DATALYZER International
Partners in Continuous Improvement

Integrating SPC and SQC

A recommendation to overcome the disadvantages of both techniques

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1.1 Introduction

SQC and SPC are both powerful techniques, but they both have disadvantages. In this document a methodology is presented which will overcome the disadvantages of the separate systems by integrating the techniques. The amount of calculations necessary to apply the solution given requires automatic data entry in attribute charts.

1.2 Problems applying SQC

SQC is short for statistical quality control and deals with the statistics used for acceptance sampling. Based on consumer, producer risks, lot sizes and acceptable reject levels a specific sampling plan and acceptance numbers are chosen to take samples of a lot.
Well known and often used techniques based on SQC are Mil standards 105D also known as ABC standard.
Although the statistics used in SQC will bring the quality of delivered goods to a predictable level there are some negative points about SQC.
SQC is always at the end of a process, when the problems already have occurred. SQC in itself will not improve the process and give proper signs when a problem has appeared. It will only inform the inspector whether the lot is good enough to be shipped.
When inspecting during the process to find possible problems as soon as they appear the technique of SPC is often used.

1.3 Problems applying SPC

The advantage of SPC is that sampling is done with a high frequency which will increase the chance of finding a process problem in the early stages.
The technique used when applying SPC are attribute control charts.
Attribute control charts have a few disadvantages:

1. Different defects are combined in an attribute chart. This means that no distinction is made between major and minor errors and especially if the number of minor errors is bigger than the number of major errors

this will influence the statistics. The solution in this case could be to make separate charts for minor and major defects but that will increase the amount of administrative work.

2. Attribute charts assume that the data can be treated as coming from a normal distribution which is only true if the number of errors is so high that np > 2.5. A solution can be to calculate the limits based on X moving Range instead of normal calculations. This approach will give good results as long as the number of errors in the subgroup is 1 or higher. In most attribute processes the number of errors is lower. This means you need to combine subgroups to get subgroups big enough to get an average of 1 or higher.
3. The attribute control charts will give the operator information when the process is out of control but it will not give proper information when the lot should be blocked based on chosen consumer and producers risks. This means in case of an out of control SQC should be applied to verify whether the lot can be shipped.

1.4 Solution

The problems presented above can be overcome by integrating the two techniques.
In using attribute charts you can implement solutions which will overcome the problems presented applying SPC.
The solution to the problem of different type of errors is to introduce categories of attributes. These categories can have a control limit. If the number of errors in a category exceed the control limit an alarm should be given.
The solution to problem 2 and 3 is to combine subgroups and summarize the defects in these subgroups. For each category you can should be able to enter a Sampling Plan Size and an acceptance number related to that Sampling Plan. When entering a new subgroup, the program needs to go back in the chart and combine subgroups until the number inspected for combined subgroups exceeds the Sampling Plan Size. The number of errors found in the Sampling Plan will be compared with the acceptance number and an alarm will be given if the acceptance number is exceeded. This alarm implicates the lot should be blocked and should not be shipped.

1.5 Visualize problems

The following graph is an example of an attribute chart where the solution is implemented. The chart shows the total number of defects for all categories at once. The table below the chart shows the number of defects per category. If a control limit for a category is exceeded the value in the table is shown in red.

