

# **Quality Data Analysis and Statistical Process Control (SPC) for AMG Engineering and Inc.**

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## **Abstract**

This study examines the application and use of statistical process control (SPC) tools to improve the quality of processes in a manufacturing outfit, a case study of AMG Engineering and Incorporation. It identifies the need for quality improvement and variability reduction in products. The work on this study is still in progress, tentatively, the company might need to update their machines, try to educate/train their engineers on new technology, improve the quality of material for production and eliminate overtime schedule for the technicians so as to improve their production.

## **Introduction**

Researchers have proposed frameworks, implementation, given caveats for practitioners who want to implement Statistical Process Control (SPC) and design of experiments in various manufacturing and non manufacturing domain. The definition of quality varies widely depending on the applications. Genechi Taguchi<sup>11</sup> offers a generalized definition for quality of performance where he regards performance as the major component of product or process quality. In the early 1920s, Sir R. A. Fisher introduced design of experiment as a statistical technique in his papers and he later used this technique in an agricultural experiment<sup>7</sup>. The history of the design of experiments provides an outstanding example of the usefulness of the statistical approach<sup>1</sup>. The need for quality has long been recognized as very important to both competition and survival in the business world. As such more organizations have adopted the use of statistical process control (SPC) as a mean for obtaining higher product quality. The purpose of this study is to conduct statistical process control and quality improvement in the company's processes. Quality improvement is the reduction of variability in processes and products<sup>6</sup>.

The study intends to achieve a high level of quality of conformance; this is influenced by a number of factors which includes the choice of manufacturing processes, training and supervision of the workforce, type of process control, tests and inspection activities that are employed, and the motivation of the workforce to achieve quality. The first section of this paper provides a brief historical background of Statistical Process Control. The second section discusses control charts and its importance for controlling, monitoring and process improvement and conclusions and recommendations given in the final section.

Statistical Process Control (SPC) is a scientific, data-driven methodology for quality analysis and improvement. Statistical Process Control (SPC) is also said to be a powerful collection of

problem solving tools useful in achieving process stability and improving capability through the reduction of variability<sup>7</sup>. It is a technique used to determine whether a process is in statistical control. In industry, the Shewhart chart is the most commonly applied statistical quality control methods for studying the variation in output from a manufacturing process. Shewhart charts are typically used to distinguish between variations due to special causes from variations due to common causes. Special causes are referred to as assignable causes like sporadic problems such as the failure of a particular machine or a mistakenly recorded measurement.

Common causes are problem inherent in the manufacturing system as a whole. The process is said to be in statistical control when the special causes have been identified and eliminated, and once statistical control has been established, Shewhart charts can be used to monitor the process for the occurrence of future special causes and to measure and reduce the effects of common causes, Montgomery Douglas<sup>6</sup>. These techniques include control charts, histogram distribution, Pareto analysis and correlation methods. The concept of Statistical Process Control has its origins in the 1920s<sup>4</sup>. Shewhart's work was used extensively during the World War II period in the American defense industry, . In the 1940's Deming continued the work of Shewhart and introduced a 14- point plan for quality management. In 1997, Bjorn Andersen and Loland H<sup>2</sup> in his paper concluded that everyone working with quality improvement and process innovations knows that there are a very large number of different improvement tools or philosophies available for use. Organization can embark on a program of continuous change if any, change is however disruptive and too many of those changes affected are unwelcome, so it is important to approach this task carefully if genuine overall improvement is to be achieved.

Control chart is the most commonly used Statistical Process Control (SPC) tools. Control charts are used to track process statistics over time and to detect the presence of special causes<sup>5</sup>. According to Duffua and Ben-Daya's Control chart<sup>2</sup> is said to be the heart of Statistical Process Control. Types of Control Charts are the X-bar and Range charts. They are called variable control charts in that; it measures the central tendency and process variability.

These are some of the reasons for using control charts:

- It is effective in defect prevention; control chart helps keep the process in control.
- It is a proven technique for improving productivity, when effectively used it reduces scrap and rework which are the primary productivity killer in any operation, by reducing scrap and rework productivity increases, cost decreases, and production capacity increases (measured in the number of good parts per hour).
- It provides information about process capability and also control chart is among the most effective management control tools, they are as important as cost control and material control.

Six Sigma, according to the Motorola website,<sup>8</sup> is defined as the measure of quality that strives for near perfection, a disciplined, data-driven methodology focused on eliminating defects. A Six Sigma defects is defined as anything that falls outside of a customer's specifications. Six Sigma methodologies was first derived/implemented by Motorola in the 80s during the quest to formulate/ find out processes which can help in the reduction of failures at all level in production, Nilesh Parker<sup>9</sup>. According to the Motorola website,<sup>7</sup> examples of companies that practices Six Sigma are:

- Motorola, the pioneer of Six Sigma reported a savings of \$17 billion from 1986 to 2004 in sales and marketing, product design, manufacturing and customer service.

