end-point. But it also suggests that the customer may bear some responsibility (if not accountability) for the actual quality of the service. For instance, a particular customer may be having a "bad day" or perhaps has *unreasonable* expectations, depending on how the term "unreasonable" is defined in a given situation.

SPC Implications: In the case of services, the customer often introduces an element of variability to the process, depending on his or her involvement in the process. Furthermore, the degree of variability induced will differ from one customer to the next. Some customers, for instance, are more cooperative than others in making the process work effectively and efficiently—as we might expect in the haircut example. Even from one day to the next the same customer will experience psychological, emotional, and physiological shifts that can affect his or her contribution to the process. Therefore, depending on the process and which aspects of the process we wish to monitor and control, it may be necessary to account for—or at least be aware of—the variance that is introduced by the customer. Any decision to take action based on SPC indicators of process performance should consider the relative *degree of customer involvement* factor—not for the purpose of affixing blame, rather for the sake of making rational decisions on how and when to modify the process.

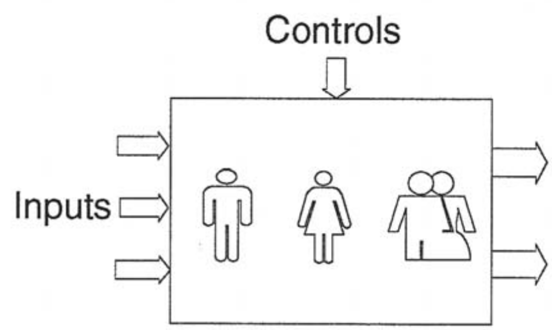


Figure 3

Key Performance Indicators

The earlier discussion regarding the Law of Unintended Consequences described the potential downside of choosing improper indicators to measure and monitor process performance—especially the human concerns. When setting up an SPC system to support a service process, it is also important to consider the following:

- The benefit of getting the process team involved in selecting the appropriate performance indicators
- The selection of key performance indicators that are capable of providing "early warning" of how the process is performing—the *leading indicators*, so to speak
- The danger of selecting process performance indicators on the basis of *available* data rather than *meaningful* data

Elaborating on the last point, it is better to avoid SPC entirely than to establish a system that measures and monitors superficial or meaningless indicators of process performance. For instance, I question the value of monitoring "keystroke errors" in an environment where everyone has access to computerized spelling and grammar checkers. At most I would limit this practice to certain critical documents, such as sales orders, rather than every document produced.

A key performance indicator should be just that. To the extent possible, I suggest monitoring parameters that provide an early indication of potential problems that may, if allowed to pass, have a significant impact on the downstream customer. Naturally, in those processes for which there is a high degree of customer involvement, this may be a challenging task. One approach for identifying the key performance indicator(s) is as follows:

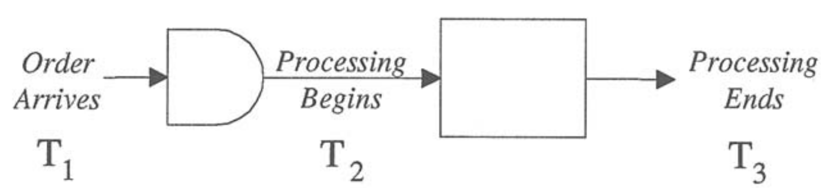
1. Start by identifying a problem condition that has a "reasonable" chance of occurring *and* that would significantly impact the customer should it occur.
2. Using the Fishbone Diagramming technique[4] or the Process Classification method[5] have the process team create a list of possible causal factors.

3. Using Pareto Analysis[6] or the Q-Sorting technique[7] have the process team isolate the critical few causes.

4. If a direct indicator is available for representing the *behavior* of the process at the point where the causal condition occurs, this would likely serve as an acceptable performance indicator. But, in some cases, it may be necessary to devise an indirect metric that mirrors the performance of the process at the control point in question.

In addition to subjecting the *short list* of potential performance indicators to the test for unintended consequences, it is desirable to know the cost-effectiveness associated with each potential performance indicator. In other words, we would likely wish to have some idea of the degree of difficulty of obtaining and recording the data in question.

