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# Application of Statistical Process Control (SPC) in Manufacturing Industry in a Developing Country

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**Abstract**

This research focused on studying the statistical process control tool in manufacturing systems with the broad aim of upgrading them to improve on quality and cost effectiveness. It represents an attempt to address the deficiency in the literature of SPC implementation. With emphasis on early detection and prevention of the problems, SPC was shown to have a distinct advantage over quality methods such as inspection of end product. There was need to check gauges and machines, and determine need for some maintenance or overhaul work to be carried out as faulty machines could not produce quality good products. There was need for operators to be trained, new documents to be produced and actions for the future to be agreed on. A system of reviewing the progress and monitor the result was to be effected with as much priority as that given to financial results.


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*Keywords:* SPC, quality control, inspection, conformance, competitiveness, TQM

## 1. Introduction

In today's tough world market environment, the need to be better is more demanding, and the need to be more competitive is a necessity to survive. A company cannot rest on the success of the past performance and expect to continue to remain successful [1,2]. There are many well-known examples of companies both large and small that were once leaders in their fields and now are skeletons of themselves.

The key to being competitive lies in the ability to exceed customers' needs and expectations; as well as providing , in the manner required by the customer, a quality product at low cost, on time, every time[3,4,5].

In this era of strains on resources and rising costs of manufacturing, it becomes increasingly apparent that decisions must be made based on facts, not just opinions. Consequently, data must be gathered and analyzed. This is where statistical process control (SPC) tools comes in to help in the decision-making and determining if the process is operating at an acceptable level [6].

The major challenge the industries in Zimbabwe face is associated with competitiveness as manufacturing organization fail to compete in region and globally. In this regard, there is need for these entities to work on improving product quality and cutting cost as they manufacture their products [4]. Thus this study is intended to spell out the concept of SPC for the benefit of those intending to use it their processes. Literature on the implementation of SPC mostly concentrates on the development of statistical tools like control charts [7,9]. However, implementation of the methodology SPC in organization and its implications are hardly discussed in detail.

## 2. Overview of SPC

### *2.1 Background*

Statistical Process Control (SPC) is the application of


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statistical methods to monitoring and control of a process to ensure that it operates at its full potential to produce a conforming product. Under SPC, a process behaves predictably to produce as much conforming product as possible with least possible waste. Key tools in SPC are control charts, continuous improvement and design experiments [8, 10].

Variations in the process that may affect the quality of the product can be detected and corrected, thus reducing waste as well as the likelihood that problems will be passed on to the customer. With its emphasis on early detection and prevention of problems, SPC has a distinct advantage over other quality methods, such as inspection, that apply resources to detecting and correcting problems after they have occurred [11].

When a process is considered out of control, an alarm is raised, so that engineers can look for assignable causes of variation and try to eliminate them. It is more effective to take a proactive approach to prevent the occurrence of out of control situations allowing the process to be adjusted in a preventive way so that fewer non-conforming items will be produced[12, 13].

### *2.2 SPC implementations*

In SPC application, it is important to understand and identify key product characteristics which are critical to customers or key process variation as shown in Fig 1. The key steps for implementing SPC are [1,2]:

- Identify defined processes
- Identify measurable attributes of the process
- Characterize natural variation of attributes
- Track process variation
- If the process is in control, continue to track
- If the process is not in control
  - Identify assignable cause
  - Remove assignable cause
  - Return to 'Track process variation'

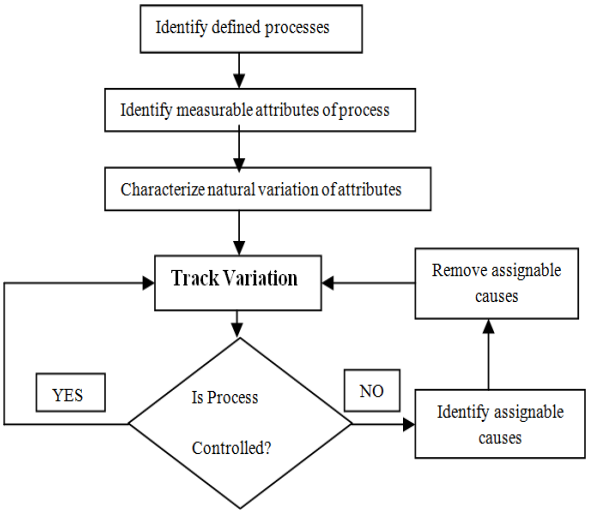


Fig .1 Steps in SPC implementation (*Source GOLD PRACTICE*)

The Pareto effect has to be used to identify the vital few processes, which control manufacture, and then building the planning around these key processes and products for quality control activities.

### *2.3 SPC tools*

In practice, reports of SPC in manufacturing tend to concentrate on a few processes. Thus to say SPC has been used to control formal inspections, testing, maintenance and personal improvement processes. Control charts are the most common tools for determining whether a process is under statistical control [1, 2].

Table.1 Seven SPC quality tools (*Source GOLD PRACTICE*)

| **Tool** | **Application / Use** |
|---|---|
| Check Sheet | To count occurrences of problems |
| Histogram | To identify central tendencies and any skewing to one side or the other |
| Pareto Chart | To identify the 20% of the modules which yield 80% of the issues |
| Cause and Effect Diagram | To identify assignable causes |
| Scatter Diagram | For identifying correlation and suggesting causation |
| Control Chart | For identifying processes that re out of control |
| Graph | For visually displaying data e.g in a pie chart |

The combination of an Upper Control Limit (UCL) and a Lower Control Limit (LCL) specify, on control charts, the variability due to natural causes.

Also Table 1 shows some of tools used in SPC, as away to explore the natural variability of processes. Some are used as techniques for eliminating assignable causes. Analysis of defects is the most common for eliminating assignable causes. Also analysis-related techniques such as Pareto analysis and brainstorming are applied [11].

SPC requires defined processes and a discipline of following them. It requires a climate in which personnel are not punished when problems are detected [15].

### *2.4 SPC benefits*

Statistical techniques provided by SPC enable optimizes the amount of information needed for decision making, through understating of business baselines, insights for process improvements, communication of value and results of processes, and active as well as visible involvement. SPC provides real time analysis to establish controllable baselines; learn, set and dynamically improve process capabilities; and focus business on areas needing improvement [16].

## 3. Methodology

Questionnaire surveys and interviews were done on a population which was derived from Zimbabwean manufacturing industry based in Harare. Data collection also