Benefits of SPC in nonmanufacturing areas

John Clifton

The benefits of SPC are not limited to the shop floor. Service and support operations can be improved significantly by using SPC techniques to reduce data-entry errors.

Market forces continue to increase the implementation of statistical process control (SPC). Our company adopted this approach in 1982, and the positive results have made us an enthusiastic user and promoter of SPC. Commitment to the program, which began at the top with the president of the company, now extends throughout the entire organization. Our corporate goal is to achieve ongoing improvement in all aspects of our business: product, service, and work environment. We believe that SPC is essential to the achievement of these goals.

Perhaps this sounds like rhetoric. Nevertheless, we have embraced SPC out of the need to become competitive in the global marketplace. This means providing customers with the best product value. In today's market, product value encompasses more than just the product itself. The concept of product value also includes service-oriented issues, such as inquiry response time, delivery time, product documentation, and spare-parts service and availability. We have discovered that SPC can be applied to improve performance in all of these areas.

Implementation of SPC

This article presents our experiences in implementing SPC and the subsequent effects on our products and on our organization. In 1982, after being "encouraged" by some of our larger customers, the company president decided to implement SPC in our manufacturing operations. We hired outside consultants and trained most of our executive team and many of our key manufacturing management employees in statistics.

There were problems. We were not fully committed, and we tried to implement SPC with part-time attention. It soon became apparent that the program would not be effective without complete support from the top on down. It needed full-time attention and the allocation of substantial resources, money, and people. In November 1984, our executive team met to discuss Deming's 14-point philosophy. The president of the company kicked off the meeting by stating that:

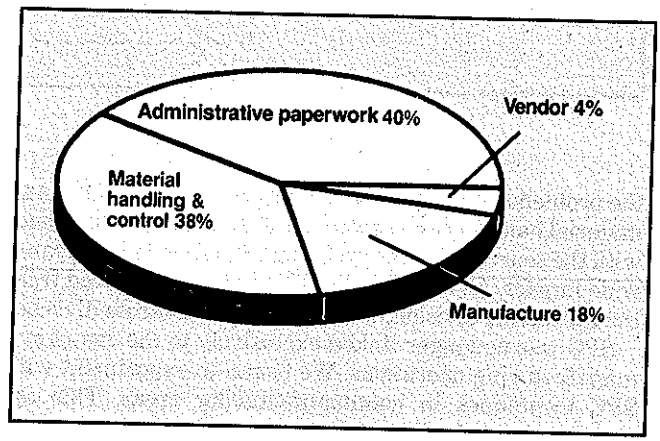
1. We were going to talk about the Deming philosophy.
2. We were going to get an agreement on it.
3. We were going to run the company by it.

It was the kind of direction that couldn't be ignored. The company initiated a full-scale SPC program by:

- Hiring a full-time SPC manager who reported to the vice-president of operations
- Developing a training program for SPC analysts
- Developing a roll-through program designed to rotate all of our supervisory personnel through the SPC department.

