1. INTRODUCTION

Statistical Process Control (SPC) is a technique for error prevention rather than error detection. SPC products will be of the required quality because they are manufactured properly and not because they are inspected. Thus it increases productivity by reducing scrap and rework and provides continuous process improvement. Other methods — such as: flexible manufacturing systems (FMS), computer integrated manufacturing (CIM, and just-in-time (JIT) — which have aimed at increasing productivity, concentrate to hardware flexibility, integration of information flow or reduction of inventory. Seldom a system uses technology flexibility to produce correct products.

SPC is accomplished by technological means, statistics for detection and technology for prevention.

1.1 Introduction to SPC

SPC is statistically based and logically built around the phenomenon that variation in a product is always present.

There is a natural variation inherent in any process due to wear of tools, material hardness, spindle clearance, jigs and fixtures, clamping, machine resolution, repeatability, machine accuracy, tool holder accuracy, accumulation of tolerances, operator skill etc. Variation will exist within the processes. Parts that conform to specifications are acceptable; parts that do not conform are not acceptable. However, to control the process, reduce variation and ensure that the output continues to meet the expressed requirements, the cause of variation must be identified in the collected data or in the scatter of data. Collection of these data is characterized by a mathematical model called ‘distributions’ which is used to predict overall performance.

Certain factors may cause variation that cannot be adequately explained by the process distribution. Unless these factors, also called ‘assignable causes’ are
CHAPTER 14

identified and removed, they will continue to affect the process in an unpredictable manner.

A process is said to be in statistical control when the only source of variation is the natural process variation and ‘assignable causes’ have been removed.

SPC identifies changes between items being produced over a given period, and distinguish between variations due to natural causes and assignable causes. Corrective action may therefore be applied before defective products are produces. A properly conducted SPC program recognizes the importance of quality and the need for never ending search to improve quality by reducing variation in process output. Parts will be of the required quality because they are manufactured properly, not because it is they are inspected. SPC is basically opposed to methods involving part sorting, such as sorting of conforming parts from nonconforming ones.

Variations that are outside of the desired process distribution can usually be corrected by someone directly connected with the process. For example, a machine set improperly may produce defective parts. The responsibility for corrective or preventive action in this case will belong to the operator, who can adjust the machine to prevent recurring defects. Natural variation will establish process capability. The process must be in control in order to apply SPC. A process in control has its upper and lower control limits, which establish the suitability of the process to the task and the anticipated scrap and rework percentages. Inherent capability of process factor \((Cp)\) will indicate if:

\begin{align*}
\text{a. the process is capable; } \\
\text{b. the process is capable but should be monitored; or } \\
\text{c. the process is not capable. (Fig 4.5).}
\end{align*}

Natural process variation may only be corrected by redesigning the part and the process plan.

Successful SPC control requires action in a form of a monitoring system and feedback loop, in a corrective and preventive action plan. A control chart may be in place to record the average fraction defective at a work station, but it is only of marginal value unless the people responsible for the process know what action to take when the process moves out of control.

SPC eliminates subjectivity and provides a means of comparing performance to clearly defined objectives. The control chart used to identify variability and existence of assignable causes will be used to track process improvements.

Through application of statistical techniques, problems are identified, quantified and solved at the source in an optimum time. Out-of-Control conditions become evident quickly as does the magnitude of the problem. With this information, action can be taken before the condition becomes a crisis.

Immediate feedback is the key to the success of any SPC system. SPC is not solely a quality department function. The responsibility for control is in the hands of the producer. This provides the dual advantage of giving the operator a better understanding of what is expected, as well as providing a means of detecting undesirable conditions before it is too late.