- General Electric (GE), reports had it that the company saved \$750 million by the end of 1998.
- Also Allies Signal/Honeywell initiated Six Sigma efforts in 1992 and saved more than \$600 million a year by 1999.

## Objectives

The following are the objectives of this study:

- Variation reduction for high quality products.
- Determination of minimum tolerance that will reduce number of defectives.
- Identification of the most appropriate management tool that will ensure better output.

In figure 1, according to Software Technology News article, an annual publication from The Department of Defense Information Analysis Center (IAC) <sup>10</sup> depicts the steps in an implementation of Statistical Process Control (SPC). The key steps for the implementation of Statistical Process Control are:

- n Identify defined processes
- n Identify measurable attributes of the process.
- n Characterize natural variation of the attributes
- n Track Process variation
- n If the process is in control, continue to track.
- n If the process is not in control:
  - Identify assignable cause
  - Remove assignable cause
  - Return to “Track process variation”

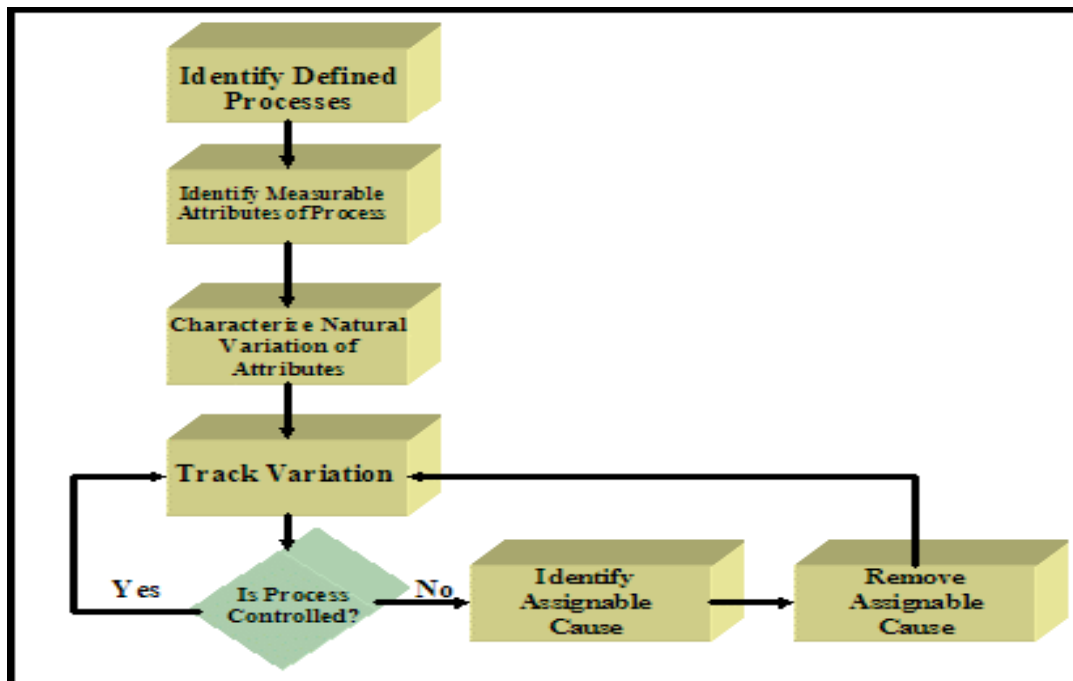


Figure 1: Schematic chart of Statistical Process Control (SPC)

## Methodology

A data recorded for a year performance of the operator on the machines was obtained from the company also personal phone calls and e-mails were made to the company's supervisor in order to get more information on the type of machines available in the company with their maintenance history, number of hours machine is subjected to use, lifecycle of the machine, the machinists or operators performance measure and overtime schedule was also obtained. Sample parts from the company were also obtained and information was obtained from the library and regular research was made on the internet to get more detailed information on the study. The research work is still in progress and visitation to the company site had been scheduled on the need for achieving six-sigma quality goals for the company.

## Data Analysis

Data and sample parts obtained will be assessed and AutoCAD diagram of the part will be made, and preliminary analysis on the data obtained from the company using MINITAB will be made, and process capability ratio conducted. Figures 2 through 4 show samples of parts produced by AMG Engineering and Machining Inc.

