Quality Inspection System in TirupurGarment Industry

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ABSTRACT

The Knit Capital city Tirupur is contributing about half of the garment export of the country. In Export business quality control is a process that ensures customers received products free from defects and meet the buyer's needs. The Quality inspection system helps to identify the faults at the earliest possible stages of production and maintain high quality. The present study has made an attempt to analysis the quality inspection system of the Tirupur Garment Industry. The main objectives of the study are: a) to study the importance of quality inspection system in Tirupur garment industry.b) to analyze the quality inspection system of selected garment industries in Tirupur. c) to provide suggestion to improve the quality system. In this study, analytical research design has been adopted. Convenience sampling technique has been used to collect the data. The study has used secondary data which has been collected from final inspection reports of different buyers and different styles. 200 inspection reports from 20 factories in Tirupur garment industry are taken as the sample for this study. Percentage analysis is used to describe the garment inspection parameters of the selected 20 companies. Factor analysis is used to identify the underlying factors of parameters which determine the quality of the garment. Discriminant analysis is used to analysis the two groups of companies such as high mean scores in specs and low mean scores in specs with the seven predictor variables. The present study concluded with that the measurement quality parameter highly depends upon the quality of knitting, dyeing and packing. The quality parameters appearance of the garment and workmanship are very poor in all the companies irrespective of styles of the garments. For attaining good quality and avoid the rejected level of products the companies concentrate more on the above said quality parameters.

Key words: Quality Control, Quality Inspection System, Tirupur Garment Industry, Garment Inspection

1. INTRODUCTION

Tirupur, the heartland of the Knitwear industry in India has 44.29 per cent in all India market sharesof knitwear exports and generate direct employment for over 300,000 persons. Quality is of prime importance in any business. Customers demand and expect value for money. Garment industry has a complex supply chain where garment makers source materials, stitch garments and sell goods to retailers. Through buyers and retailers quality garments reach to end user located all over the world. No wearers will buy a garment with poor quality and visible defects. So buyers and retailer knowingly do not purchase a product that does not meet the quality requirement. In the garment industry quality control is practised right from the initial stage of sourcing raw materials to the stage of final finished garment. For apparel industry product quality is calculated in terms of quality and standard offabric construction, colour fastness, surface designs, measurements and packing methods and the final finished garment products. However quality expectations for export are related to the type of customer segments and the retail outlets. There are a number of factors on which quality fitness of garment industry is based such as - performance, reliability, durability, visual and perceived quality of the garment. Quality conscious buyers have a strong quality inspection system in place to avoid purchasing of defective goods.

In the Garment industry inspection can be defined as the visual examination or review of raw materials, partially finished components of the garments and completely finished garments in relation to some standards, specifications or requirements, as well as measuring the garments if they meet the required measurements. In each section of a garments industry, there are arrangements for inspection. The main purpose of inspection is to identify the faults at the earliest possible steps for production of garments and earlier the defects will be detected lesser will be the wastage of time and money. The present study has made an attempt to analysis the Quality Inspection System of Tirupur garment industry. The study has also tried to analyze the important quality parameters of the selected companies and provide suggestion to improve the quality of the garments.

2. REVIEW OF LITERATURE

Only limited studies are made in quality inspection systems. The present study tries to attempt the evaluation of inspection system of the Tirupur garment industry. The following literature studies are helpful for the present analysis.

The inspection that is done for controlling the quality of garments is mainly meant to examine in bare eyes. Checking of the fabrics of garments, sewing, button, thread, zipper, measurements of garments etc. with the standard process is called the inspection. For conducting successful and meaningful inspection, steps can be adopted as per the 'inspection loop' described below. First, identify defects through inspection, inform about the defects to the concerned person, identify the causes of defects, and rectify them.For inspection, to be effective, the entire inspection loop must be completed**[1].**

