

# A Comprehensive Study on Improving the Quality of Cigarette Manufacturing

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## ABSTRACT

Cigarette Industry is one of the most Controversial Manufacturing Industries throughout the world. Most of the countries in the world have enacted some rules and regulations for Cigarettes and Tobacco industry. In Sri Lankan context also, there is very restricted area due to the new government regulations on Tobacco and Alcohol. Cigarettes are manufactured in mass quantity. Due to this mass volume, some quality issues are encountered during the manufacturing process. Therefore quality has become a salient factor for any manufacturing industry in economical world today. One of the common objectives of quality is manufacturing products within specifications. According to the above objective, this study is carried out from considering three major variables namely Pressure Drop, Circumference and Weight of cigarette. The mean and standard deviation are evaluated with respect to their specifications to assess the quality of cigarette for each three variables. After that correlations are calculated and identify the significance of these variables. Finally quality control charts are constructed to monitor whether the process is in control or not.

**KEYWORDS:** Cigarette Manufacturing, Circumference, Pressure Drop, Quality, Weight

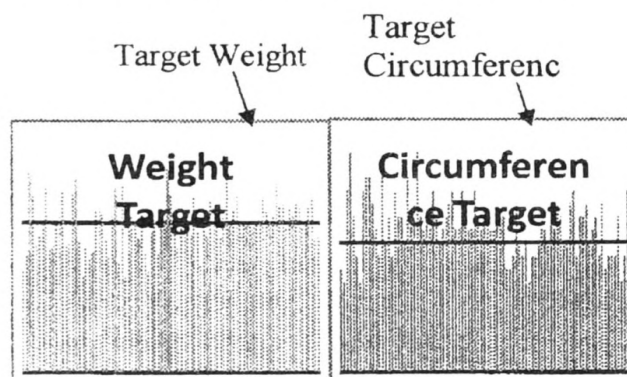
## INTRODUCTION

Today cigarette industry has become a very critical industry throughout the world due to the newest regulations on cigarette and tobacco products. As well as this industry is very controversial industry in this era. On one hand this industry contributes government revenue comprehensively, but on other hand this industry has caused to some health problems all over the world.

Cigarette industry is one of the major industries in Sri Lanka which has a significant contribution to the government revenue. As well, this industry generates many employment opportunities to rural population since this requires a lower level of education.

In today's industrial world, quality becomes an important factor for any manufacturing

industry. One objective of the quality is manufacturing products within specification.



**Figure 1: Target Levels**

Figure 1 has shown that some actual values are higher and some are lesser than the target levels. Therefore these deviations should have to be reduced to improve the quality. If any product goes beyond the specifications it will be considered as a waste. Machine breakdowns significantly affect to the manufacturing process. The major issue for above reason is carelessness of humans. If humans are conscious their task and responsibilities perfectly there will be no more any quality issues in manufacturing process.

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## Research Objectives

The objective of the research is to discover which variable(s) are significantly affected to the manufacturing process of cigarette, because it relates to the company's productivity. Furthermore, identify the root causes and alternative solutions for deviations of the specified targets.

## LITERATURE REVIEW

The quality is one of the demanding issues in today's businesses irrespectively of the size, legal position, private or government, service or manufacturing or any other base. Each and every business endeavors wish to improve the quality. And also enhancing the quality, in any means, is vital since it determines the economics progress of a country at large.

### Quality

Quality itself has been defined as fundamentally relational, 'Quality is the ongoing process of building and sustaining relationships by assessing, anticipating and fulfilling stated and implied needs'.

### Quality Assurance

Quality Assurance for short refers to a program for the systematic monitoring and evaluation of the various aspects of a project, service, or facility to ensure that standards of quality are being met.

Two key principles characterize Quality Assurance: "fit for purpose" (the product should be suitable for the intended purpose) and "right first time" (mistakes should be eliminated). Quality Assurance includes regulation of the quality of raw materials, assemblies, products and components; services related to production; and management, production and inspection processes.

