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*Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird*
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# STATISTICAL QUALITY CONTROL PRACTICES IN CLOTHING INDUSTRY

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***Abstract:*** *The paper presents a quality improvement plan based on a complex product analysis, using statistical tools. Employing specific techniques and monitoring the production flow, we managed to increase the process quality for trousers manufacturing.*
***Key words:*** *quality, clothing industry, statistics, inspection*

## 1. INTRODUCTION

Nowadays, we cannot imagine a world without textiles, and especially without quality textiles. Thus, all the producers are trying to offer to their clients the best quality items, making efforts to assure this quality level with specific practices and using statistical control techniques (Kayaalp & Erdoğan, 2009).

The increasing competition in the clothing market has forced manufacturers to put into practice the concept of Total Quality and to adopt Zero Defects policy. If in the past were accepted levels of 1.5 or 4% defects, today there are companies that measured their production error in percentages per million (Atilgan, 2007). Since obtaining a high quality 100% is impossible just by inspection, the actual direction is to reduce the importance of product checking and enlarge on the process control.

This paper presents an application of Quality Management principles for “trousers" product, which is concluded through an action plan for improving product quality level. In this study quality management tools, like flow chart, histograms, Pareto chart, cause and effect diagram are used to establish specific inspection methods adapted for each defect type and to prevent their appearance in product.

## 2. PRODUCT SPECIFICATIONS

Our case study was achieved based on trousers manufacturing process in a famous clothing company from Sibiu. The analyzed item is a five-pocket trouser, with two jeans type front side-pockets, 0.2 and 0.6 cm stitched and two back-pockets stitched around. The product has also a coin pocket on the right front-pocket back piece and a basque on the backside. Hem is stitched and waistband is lined. Model specifications included model card, graphics design specifications, final dimensions and tolerances admitted to final dimensional inspection (fig. 1) (Brad, 2007).

## 3. PROCESS ANALYSIS AND CONTROL SYSTEM

The technological process is presented below using a flow chart. In this graph, operations involved in developing the product and inspections are highlighted. The self-control and control in chain are reported near the points of fixed-term and final inspection, in addition with supervisors and hierarchical control (fig. 2) (Brad, 2007).

The three positions of checking points in the manufacturing process are established based on client requests regarding the pants control system, and complexity of critical operations. These operations are characterized by a required quality close to the quality level of machines or workmanship, being the probable location of defect causes. First control point is placed before the waistband had been topstitched, the second checkpoint is fixed before washing, and the third one is established after the pressing operation. In this case, final and the second intermediate inspection are grouped in a centralized exam.

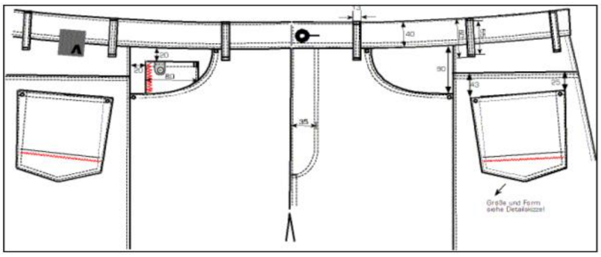

Fig. 1. Technical sketch for the upper of trousers

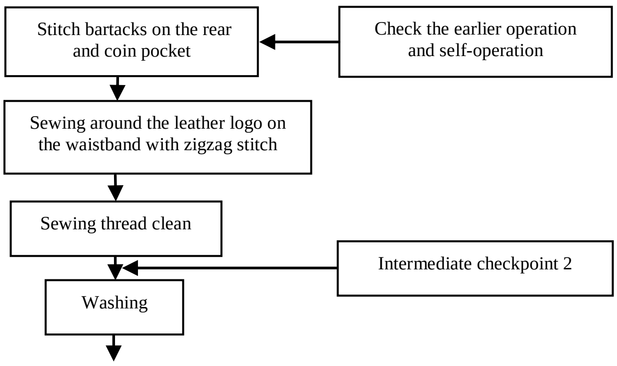


Fig. 2. Part of flow chart for trousers, including control points

Each control point has specific inspection procedure, which indicates the rules and the order of exams. *For intermediate checkpoint 2*, the procedures are the following: the inspector must check the sizes of waist, hip and the inseam using a random sampling basis, for at least 20% of the lot, but not less than one piece. Tolerances used are specified, unless the accepted deviation is ±1 cm for the main dimensions. All the products are examined starting from the inseam making till the final operations in the sewing stage, before the washing. At the beginning of a new order, the inspector needs card matching, product description, product design, model approved, product labels, table sizes, and verify the following: inseam operation, lap seam stitching, bartacks setting (strap, pockets, slit), buttonholes, buttons positioning and sewing, decorative topstitch on the waistband, side seam, applied back pocket, matching after card for stickers, buttons, hooks, threads, and product dimensions as the table sizes - waist, hip, inner length. Identify defects with stamps. He must store nonconformities in special places on defect typology and verify products after defects remedying; notify any defects, undetected at checkpoint 1; record all non-conformities found in the checklist. Inform the supervisor, the inspector from first point and find solutions with them to remedy the defectives; inform the hierarchical head of all the found quality problems and propose sanctions to the operator, which led to the production of non-compliant.

In these points, data were recorded in check sheets and daily statistics can be done for one month. Collected data were grouped in following classes of defects: contamination, shade, finishing, workmanship and fabric's defects. For these defects categories, the percents defective for each point were represented in a specific chart, after defects analyses (Brad, 2007; Mehta, 2008). Taking into account all the types of workmanship defects and arranging the numbers of occurrence of defects in descending order, Pareto charts for each control exam were designed (fig.3).