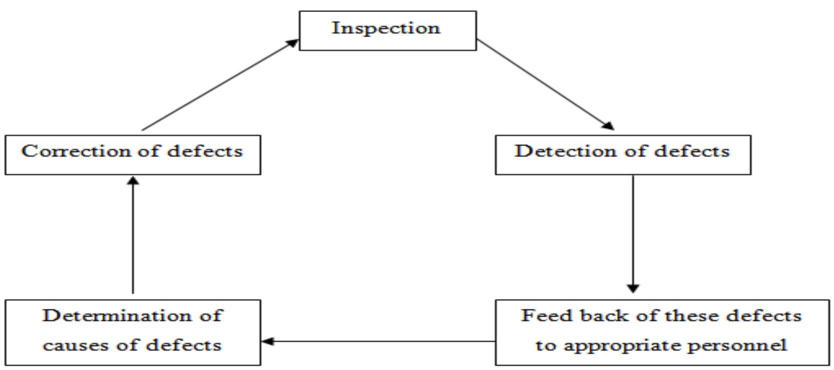

Fig. 1. Garment Inspection Flow Chart

FABRIC INSPECTION

Just the moment for production of garments, fabric is required, which is the main element of garment. Local or foreign that means whatever be the country of origin of fabrics, the quality of fabrics should be well judged before purchasing of fabrics, because, if not so, both time and money may be wasted. Specially, due to the low-grade fabrics, burden of irreparable loss may have to be borne. Some factories do inspection after reaching the fabrics at their factories. But it is wise to do the fabric inspection at seller's factory.There are various fabric inspection systems:

- 10-Point System.
- Graniteville "78" system.
- Dallas system.
- 4- Point system.

In Tirupur most of the export units follow the 4-point system and 10-point system.

FOUR POINT SYSTEM

The 4-Point System is also called the American Apparel Manufacturers (AAMA) point-grading system for determining fabric quality. It is widely used by producers of apparel fabrics and is endorsed by the AAMA as well as the ASQC (American Society or Quality Control).

The 4-Point System assigns 1, 2, 3 and 4 penalty points according to the size and significance of the defect. No more than 4 penalty points can be assigned for any single defect. Defect can be in either length or width direction, the system remains the same. Only major defects are considered. No penalty points are assigned to minor defects.

In this system, one should inspect at least 10 per cent of the total rolls in the shipment and make sure to select at least one roll of each colour way. Fabric defects are assigned points based on the following Table.2.1. Total defect points per 100 square yards of fabric are calculated and the acceptance criteria is generally not more than 40 penalty points. Fabric rolls containing more than 40 points are considered "seconds".

Table:2. 1 Penalty Point for Fabric Detects

Size of defect	Penalty
3 inches or less	1 points
Over 3 but not over 6	2 points
Over 6 but nor over 9	3 points
Over 9 inches	4 points

10 POINTS SYSTEM

The 10-point method is a point per fault system, which gives a measurable guide to quality grading per roll. In 1955s "Ten Points" piece goods evaluation was adapted by the Textile Distributors and National Federation of Textiles**[2].**Penalty points are assigned as per the following:

Table:2.2 Penalty Point for Fabric Detects

Warp Defects	Penalty Points
10 -35 inches	10 points
5-10 inches	5 points
1-5 inches	3 points
Upto 1inches	1 points
Filling Defects	**Penalty Points**
Full width	10 points
5 to half the width of Fabric	5 points
1-5 inches	3 points
Upto 1inches	1 points

3. SIGNIFICANCE OF THE STUDY

Quality inspections are measures aimed at checking, measuring, or testing of one or more product characteristics and to relate the results to the requirements to confirm compliance. This task is usually performed by specialized personnel and does not fall within the responsibility of production workers.

Globally, Tirupur garment industry has to face more competition. Many countries such as China, Bangladesh, and Vietnam are big competitors. So Tirupur garment industry has to focus on good quality of the product to hold the buyer and long-termbusiness. Inspection system ensures the quality of the product. Hence, inspection system hasplayed a vital role in success of Tirupur garment industry.

4. SCOPE OF THE STUDY

- In the proposed study, my investigation focuses on the quality inspection system in Tirupur Garment industry.
- The study is restricted to the limited factories in Tirupur Garment industry.
- The study will be useful for the selected companies to understand their quality standards and find their weak area in quality.
- Sample size is limited to 20 selected companies, which are export units, selected based on their turn over. Their yearly turnover is more than 50 crores.
- The study was conducted only in Tirupur city, which compelled to neglect several potential analysis samples outside this area, so the findings may not be applicable to any other cities.

5. OBJECTIVES OF THE STUDY

- To study the importance of quality inspection system in Tirupur Garment industry.
- To analyze the quality inspection system of selected garment industries in Tirupur.
- To provide suggestions to improve the quality system.

6. SOURCES OF DATA AND METHODOLOGY OF THE STUDY

In this study, analytical research design has been adopted. Convenience sampling technique has been used to collect the data. 200 inspection reports from 20 factories in Tirupur apparel industry are taken as the sample for this study. The study has used secondary data which has been collected from final inspection reports of different buyers and different styles.