It is important to realize also that quality is determined by the intended users, clients or customers, not by society in general. Even goods with low prices can be considered quality items if they meet a market need. Quality Assurance is more than just testing

the quality of aspects of a product, service or facility; it analyzes the quality to make sure it conforms to specific purpose.

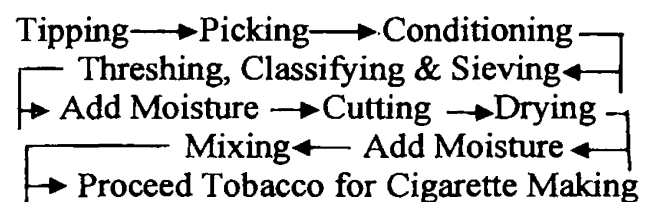
### Steps for Quality Assurance Process

- test previous articles
- plan to improve
- design to include improvements and requirements
- manufacture with improvements
- review new items and improvements
- test new items

The process for Quality Assurance is very rigorous and requires a lot of testing and planning. The team or firm has to comply with previous requirements, implement new requirements and improve the old item. Other than the following requirements, the team or firm has to comply with consumers needs.

### Processing of Tobacco

Tobacco leaves consist of two major parts called, Stem and Lamina. Therefore tobacco processing is done in above mentioned areas separately. The processes involved in the conversion of tobacco leaves for manufactruing cigarette as follows.



## METHODOLOGY

Research design is the science of planning procedure for conducting studies so as to get the most valid findings. The first step in research design is to identify the research problems. The ultimate purpose of this research is to suggest ways to improve the quality by finding the root cause for quality issues.

### Correlation between Variables

The Karl Pearson's correlation coefficient was used to measure the correlation coefficient between the variables.

Interpretation of the correlation coefficient is shown in Table 1.

**Table 1: Correlation Table**

Correlation	Negative	Positive
Small	-0.3 to -0.1	0.1 to 0.3
Medium	-0.5 to -0.3	0.3 to 0.5
Large	-1.0 to -0.5	0.5 to 1.0

**Significance of Correlations**

Hypothesis was developed to test the significance of correlation coefficient. This significance is checked by using p value. Now the probability that the observed correlation occurred by chance could be determined. That is, a significance test can be done. In this case, the mutually exclusive hypothesis is tested.

Null Hypothesis:  $r = 0$   
 Alternative Hypothesis:  $r < 0$

Where the common significance level of  $\alpha = 0.05$  is used.

**Quality Control Charts**

Two different quality control charts are used to identify whether the process is in control or not. They are, Individual Chart and Moving Range Chart. Individual chart displays the individual measured values. The Moving Range chart displays the difference from one point to the next. The formulas for two charts are follows:

Individual Chart  $UCL = \bar{X} + E_2\overline{MR}$   
 $LCL = \bar{X} - E_2\overline{MR}$   
 Moving Range Chart  $UCL = D_4\overline{MR}$   
 $LCL = D_3\overline{MR}$

The process is said to be out of control if any one of following tests is true.

- Test 01: 1 point more than 3 sigmas from the center line.
- Test 02: 9 points in a row on the same side of the center line.
- Test 03: 6 points in a row all increasing or decreasing.

**DATA COLLECTION AND ANALYSIS**

Data were collected in daily basis for each three variables for each three machines separately.

In analysis section, there were several steps which are carried out to enhance the overall efficiency of research. They are;

- compare the machine performances
- check the correlation between variables
- test the significance of correlations
- construct the quality control charts

**RESULTS AND DISCUSSION**

According to the descriptive statistics, there are some deviations occurred in every variable.

**Table 2: Descriptive Statistics Data**

	Pressure Drop	Circumference	Weight
<b>M1 Mean</b>	130.3	24.61	929.1
<b>SD</b>	3.281	0.02197	4.599
<b>M2 Mean</b>	128.2	24.61	928.8
<b>SD</b>	2.414	0.02743	4.704
<b>M3 Mean</b>	128.0	24.61	931.0
<b>SD</b>	1.448	0.01553	2.211

Table 2 shows that the pressure drop values of all three machines are below the specifications. Every circumference values are above the specifications. Weights also have not achieved the specifications. If we take standard deviations for three machines, machines 03's perform well comparing to other two. Machine 01 showed very bad performances due to the highest dispersion in each variable.