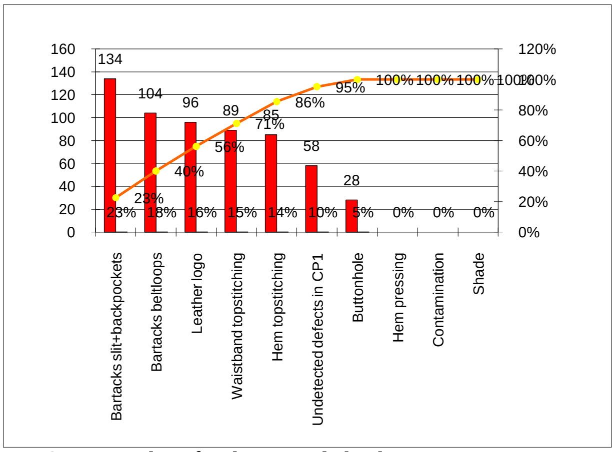


Fig. 3. Pareto chart for the second checking point

Pareto chart is a tool that helps identify those defects that cause most problems and acting first on those defects, quality improvement can be made (Chuter, 2002). In the Pareto chart shown in fig. 3, the most important defects that were detected in Control Point 2 are the bartacking, leather logo sewing and waistband topstitching. For bartacks errors, the main cause is physical and moral usage of bartacking sewing machines, imposing new acquisitions. To prevent defects in leather logo stitch, the operators must be trained or replaced. By automating the waistband stitching, the number of faults in this operation will decrease. For first class of defects, a Fishbone diagram can be done, emphasizing the potential causes which can be managed to the analyzed effect and nonconformity.

Grade 1 defect analysis can be realized using cause-and-effect diagram, which reflects the relationships among processes, materials, and variations within products (Kadolph, 2007). In fig. 4 a Fishbone diagram is contrived for the most important flaw detected in CP 2 - bartacking errors on slit and back-pockets. The root causes considered in this data analysis are machine, people, material, method, system, for that the secondary causes are identified. This analysis is a basis for corrective and preventive measures, which are designed for quality improving.

In our case, as prevention measures for CP 1 recorded defects, it is recommended to automate the fitted waistband operations, slits processed and back pockets processing, but also creating a new checkpoint after slits preparation and pockets processing. In order to detect faults faster and to remedy easier, with minimal cost, statistical control techniques may be applied in this supplementary control point.

The setting up of a new interim checkpoint that allow fair sharing of operations and the amount of labor between intermediate checkpoints 1 and 2 is sustained by the Pareto chart drawn for control point 3, which is made after product finishing. One can note that 55% of defects are unreported defects on the first control point, indicating that at this point, the inspection is not effective. In stage 3 a large defects proportion is occupied by the fabric defects. To improve product quality in terms of raw material it can be recommended to employ an automatic defect detection system.

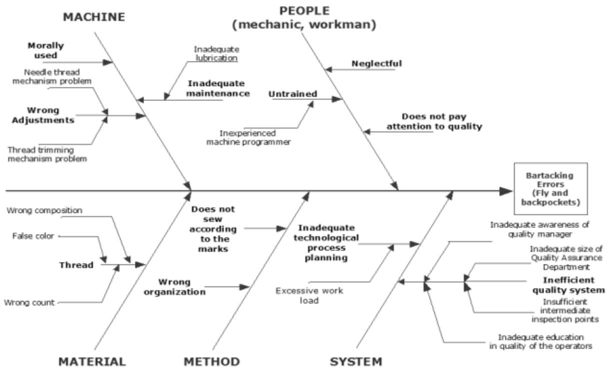


Fig. 4. Fishbone chart for the second checking point

The next flaw is twisted leg. The main cause of this defect consists in an inadequate spreading and a lack of inspection after cutting. Fig. 5 presents production charts with defects and their percentages for March 2007 trousers manufacturing, which confirms earlier assumptions about the percentage of defects in the three control points. Analyzing these graphs together with Pareto charts, we noticed a large number of defects that passes undetected by the control points 1 and 2, observed only in the final inspection, requiring the implementation of above recommendations.

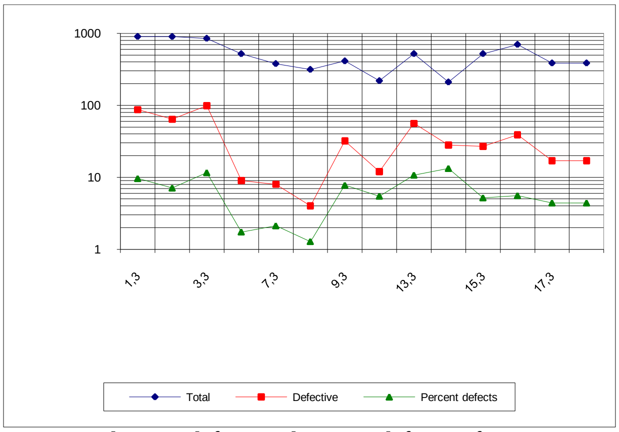


Fig. 5. Production, defects and percent defective for trousers

## 4. CONCLUSION

The paper presents a quality assurance methodology, including statistical techniques that can be adjusted depending on product destination and required quality levels. There must be a balance between the imposed quality and quality costs, which affects the control structure for product quality control. Based on statistical techniques, the control system can be redesigned and improved continuously.

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