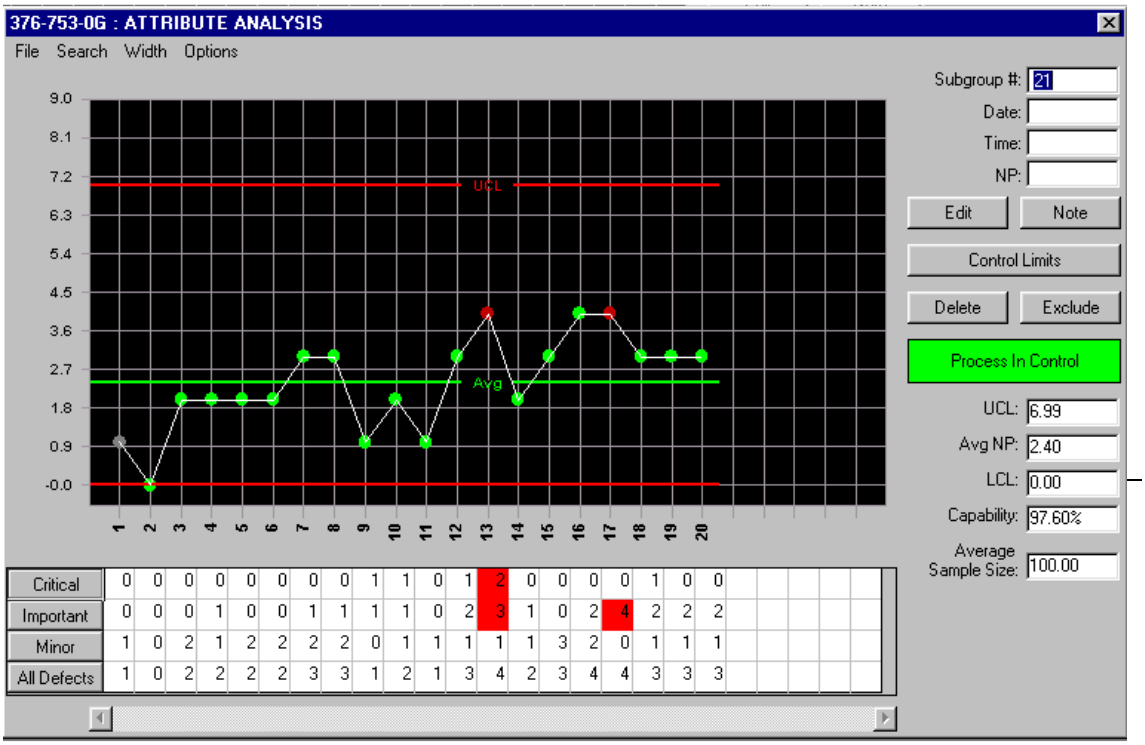

Figure 1: Attribute charts with defect categories

1.6 Benefits

The benefits of the described methodology are obvious.

Companies applying only SQC

The benefits of SPC over SQC are obvious. A lot has been said in recent years about these benefits: Faster feedback, problems are discovered as soon as they occur, production people making the quality are also responsible for verifying the quality, no inspectors necessary

anymore in the warehouse. The solution described above still provides all the customer requirements related to SQC but the task is performed much more efficiently.

Companies applying only SPC

The benefits for companies applying SPC are less obvious. The major benefit lies in the fact that attribute SPC with low defect levels is not always working properly. In practice you will see that these charts are not much more then check sheets and no action is taken when control limits are violated. Implementing the solution described will make people much more aware of the problems with traditional attributive SPC and will help them to take better decisions when action is required. The second big advantage is that the solution described will make it possible to tell something about the consumer's risk of your processes.

Companies applying both SPC and SQC

If companies apply both SPC and SQC the amount of lot inspection can be decreased a lot without decreasing the consumer's risk. The optimal frequency and subgroupsizes of the SPC checks can be established. Based on relevant process information and the required AQL level you can establish the optimum combination of SPC and SQC inspection.

For example if we use a subgroupsize of 10 during the SPC inspection and inspect production 100 % since the last subgroup in case we find 1 defect in the subgroup we can establish the Average outgoing Quality (see figure 2)