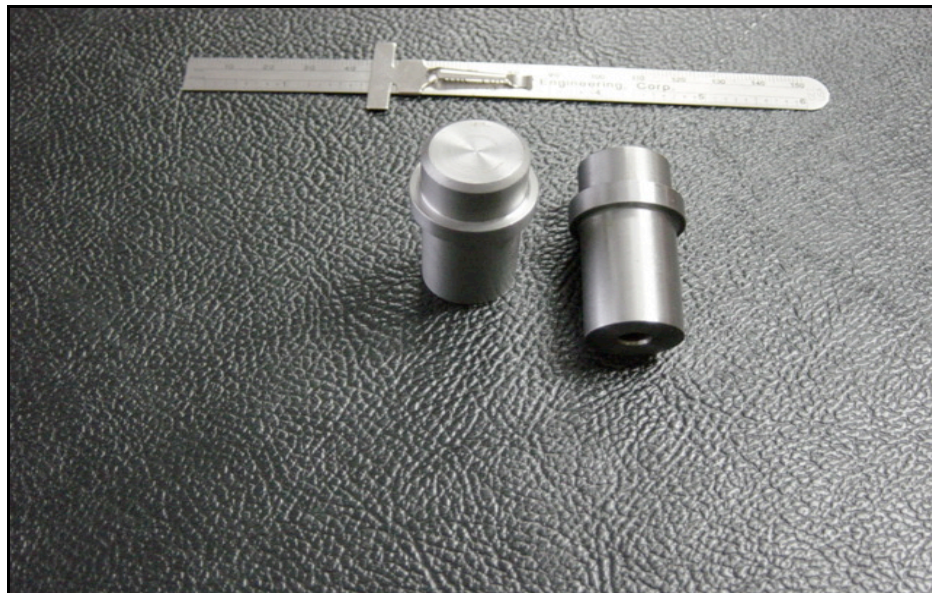


Figure 2: Retainer



Figure 3: Lathe Machine for Turning

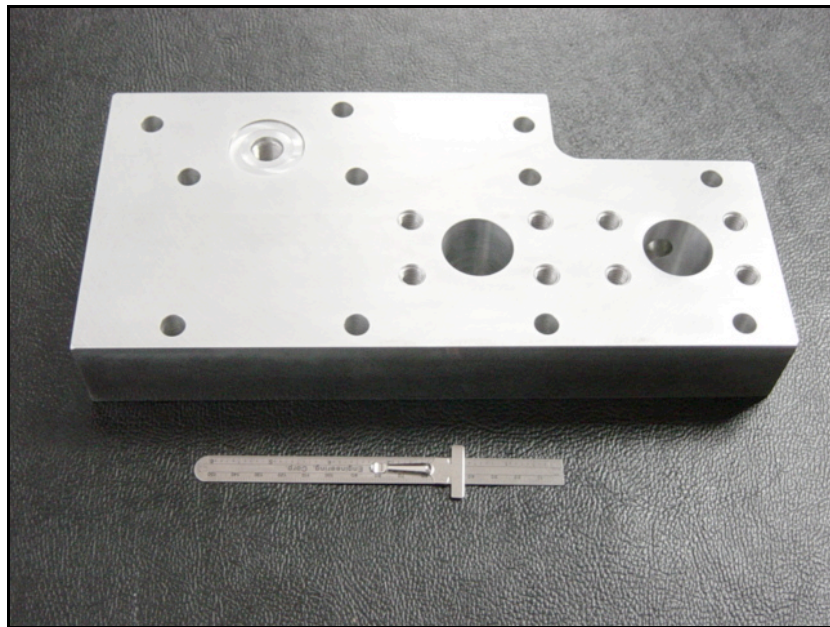


Figure 4: Manifold Plate

## **Expected Results**

- Results from the study will help the company to improve in their production.
- Good management control for better output will be achieved based on the result from the study.
- Results obtained will help the company to ensure optimal production with a better quality output.
- Dramatic reduction in variability and scrap will be achieved with the results of the study.
- Results of the study will help the company to reduce their overhead cost.

## **Recommendations**

The following are recommended in order to achieve quality improvement in company processes:

1. Companies should practice modern training methods and invest in on- the job training for all employees. Everyone should be trained in the technical aspect of their job and in productivity-improvement methods as well.
2. Improve leadership, and practice modern supervision methods. The number one goal of supervision should be to improve the work system and the product.
3. Companies should focus on continuous improvement, i.e. constantly trying to improve the production and service system.
4. Companies should not rely on mass inspection to control quality, inspection typically occurs too late in the process.

## **Conclusion**

Implementation of Statistical Process Control at the AMG Engineering and Machining Incorporation is expected to improve their processes and reduce variability or waste because it may not be possible to completely eliminate variability. With reduced variability the cost of dealing with scrap, rework, and other losses created by defectives which is an enormous drain on any company will be greatly reduced.

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