

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING COURSE

DIPLOMA PROJECT

IMPLEMENTATION OF QUALITY CONTROL PROCEDURES

IN A METAL WORKING INDUSTRY

M / 756

BY: VASILIOU VASOS

JUNE 1996

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING
COURSE

DIPLOMA PROJECT

IMPLEMENTATION OF QUALITY
CONTROL PROCEDURES IN A
METAL WORKING INDUSTRY

M/756

VASILIOU VASOS

JUNE 1996

HIGHER TECHNICAL INSTITUTE	PROJECT NO 2597
----------------------------------	--------------------

**IMPLEMENTATION OF QUALITY CONTROL PROCEDURES
IN A METAL WORKING INDUSTRY**

by

Vasos Vasiliou

Project Report

Submitted to

the Department of Mechanical Engineering
of the Higher Technical Institute
Nicosia Cyprus

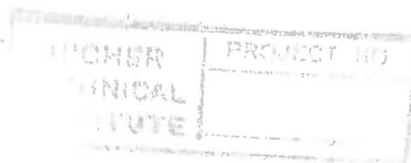
in partial fulfillment of the requirements

for the diploma of
TECHNICIAN ENGINEER

in

MECHANICAL ENGINEERING

JUNE 1996



CONTENTS

Acknowledgments

Summary

Chapter 1

Page

1. Quality Control and its importance	1
1.1 Meanings of quality	
1.2 Meanings of control	
1.3 Definition of quality control	2
1.4 Why is quality important?	
1.5 Object of quality control	4
1.6 Statistical process control	5
1.7 Continuous improvement quality tool	6
1.7.1 Cause and effect diagrams	
1.7.2 Flow Charts	
1.7.3 Pareto Charts	7
1.7.4 Run Charts	
1.7.5 Histograms	8
1.7.6 Scatter diagrams	
1.7.7 Control Charts.	9

Chapter 2

2. Existing Process Flow	10
2.1 General description of the industry	
2.2 Parts Department	11
2.2.1 End plate assembly	
2.2.1(a) Retaining ring	12

2.2.1(b) Mounting plate	13
2.2.2 Canister	14
2.2.3 End Caps	
2.2.4 Stirrups	
2.2.5 End Cap assembly	
2.2.6 Antidrain valve assembly	15
2.3 Assembly Department	
2.3.1 Oil Filter	
2.3.2 Air Filter	16

Chapter 3

3. Quality Control procedures used in the industry	25
3.1 Diagnostic stage	
3.2 Manufacturing stage	
3.3 Inspection	27
3.3.1 Incoming Inspection	28
3.3.2 Process Inspection	29
3.3.3 Final Inspection	
3.4 Inspection carried out during manufacture of the different parts of the filter	
3.4.1 Raw material inspection	
3.4.2 Flow chart	30
3.4.3 Retaining ring inspection	
3.4.4 Mounting plate inspection	31
3.4.4(a) Eccentricity test	
3.4.4 (b) Threading inspection	
3.4.5 End plate assembly inspection	32
3.4.6 Canister inspection	
3.4.7 End caps inspection	33
3.4.8 End Caps and antidrain valve assemblies inspection	

Chapter 4

4. Suggestions for improvement of the existing quality control practices	
4.1 Organizational-Structure	37
4.1.1 Teamwork	
4.1.2 Quality policy manual	
4.1.3 Employment of a Quality Control Manager	38
4.2 Suppliers- Inputs	
4.3 Design Stage	39
4.4 Manufacturing stage	40
4.5 Training of the staff	41
4.6 Cause and effect diagram	42

Chapter 5

5. Theory on SPC charts and Implementation of Quality Control procedures in parts Department	44
5.1 Common and special causes of variation	
5.2 Types of control charts	45
5.2.1 Variable Charts	
5.2.1(a) Average and range control charts	46
5.2.1(b) Average and standard deviation (σ) control charts	
5.2.1(c) Control Charts for individual measurements(\bar{X} ,moving R charts)	47
5.2.2 Attribute Charts	
5.2.2(a) Control Charts for proportion defectives (p-charts)	
5.2.2(b) Control Charts for count of defectives (np charts)	48
5.2.2(c) Control Charts for average occurrences-per-unit- (u charts)	
5.2.2(d) Control Charts for counts of occurrences per unit.	
5.2.2(e) Multiple characteristics charts	49
5.3 Control Chart Selection	
5.4 Subgroup equations for average and range charts	
5.5 Control limit equation for average and range charts	50

5.5.1 Control limit equations for range charts	
5.5.2 Control limit equations for average charts using-R-bar	
5.6 Check if the process is out of control-Special causes.	
5.7 Control limit equations for np charts	51
5.8 Control limit equations for C chart	52
5.9 Statistical analysis of process capability data	
5.9.1 Control chart method: variable data	
5.9.1(a) Process capability indices	53
5.9.2 Control chart method: attributes data	54
5.10 Implementation of SPC charts with calculations and analysis during manufacturing procedure in parts department	60
5.10.1 Chart Reference 1,2,3	
5.10.2 Chart Reference 1	61
5.10.3 Chart Reference 2	62
5.10.4 Chart Reference 3	63
5.10.5 Chart Reference 4	64
5.10.6 Chart Reference 5	65
5.11 Pareto Charts	66
5.11.1 Pareto analysis of defects observed during canister forming inspection	
5.11.2 Comments on the pareto diagram	67

Chapter 6

6. Cost of quality	68
6.1 Quality cost categories	
6.1.1 Prevention costs	
6.1.2 Appraisal costs	
6.1.3 Internal failure costs	69
6.1.4 External failure costs	
6.2 Calculations of the proposed methods of improvement of quality control procedures	70

6.2.1 Organizational-Structure	
6.2.2 Raw material (inputs)	
6.2.3 Design Stage	71
6.2.4 Manufacturing stage/inspection	
6.2.5 Training of the staff	
6.3 Comments on the cost estimation	72

Chapter 7

7. Conclusions	73
7.1 Company's benefits	
7.2 Personal benefits	74

Appendices

Appendix 1

Appendix 2

Appendix 3

References

ACKNOWLEDGMENTS

I would like to thank Mr. Vassos Messaritis, lecturer in HTI, for his assistance and guidance offered to me in carrying out the presented diploma project.

I wish also to thank Mr Ionas Angeli, lab assistant of 1st grade in HTI, for all the help, assistance and guidance offered to me.

Many thanks also to the management and staff of ALCO industry who supplied me with necessary information relevant to the subject of the diploma project.

Finally I want to express my extremely love to my cousin Savvi Savva who typed the whole content of the diploma project.

SUMMARY

The objectives of this project are to study quality control theory, to investigate the quality control procedures used in a metal working industry and to suggest methods of improvement of the existing quality control practices. Also the effectiveness of the suggested techniques should be tested by carrying out sampling measurements and the process capability should be measured. Finally an economic comparison between the existing and proposed quality control procedures and techniques should be carried out.

The whole content of the project is divided into seven main chapters.

In chapter 1 an introduction to quality control and its importance was made.

In chapter 2 a description of the main processes used at the factory was carried out.

In chapter 3 an investigation of quality control procedures and techniques already used at the parts department of the factory was carried out.

In chapter 4 suggestions for improvement of the existing quality control practices are described.

In chapter 5 different processes carried out in parts department were selected, and tested if they were in a state of statistical control. The process capability was also measured by variable and attribute data to find out the degree of which the products meet specifications.

In chapter 6 the various quality costs are defined and the cost of recommended techniques is evaluated.

In chapter 7 the final conclusions of the project were carried out.