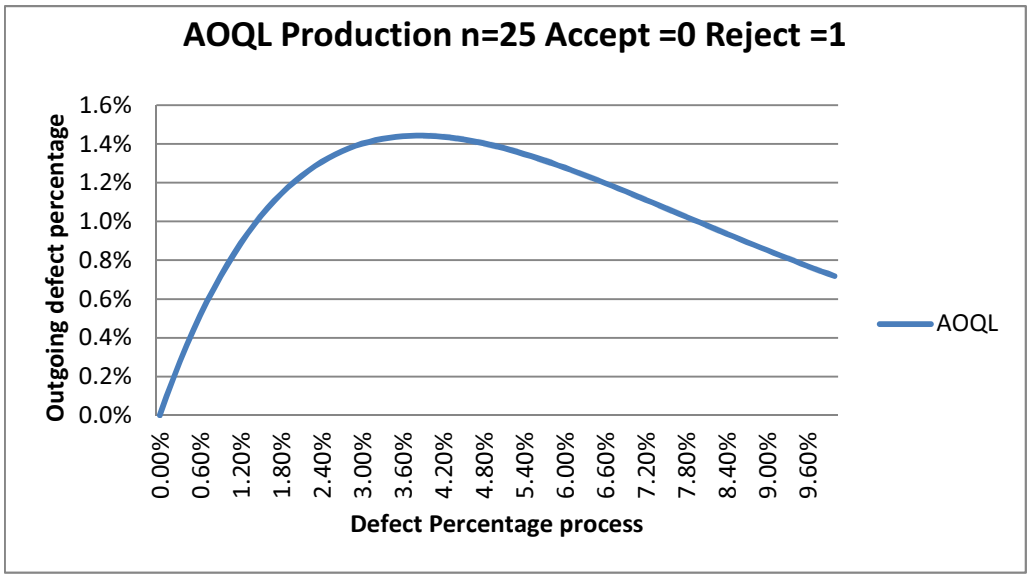

Figure 2: Average outgoing quality for a specific defect percentage

We can also establish how much inspection is required combining the SPC and SQC method (see figure 3).

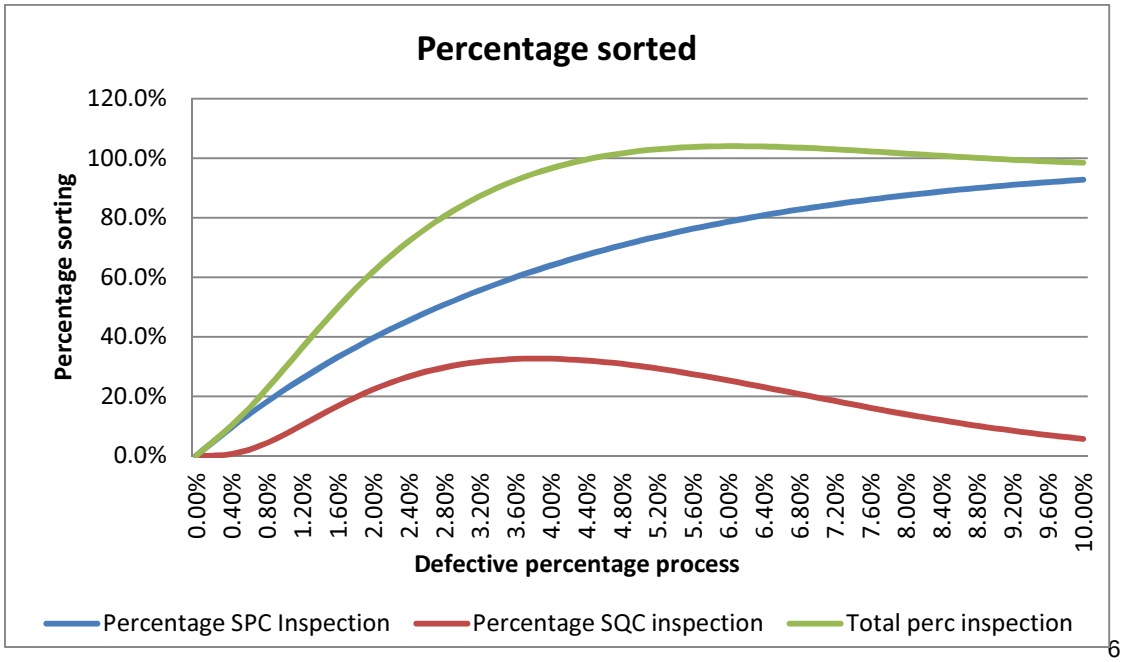

Figure 3: Percentage of production which will be sorted 100%

By varying the methods we can establish the optimum combination of SPC and SQC methods for a given production situation.

1.7 Further reading

SQC:

Statistical Quality Control
By Eugene L. Grant, Richard S. Leavenworth
McGraw-Hill, ISBN: 0-07-024117-1

SPC:

Advanced Topics in Statistical Process Control
By Donald J. Wheeler, Ph.D.
SPC Press, ISBN: 0-945320-45-0