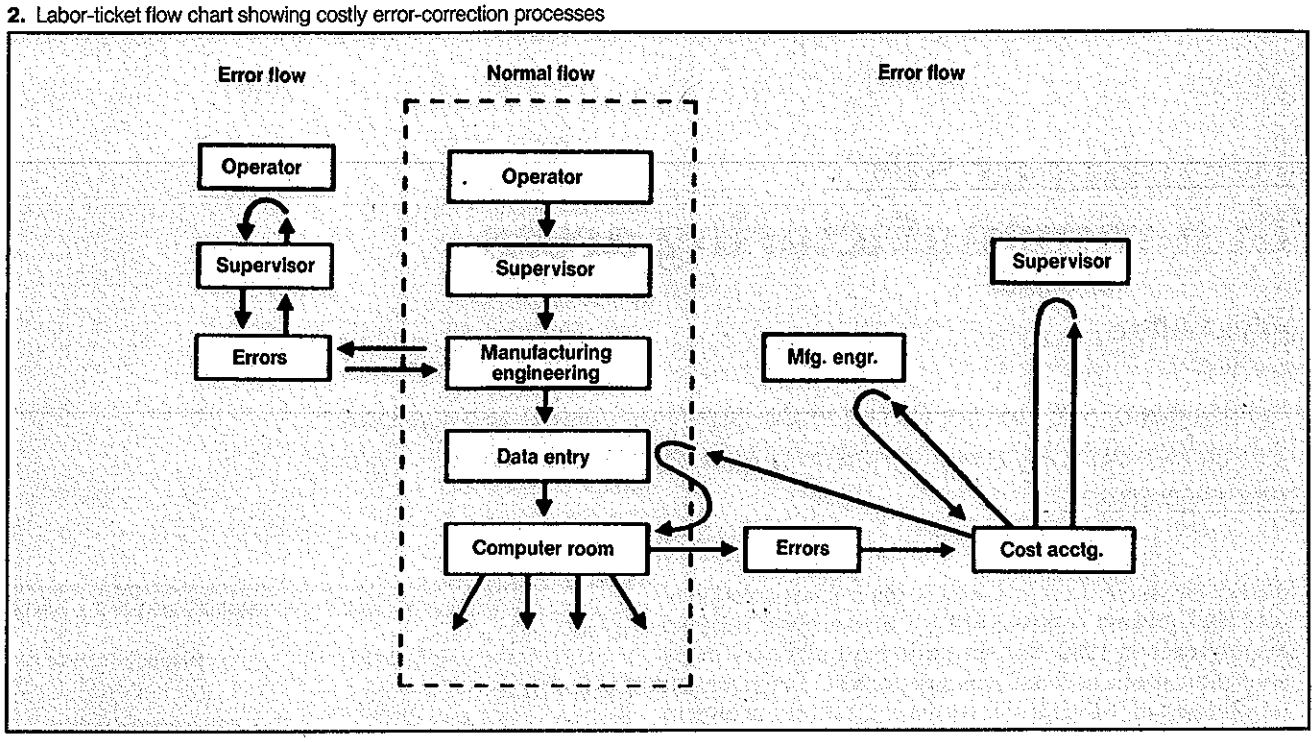
A year later, it had become apparent that the problems affecting product quality came from multiple sources and that SPC could not be restricted to a single division within the company. **Figure 1** illustrates the results of a five-year analysis of the problems in one of our assembly areas. Administrative paperwork such as drawings, bills of materials, sales, orders, etc. were responsible for 40% of

1. Source of problems in a typical shop assembly area over a five-year period



Clifton is the manager of SPC at the Falk Corp., 3001 W. Canal St., Milwaukee, Wis. 53201.

2. Labor-ticket flow chart showing costly error-correction processes



the problems, vendors for 4%, manufacturing for 18%, and material handling and control for 38%. To successfully deal with the sources of these problems, SPC needed company-wide impact. As a result, the SPC group was moved from the operations division into the human resources division.

SPC was no longer linked exclusively to the company's manufacturing operations. We began to experiment with SPC techniques in nonmanufacturing areas. This approach led to a significant change in our corporate culture. By involving everyone in the company, we created a work force that was committed to ongoing improvement as a team.

What is SPC?

So what exactly is statistical process control? The term "statistical" implies the use of facts to draw conclusions instead of "gut feelings." A "process" is a particular way of doing something that involves multiple steps. This term can be used to describe the procedure for manufacturing a part, entering an order, or even making a deposit in a checking account. The term "control" means to keep something within boundaries or to make it behave the way you want it to behave.

The SPC technique is simply a method of using data to control a process. SPC prevents defects from happening. The old inspect/reject process weeds out defects after they've happened—at a substantial cost in scrap, lost time, and worker morale.

SPC is also a philosophy. In our company, only 10% of the SPC analyst's job is statistical evaluation. The other 90% involves helping people to use basic SPC concepts to improve systems and products, i.e., training, facilitating communications, and supporting teamwork.

SPC training and roll-through

Our SPC group consists of 10 full-time analysts who are recruited from various technical and supervisory positions throughout the organization. We have developed a roll-through plan that rotates the analyst staff on a regular basis. The roll-over each year is about 50%.