The research tool used in this study is inspection reports of 20 selected companies. Percentage analysis is used to describe the garment inspection parameters of the selected 20 companies. Factor analysis is used to identify the underlying factors of parameters which determine the quality of the garment.Discriminate analysis is used to present the relationship between lower Specs group of companies and higher Specs group of companies with the quality parameters viz., Appearance of the garment, Knitting, Dyeing, Workmanship, Printing & Embroidering, Packing and Accessories.

7. RESULT AND DISCUSSION

In this section we have presenting the analysis of the 200 inspection reports of 20 selected companies with different 10 styles of garments. Descriptive statistics analysis is used to describe the garment inspection parameters of the selected 20 companies. Factor analysis is used to identify the underlying factors of parameters which determine the quality of the garments. Discriminate analysis is used to present the relationship between lower Specs group of companies and higher Specs group of companies with the quality parameters Appearance of the garment, Knitting, Dyeing, Workmanship, Printing & Embroidering, Packing and Accessories.

7.1. SUMMARY STATISTICS OF GARMENT INSPECTION PARAMETER

The present study has made a descriptive statistic of Arithmetic Mean, Standard Deviation and Coefficient of Variation for the analysis of 8 quality parameters of the various styles of the 20 company's garments. The results are presented in the following Table: 7.1

TABLE:7.1.SUMMARY STATISTICS OF GARMENT INSPECTION PARAMETER

Sl.No.	Quality Parameter	Min	Max	Mean	SD	CV(%)
1.	Appearance	1	5	3.99	0.85	21.3
2.	Knitting	3	5	4.56	0.59	13.0
3,	Dying	1	5	4.56	0.66	14.5
4.	Workmanship	1	5	3.34	0.99	29.6
5.	Printing & Embroidery	1	5	4.04	1.03	25.5
6.	Accessories	3	5	4.76	0.51	10.8
7.	Packing	1	5	4.48	1.03	23.0
8.	Specs	2	5	4.53	0.81	17.9

The appearance of the different styles of garment in 20 companies is moderate value of 3.99%, the standard deviation of 0.85 and coefficient of 21.3% with 4.0 point scale standard. It shows that the companies have to concentrate more on the good looking of the garment. The knitting of the different styles of garment in 20 companies are good with the mean value of 4.56%, the standard deviation of 0.59 and coefficient of 13.0% with 4.0 point scale standard. The dyeing of the different styles of garment in 20 companies are good with the mean value of 4.56%, the standard deviation of 0.66 and coefficient of 14.5% with 4.0 point scale standard.

The workmanship of the different styles of garment in 20 companies are moderate with the mean value of 3.34%, the standard deviation of 0.99 and coefficient of 29.6% with 4.0 point scale standard. It infers that the companies should take care in workmanship activities particularly cutting, stitching of the garments and proper handling of the garments. The printing & embroidery of the different styles of garment in 20 companies are good with the mean value of 4.04%, the standard deviation of 1.03 and coefficient of 25.5% with 4.0 point scale standard. The accessories of the different styles of garment in 20 companies are almost excellent with the mean value of 4.76%, the minimum standard deviation of 0.51 and coefficient of 10.8% with 4.0 point scale standard. It infers that there is uniformity among the companies to maintain high quality of accessories of the garments.

The packing of the different styles of garment in 20 companies are good with the mean value of 4.48%, the standard deviation of 1.03 and coefficient of 23.0% with 4.0 point scale standard. The specs of the different styles of garment in 20 companies are more than the scale value of good with the mean value of 4.53%, the standard deviation of 0.81 and coefficient of 17.9% with 4.0 point scale standard. The result shows that the parameter specs plays a vital role in quality of the garments unanimously.

7.2. FACTOR ANALYSIS

Using all the 8 quality parameters viz., Appearance of the garment (X1) Knitting (X2),Dyeing(X3), Workmanship(X4), Printing & Embroidering(X5) Packing(X6) andAccessories(X7)) and Specs(X8), factor analysis is performed in order to group these variables onpriority basis based on the strength of inter-correlation between them , called 'Factors' and cluster theses variables in to the factors extracted.

To measure the sample adequacy for using Factor Analysis the KMO and Bartlett's test of sphericity has been performed.The internal consistency is estimated by Crombach's alpha reliability coefficient normally it ranges from 0 and 1. The Crombach's alpha value for 8 quality variables is 0.7, which is higher than 0.6, therefore it suggests a satisfactory reliability.