**Table 3: Correlation Values**

	Pressure Drop	Circumference
<b>M1 Circumference</b>	-0.299	
<b>Weight</b>	0.324	-0.031
<b>M2 Circumference</b>	-0.301	
<b>Weight</b>	0.113	0.004
<b>M3 Circumference</b>	-0.009	
<b>Weight</b>	0.211	0.126

According to the correlation values in Table 3, there is inverse relationship between pressure drop and circumference in every three machines. This implies that the increase of circumference will decrease the pressure drop. According to the Table 1, machine 01 and machine 02 shows the negative small and medium correlations

between pressure drop and circumference respectively. There is no relationship between pressure drop and circumference in machine 03. If we consider circumference and weight, there is no considerable relationship exist in three machines.

**Table 4: P Values**

	Pressure Drop	Circumference
M1 Circumference	0.004	
Weight	0.002	0.774
M2 Circumference	0.007	
Weight	0.322	0.971
M3 Circumference	0.935	
Weight	0.049	0.242

According to the Table 4, the P values are less than 0.05 for some correlations. Therefore Null Hypothesis ( $H_0$ ) is rejected. That means, there is a correlation between pressure drop and circumference in both machine 01 and machine 02. In machine 01's and machine 03's weight and pressure drop relationship are also significant. There is no significance relationship between circumference and weight in each machine.

**Table 5: Summary of Quality Control Chart**

		M1	M2	M3
Pressure Drop	Individual chart	*	*	*
	MR Chart	*	*	*
Circumference	Individual chart	*	*	*
	MR chart	*	*	✓
Weight	Individual chart	✓	✓	✓
	MR chart	*	*	*

Where; ✓ - Process is Control  
\* - Process is not Control

According to the Table 5, individual charts for weight records are in control in all three machines. The circumference performance in machine 03 is control in Moving Range Chart. But the pressure drop values are not in control in Individual and Moving Range Charts. Circumference Individual Charts and Weight Moving Range Charts are also not in control.

There are some relationships between pressure drop and circumference and

pressure drop and weight. However Individual charts for weight are in control and Individual charts for circumference are not in control for every three machines. According to these results, deviations of circumference are mainly caused to the deviations of pressure drop.

**Root Causes and Alternative Solutions**

There are three major root causes identified during this study for deviations in variables. They are carelessness of humans, problems in raw materials and high speed in machine 01.

To overcome those root causes, following solutions are beneficial for the company. They are,

- building up the awareness of the operators
- conducting the proper maintain procedure
- increase the frequency of sample checks

Cigarettes have to be manufactured within the specified target which company defined is needed to maintain the quality. To achieve the specified target, operators' involvement should be comprehensively important. Therefore, Executives have to guide and build operators' awareness thought out the manufacturing process to enhance the quality.

All the three machines have small but very important adjustable control devices. If they could monitor the above sensitive parts in machines during their manufacturing process, it is very easy to maintain the quality of products.

If sample-checking frequency is high, it means the efficiency and accuracy of the quality, reviewing process is more accurate.

**CONCLUSION**

The main objective of research is improving the quality with special reference to the achieving the defined specified target values. Doing the research it was found, that quality was declining due to malfunction of

employees and some machine faults. Therefore, quality can be improved if the company can achieve the targets for the relevant variables. Due to the lack of concern to the quality of the cigarettes, quality is dropping down. Therefore, by paying more attention to the quality than quantity, the management can enhance their quality. Otherwise, although the manufacturing department is producing large amount of cigarette quantity without considering the quality, overall the factory performance will go down, it would not lead and it might not be increase the profit.

If the company can maintain the better performances in circumference, it will cause to keep better pressure drop and it also causes to improve the quality of cigarettes.

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