In some cases, the most direct indicator of the parameter we wish to monitor may also be the most difficult or most costly to obtain. For instance, at some stage in the process of filling a sales order, we may be interested in tracking the time consumed *before* the order begins to receive attention—depicted by the time differential, T_2 minus T_1, in Figure 4. If for some reason it is infeasible to time-stamp the sales order when it begins to receive attention (i.e., the T_2 data were for some reason costly or difficult to obtain), an acceptable alternative may be to subtract T_1 from T_3 and then subtract from this the pre-determined "average time" required to process an order at this stage of the process. This might provide us with a "reasonable" and less costly estimate of the time delay, $T_2 - T_1$, especially if the average processing time, $(T_3 - T_2)_{avg}$, is relatively constant.



$$\text{Delay Commencing Processing} = T_2 - T_1 \cong \left[T_3 - (T_3 - T_2)_{avg} - T_1\right]$$

Figure 4

A Word or Two About Control Limits

Earlier I discussed the fact that service processes can experience shifts in the process baseline as well as added variance as a result of both the high labor content and the high degree of customer involvement. Since these are technically *induced*, rather than *random*, sources of variation, it may be desirable to expand the process control limits—when control limits are indeed relevant—

and somewhat relax the "when-to-take-action" criteria that would otherwise apply to manufacturing processes.

Unfortunately, there are no hard and fast rules on how much the control limits might be expanded. Often it comes down to a matter of judgment based on intimate knowledge of the process and the specific characteristics of the service environment. For instance, if both of the factors mentioned have little bearing on the stability and reliability of the process, then the control limits may be established using a standard *process capability study*. Also, in some cases, as when Run Charts are involved, control limits are not an issue.

Figure 5 depicts a condition where the $\pm 3\sigma$ control limits of a certain SPC chart have been extended by the amount of $\pm\ \Delta$ to compensate for anticipated shifts in the process that are induced from the sources identified above. If, in this case, the chart plots the sample averages of a certain process parameter, it is possible to determine the magnitude of Δ from the following equation:

$$\Delta = \frac{k}{\sqrt{n}}$$

where k is the amount (in standard deviations) by which the process parameter in question is expected to shift in either direction, and n is the sample size used in establishing the sample averages. For example, if we anticipate an induced shift in the process of $\pm 0.5\sigma$ and the sample size is 4, then the process control limits in Figure 5 would be extended in both directions by 0.25σ (i.e., $0.5\sigma \div \sqrt{4}$).

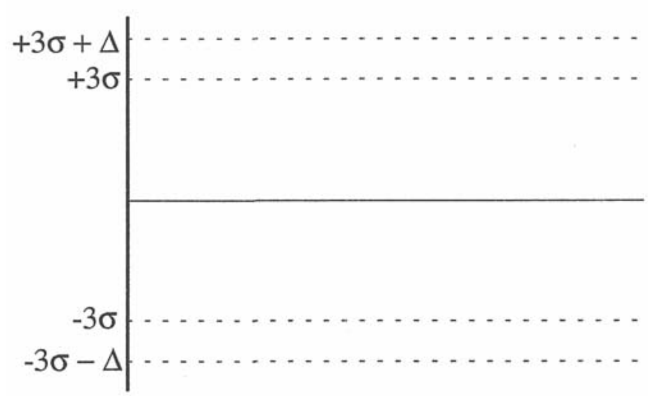


Figure 5

The Right Tool for the Job

As far as SPC in theory is concerned, there is no distinction between service processes and manufacturing processes. The tools are as valid for one as they are for the other. But, from a practical point of view, based on what we know about the nature of service processes, certain charting tools are more appropriate than others.

Here are some practical considerations relevant to the "typical" service process that may have bearing on the setup and maintenance of your SPC system:

- The data that are available for characterizing the performance of service processes often are not conformable to sampling schemes. For instance, the data from service processes tend to occur aperiodically and somewhat infrequently rather than continuously and frequently, as with manufacturing processes. This lends support to the use of such tools as Run Charts, Scatter Diagrams, Moving Range Charts (for charting individual values), Pre-Control, as well as plots of certain Critical Ratios[8] that are able to account for relative changes in two or more interrelated factors.

- *Attribute data* relating to "number or percent of defectives" should be used with caution in a service environment. As discussed earlier, due to the real-time nature of service processes, it may be unacceptable to tolerate *any* defectives—especially those occurring at points in the process where the customer could immediately experience the resulting impact.

- Service jobs, in contrast to manufacturing jobs, require a high degree of physical mobility on the part of the employees. Likewise, the processes themselves are often not tied to a specific physical location, as is almost always the case with manufacturing processes. Consequently, the task of collecting and recording data in a service environment adds a measure of difficulty. These, and perhaps other workplace realities, should be carefully considered when establishing the charting and data collection requirements.

A Final Point to Ponder

SPC has much to offer any service organization that is serious about fact-based decision making. On the other hand, there are some critical pitfalls in attempting to apply SPC in a service environment. My advice? Carefully review the points described herein while assessing their implications to your situation. Also, to the extent possible, I recommend involving the process team when planning and setting up your SPC system. I can assure you that if you pay heed to this advice that you will be well on your way to enjoying the benefits that SPC has to offer.

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