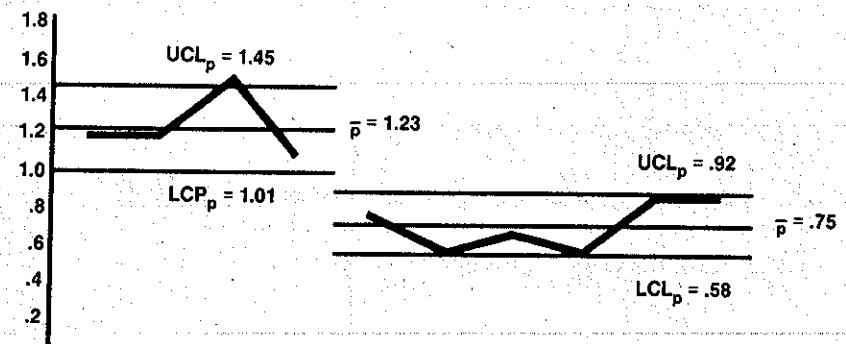
We are currently working with manufacturing supervision. A small group of supervisors is selected and rolled into the SPC group as analysts. First, they go through an intensive 160-h classroom training program. Basic SPC concepts are covered in detail: Pareto charts, attribute charts, organizational problem-solving techniques, control charts, process capability studies, measurement variation, data analysis, management styles, and planning. After spending some time in the SPC group, the new analysts are given advanced training that includes: analysis of variance (anova), Taguchi techniques for experimental design, quality function deployment, and internal sales.

Internal sales involves "selling" the SPC approach to all of our employees. We want the employees to embrace the SPC process because they believe in its benefits, not just because the president says they must.

Analysts spend between 1 and 2 years in the SPC group before being rotated back to their original assignments. After completing initial training, each analyst is assigned to a department, where they serve as "in-house consultants." In this role, the analyst works with the department's personnel on their own projects to accomplish on-the-job training while at the same time implementing SPC. The analysts also conduct a basic 10-h SPC training course for company employees. More than 90% of our employees have received this training.

The roll-through program is an ongoing process. To date, the supervisor of quality control, the supervisor of quality

3. P-chart of labor ticket errors



Number of errors	259	244	363	260	188	112	162	122	240	194
Number of entries	22192	21216	23920	23584	23776	19840	24848	20160	25302	21552
Percentage	1.2	1.2	1.5	1.1	.8	.6	.7	.6	.9	.9
Week number	1	2	3	4	5	6	7	8	9	10

engineering, the weld-shop superintendent, and 10 manufacturing supervisors have served as SPC analysts for a minimum of one year before returning to their regular jobs.

The SPC group spends a sizeable amount of time providing ongoing training for shop personnel. We routinely hold followup sessions on target manufacturing and self inspection. The results have been substantial reductions in product variability in many of our lines.

SPC at work in the manufacturing area

SPC has produced some outstanding results. For example, we used SPC techniques to reduce the variability of steel hardness in our foundry. We were able to increase our control of the process and reduce variability in material hardness by 62%. The result was (a) a better, more consistent product for machining and (b) a substantial reduction in rework, which generated annual savings of $80,000.

In another manufacturing application, we reduced annual maintenance costs by $19,000. Operator productivity was increased over all three shifts by an average of 10.1%, while scrap and rework were reduced by 75%.

Self inspection is one of the common-sense SPC techniques. The machine operator assumes the responsibility of an inspector. After all, the operator is in the best position to judge whether the part is within specifications. The operator also is the one who can respond most effectively when something goes wrong. In one of our departments, self inspection led to an annual savings of more than $20,000 and eliminated 1492 lead-time days.

SPC and nonmanufacturing applications

Application of SPC has resulted in significant improvements in nonmanufacturing areas. One of the areas was the accounting department.

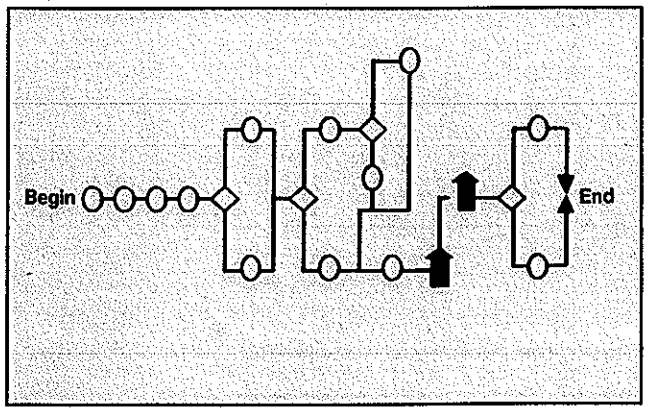
Figure 2 shows the normal process for the flow of labor tickets from the machine operator to the computer room, where the raw data are used to create various reports. It also illustrates the steps that are required to correct any errors that are discovered along the way. Our initial SPC analysis showed that these "hidden" error correction processes were time consuming and expensive. A reduction in the error rate offered the prospect of significant savings.