Table: 7.2Kmoand Bartlett's Test

Kaiser-Meyer-Olkin	Measure of Sample Adequacy	0.57
Bartlett's test of Sphericity	Approx. Chi-square	119.47
	DF	28.00
	Sig	0.00

Table: 7.3 Reliability Statistics

Cronbach's Alpha	No of items	No of Variables
0.701	200	8

The Varimax rotation is used to increase the quality of interpretation of the factors. The results are given in the following Table:7.4.

Table: 7.4 Variables

Sl.No	Variables	Factors			Communality
		1	2	3	
1	Appearance	-0.15	**0.66**	0.18	0.49
2	Knitting	0.29	0.02	**0.70**	0.57
3	Dyeing	0.27	-0.40	**0.57**	0.56
4	Workmanship	**-0.73**	-0.10	-0.13	0.55
5	Printing & Embroidery	0.15	**0.64**	-0.04	0.44
6	Accessories	**0.76**	-0.09	0.09	0.59
7	Packing	-0.15	0.26	**0.68**	0.55
8	Specs	0.51	**0.52**	-0.03	0.53
	Eigen value	1.58	1.36	1.33	4.27
	% varexp	19.75	17.02	16.61	53.38
	Cum % V exp	19.75	36.77	53.38	

Table: 7.5 Clustering of Variables

Factor	Variables	Rotated Factor Loadings
I(19.75%)	Workmanship-X4	**-0.73**
	Accessories-X6	**0.76**
II(17.02%)	Appearence-X1	**0.66**
	Printing & Embroidery-X5	**0.64**
	Specs-X8	**0.52**
III(16.61%)	Knitting-X2	**0.70**
	Dyeing-X3	**0.57**
	Packing-X7	**0.68**

Three factors were identified as being maximum percentage variance accounted. The 2 variables namely Workmanship(X4) and Accessories(X6) were grouped together as Factor I and accounts 19.75% of the total variance. The 3 variables namely Appearance(X1), Printing & Embroidery(X5), andSpecs(X8) constituted the Factor II and accounts 17.02% of the total variance. The 3 variables namely Knitting(X2), Dyeing (X3), Packing (X7) constituted the Factor III and accounts 16.61 % of the total variance. Thus, the factor analysis condensed and simplified the 8 quality variables and grouped into 3 factors explaining 53.38% of the variability of all the 8 quality variables.

The result shows that the workmanship(X4) and Accessories(X6) are grouped together as Factor I and these two factors contributing 19.75% of the total variability of 53.38 to the quality of the garment. The higher negative value of the workmanship implies that almost all the companies facing the problem of poor quality in workmanship activities particularly stitching and handling of garments. The high positive value of Accessories implies that in most of the 20 companies maintain quality in it. The reason behind is that all the companies purchasethe accessories from the nominated sellers.

7.3. DISCRIMINANT ANALYSIS

Discriminant analysis is used to analysis the two groups of companies such as high mean scores in Specs and low mean scores in Specs with the seven predictor variables includes Appearance(X1), Knitting(X2), Dyeing(X3),Workmanship(X4), Printing &Embroidery(X5), Accessories(X6) and Packing(X7).

Table:7.6 Mean Score

Explanatory Variables	Companies with Mean Specs Score	
	Lower (N1=10)	Higher (N2=10)
Appearance-X1	3.99	3.99
Knitting-X2	4.31	4.8
Dyeing-X3	4.36	4.75
Workmanship-X4	3.79	2.89
Printing & Embroidery -X5	3.95	4.13
Accessories-X6	4.53	4.99
Packing-X7	4.2	4.76

Table: 7.7 Tests of Equality of Group Means
Univariate ANOVA

Explanatory Variables.	Wilk's Lambda	F (Df=1, 18)	Sig
Appearance-X1	1.00	0.00	1.00
Knitting-X2	0.34	34.35**	0.00
Dyeing-X3	0.44	22.48**	0.00
Workmanship-X4	0.61	11.61**	0.00
Printing &Embroidery -X5	0.90	2.04	0.17
Accessories-X6	0.64	10.08	0.01
Packing-X7	0.52	16.76**	0.00

*-Significant at 5 % level

The above Table.7.7shows that there is significant difference in the mean scores between the two groups of low Specs value companies and high Specs value companies with respect to Knitting (X2), Dyeing(X3), Workmanship(X4) and Packing(X7). It implies that these factors affect the quality of the measurement of the garments. The low value Specs companies must concentrate more on setting the loop length and yarn counts selection. In dying point of view the companies should follow proper heat setting method. For the better quality in workmanship the companiesmust concentrate no. of lays and stitching machine pressure. Usually the methods of ironing affect the specs of the garments. Using proper method of ironing leads to high measurement quality of the garments.