Before applying corrective actions, the error rate averaged 1.23%. After only five weeks, this was reduced to 0.75%, as shown in **Fig. 3**. This may seem insignificant, until you realize that the total number of data entries involved each week usually exceeded 20,000. The savings we achieved through SPC amounted to a 50% reduction in the administrative time spent on rework by our accounting department.

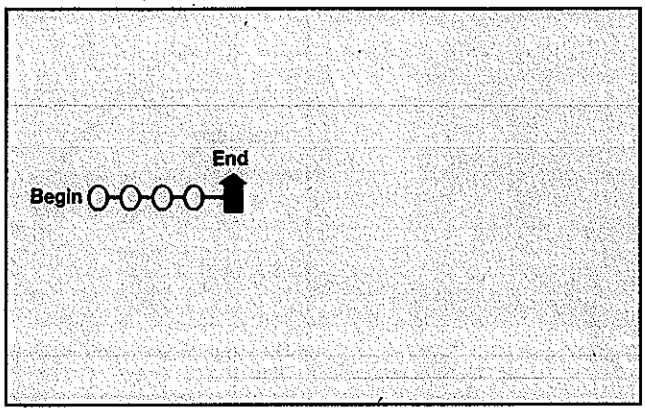
Another example involved the order entry for a common repair part (shim and gasket kits) for speed reducers. The pre-SPC process for entering an order for this part is shown in **Fig. 4**. The old process involved researching files and checking part numbers and was very time consuming. More importantly, the order-entry personnel found the process to be so complicated and confusing that we often shipped the wrong part.

The post-SPC process is shown in **Fig. 5**. This four-step process is much simpler and resulted in time savings and substantial improvements in accuracy. With the old system, 1-4 h were required to process a single order, depending on the type of unit involved. With the new

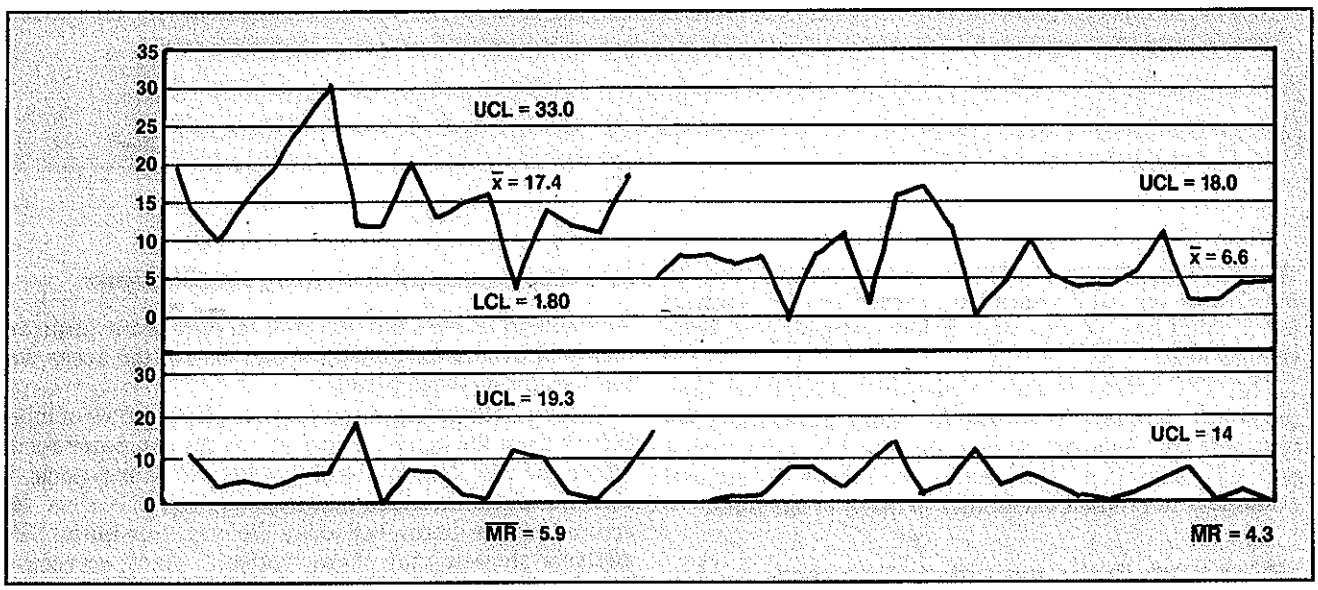
4. Pre-SPC process diagram for entering orders for shim and gasket kit