STEP WISE CANONICAL DISCRIMINANT FUNCTION FITTED:

D = -45.812 - .385 X1 + 4.128 X2 + 1.428X3 + .068 X4 + 1.799 X5 + .884 X6 + 2.308 X7

Test Functions

Eigen value: 5.729

Percentage of variation explained: 100

Wilks Lambda = 0.149

Chi-square=27.642* DF = 7p = .000

Canonical Correlation: 0 .923

CLASSIFICATION OF INDIVIDUAL

Using the Discriminant function fitted and the observed predictor variables of the companies, the companies are classified and the correct % of classification is presented on Table.7.8

Table: 7.8 Percentage of Correct Classification by Using Discriminant Function on the Data

Companies With	Lower Score	Higher Score	Total
Lower Specs Score	10	-	10
Higher Specs Score	-	10	10

From the above Table.7.8it is observed that out of 10 companies with mean specs score lower, all the 10 (100 %) were correctly classified; out of 10 companies with mean specs score higher, all the 10 (100 %) were correctly classified. Hence the percentage of correct classification is (20/20)*100 % or 100 % of original grouped cases correctly classified. The percentage of correct classification of companies using the observed observation clearly indicates adequacy of the model in discriminating from the two groups namely companies with lower mean score and companies with higher mean scores.The relative importance of each predictor variables in discriminating from the two groups is obtained and the results are presentedbelow in Table. 7.9

Table: 7.9 The Relative Importance of Variables in Discriminating from the Groups

Explanatory Variables	Importance Value of the Variable (IJ)*	Relative Importance(RJ)%	Rank
Appearence-X1	0	0.0	7
Knitting-X2	2.0229	43.4	1
Dyeing-X3	0.5569	11.9	3
Workmanship-X4	0.0611	1.3	6
Printing & Embroidery-X5	0.3238	6.9	5
Accessories-X6	0.4064	8.7	4
Packing-X7	1.2923	27.7	2
Total	4.6634	100.0	

*-(Abs Mean Diff Between Groups*Disc Coefficient)

It is seen from the above Table.7.9that three variables namely Knitting-X2, Packing-X7, and Dyeing-X3 are substantially important variable in discriminating between the two groups namely companies with lower Specs score and companies with higher Specs score among 20 companies.

8. SUGGESTIONS

Based on the results of the present study the following suggestions are put forth to the companies for enhancing the quality of the garments and avoid unwanted claims from the buyers.

The present study confirms that the companies should concentrate the quality parameter namely appearance of the garment for enhancing their quality of the product. The following points are to be taken into consideration for fair appearance of the garments:

- Selection of yarn count
- Setting loop length in knitting
- Advanced dyeing technologies such as soft flow and airflow
- Proper ironing and packing methods

For improvement of workmanship the companies should provide proper training to the laborers and frequent internal inspection by the supervisors at the time of production process to avoid workmanship mistakes.Unwanted pressure to the employees to complete the order will affect the workmanship quality. Proper production schedule can avoid last minute pressures of the employees.

The Discriminant analysis of the study shows that the companies with lower Specs score and companies with higher Specs score are discriminatingly affected by the variables Knitting (X2), Packing (X7), and Dyeing (X3). For improving the quality of the measurement, the companies should consider the following things:

- To avoid outof tolerance with measurement, companies should concentrate more on cutting and stitching in production area and also knitting, dyeing and packing.
- Avoid more no. of lays at the time of cutting,it will affect the measurement of the garment.
- Poor knitting and heat setting technologies will affect the measurement of the garment.
- Avoid unwanted stretches at the time of ironing and packing. It will also affect the measurement of the garment.

10. CONCLUSION

Quality plays a vital role in apparel business. Buyers are interested to buy the garment with good quality.The companies should give more importance to the quality parameters than the profit. Good relationship with buyer is much needed to ensure the growth of the business. Quality inspection system helps to maintain the good relationship with the buyer.Once the buyer decides that the quality of the particular company is not good,he will move to next company.To hold the buyer and for sustainable business, companies should concentrate with quality parameters such as appearance of the garment, knitting, dyeing and packing.

The present study concludes that the measurement quality parameter(Specs) highly depends upon the quality of knitting, dyeing and packing. The quality parameters i.e. appearance of the garment and workmanship are very poor in all the companies irrespective of the styles of the garments. For attaining good quality and avoid the rejected level of products, the companies should concentrate more on the above said quality parameters.

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