5. Revised process diagram for entering orders for shim and gasket kit



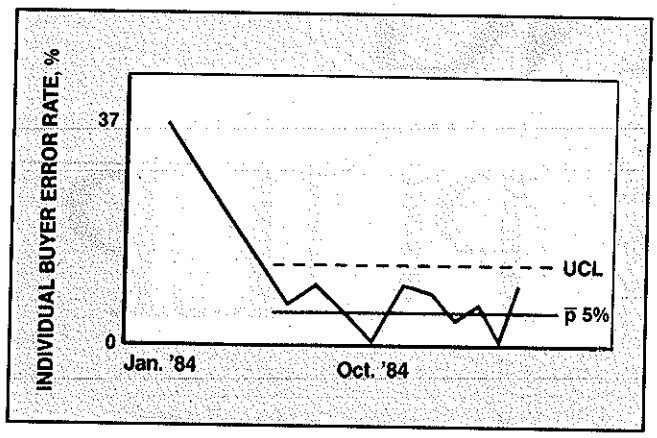
6. Shipping department error history



I. A seven-step program for reducing order-entry error rates

Step	*SPC technique*	*Results*
1. Training	...	Involved all order-entry personnel in the problem and upgraded their SPC skills.
2. Strategy planning	Gant chart	Set up an activity schedule for investigation, analysis, correction, and follow-up.
3. Identify problem	Brainstorming sessions cause-and-effect diagrams	Developed a comprehensive listing of all known potential causes of order-entry errors.
4. Determine causes	Check lists	Check lists were kept over several months to provide data on the occurrence of these causes.
5. Problem analysis	Pareto charts	Pareto analysis showed that the major causes of errors were: hearing problems, CRT problems, typing errors, and general lack of product knowledge.
6. Identify and implement solutions	...	Training on CRT usage was set up for all personnel. Volume controls were installed on telephones. Product training (including hands-on training) was started.
7. Monitor results	Run charts	Error rates fell from 5% to 0.8%; productivity increased by 26%.

7. Error reduction in purchase orders



system, we can accomplish the same function in 1 min. We save 380 processing hours each year. Best of all, since making this improvement, we have yet to receive one customer complaint on receiving the wrong material.

Our company has a number of distribution centers located throughout North America. These are essentially product warehouses, strategically located to enable us to deliver product quickly in any area. The parts are on the shelf, but that doesn't help if an error is made when entering an order.

Before SPC, one of our distribution centers had an average order-entry error rate of 5%. After applying SPC techniques, the error rate dropped substantially. For 1988, it was 0.8%. We also improved productivity. In 1984, each order planner processed 91.8 orders per month. Year-to-date 1989, each planner is processing 104.3 orders per month, a 26% increase in productivity. **Table I** shows the step-by-step procedure we followed to achieve these results.

We have had SPC success stories in other nonmanufacturing areas as well, notably in shipping and purchasing. **Figure 6** illustrates the decreasing trend in shipping department errors.

Our purchasing department had a 37% error rate in January 1984. That meant that 37 out of 100 purchase orders either had missing, inadequate, or incorrect information. Application of SPC showed immediate results. **Figure 7** shows that the error rate was reduced to less than 5% within five months. Today that same error rate is 0.2%.

SPC and partnerships in quality

Your suppliers are your partners in the production of pulp and paper products for your customers. Most of you recognize this and have established some type of certification programs for your suppliers.

An SPC-oriented supplier is one who is committed to total quality, to overall product value, and to ongoing improvement. A quality focus pervades the entire supplier/customer relationship: product, service, and support. In today's intensely competitive environment, the physical product conformance to specification is often a given. That's not necessarily true for the other aspects of the supplier/customer relationship. Is the correct product delivered? Is it delivered on time, i.e., not early or late? Is help available to install it? Are the operating instructions easy to understand? Will your supplier support the product with replacement parts? If your supplier is truly committed to SPC, you should be able to answer yes to all of these questions.□

Received for review May 1, 1989.
Accepted June 26, 1989.

Presented at the TAPPI 1989 Engineering Conference.