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PRACTICAL ASPECTS OF QUALITY ASSURANCE AND IMPROVEMENT IN TROUSERS MANUFACTURING PROCESS

Raluca Brad, Remus Brad
Lucian Blaga University of Sibiu, ROMANIA

Corresponding author: BRAD Raluca, raluca.brad@ulbsibiu.ro

Abstract: The paper presents a case-study for trousers manufacturing and more specific, an analysis of quality control system and action plan for improving the quality level. Using data collected in specific check points, the statistical tools as control chart, Pareto diagram, flow chart, histograms, and Fishbone diagram are applied in order to adjust the manufacturing process and improve the quality.
Key words: quality assurance, control system, trousers, quality improvement

1. INTRODUCTION

In the clothing industry, quality assurance requires the existence of a control system to provide timely information about the manufacturing process and in order to promptly and effectively intervene for removing the causes of potential disturbance. In the same time, using specific quality management tools and statistical techniques, we can establish solutions to improve product quality in a fundamental way [5]. The paper presents an application of quality assurance principles in the case of a pants manufacturer in order to improve product and process quality.

2. PRODUCT AND PROCESS ANALYSIS

In the first stage, style quality specifications are considered in the case of a five-pocket trouser, two jeans type front sidepockets, 0.2 and 0.6 cm stitched and two backpockets stitched around. A coin pocket and a basque on the backside completes the style. Hem is stitched and waistband is lined. Based on style characteristics, technological specifications are designed (Table 1).

Table 1. Style specifications

Season: zzz Tr. zzz Order: zzz Art. zzz	Style no. zzz	
Element:	Processing:	Observations:
Front sidepockets	2 jeans pockets	Sewn with the pocket bags, right sides together
Front sidepockets - stitching	2 needles	
Front coin pocket	On the right frontside, 80 mm width	
Frontside, fly – topstitch	No. 15	
Frontside, fly – closing	Zipper – metal	
Backside - inset	Hidden seamless	Basque material backed with pocket lining Inset with 2 needle stitch seam on the back trousers
Front pockets	2 stitched pockets	
Front pockets – form and position	See the model sketch	
Seams - front and back crutch seams	Topstitch with 2 needles	
Seams – inseam	Without topstitch	
Seams – outseam	Completed	1 x slim edge
Waistband – type	Doubled waistbands	
Waistband – width	40 mm	

Waistband – closing	Button + buttonhole	
Waistband – topstitch	Upside 1 x with slim seam allowance; Down 2 needles topstitch	
Insurance - rivets	8 rivets at the frontpockets and rearpockets	
Belt loops - No.	6	
Belt loops - length	60 mm	
Belt loops – opening	55 mm	
Belt loops - width	13 mm	
Belt loops - bartack	Up and down	
Belt loops - stitch	2 needles	
Bottom – type	stitched hem	
Hem – width	15 mm	Topstitch 1 x
Labeling	"Tag" with nits to pocket coin	
Processing the two rear pockets	2 decorative seams on both back pockets	Without a stitch on the back pockets and plaid stripes given
Logo	Label (“Back – Tag”)	
Pocket facing	Sewn to the pants front	
Place the hanger	Place the hanger as five-pocket (folded)	

Technical documents and control procedures were created. All nonconformities related to the trousers were established and classified using 5 classes: fabric nonconformities, manufacturing, finishing, shade and contamination [4]. Final dimensions and control limits for final control were also established, as presented in table 2.

Table 2. Admitted tolerances to final dimensional inspection

Part	Tolerances
Waist	±1 cm
Waist to unwashed trousers	±0,5 cm
Inseam	±1 cm
Inseam to unwashed trousers	±0,5 cm
Hip	±1 cm
Hip to unwashed trousers	±1 cm
Bottoms	±1 cm
Bottoms to unwashed trousers	±0,5 cm
Pulp	±1 cm
Pulp to unwashed trousers	±0,5 cm
Waistband width	±0,2 cm
Bottom width	±0,2 cm (left and right symmetry)
Belt loops width	±0,2 cm
Belt loops length	±0,2 cm
Inset width near the outseam	±0,2 cm (left and right symmetry)
Inset width on the middle of the backside	±0,2 cm (left and right symmetry)
Front sidepocket	±0,2 cm
Distance from the waistband to the opening	(left and right symmetry)
Coin pocket - width / height	±0,2 cm
Back pocket - width / height	±0,5 cm (left and right symmetry)
Back pocket - distances to the outseam and the middle of the back	±0,3 cm (left and right symmetry)
Double top stitching	Differences are not allowed (automatic)
Crosseams matching	Differences are not allowed
Thickness stitching on seams	Differences are not allowed, Provided: 120: 4.0 stitches / cm, 80: 3.5 stitch / cm 50: 3.0 stitches / cm, 30: 2.75 stitch / cm
Pocket bag finish	Differences are not allowed, 4.0 stitches / cm
Lock stitch	Differences are not allowed, 4.0 stitches / cm

Bartacks thickness	16 stitches / cm
Bartacks length	±0,1 cm
Bartacks tolerance	±3 stitches / cm
Bartacks width	0,2 cm; ±0,5 cm
Inner label position	±0,5 cm
Outer label position	±0,5 cm
Distance from logo to the waistband	±0,3 cm
Visible width of the logo	0,7 cm
Fly topstitching, distance from zipper to the end	±0,2 cm
Twisted leg	2 cm

3. IN-PROCESS INSPECTION SYSTEM AND IMPROVEMENT PLAN

After analysing the manufacturing process, an in-process inspection system was designed, including three process control points, based on the client requests, quality costs and complexity of the critical operations [3]. These checkpoints were located after waistbands corners stitching and pressing (intermediate checkpoint 1), before washing (intermediate checkpoint 2) and after final pressing for final checkpoint 3. Control points 2 and 3 were coupled, and controllers worked together and shared their work. In this case, final and intermediate inspections were physically grouped together for centralised exam. A process flow chart was conceived based on manufacturing process and control system design. In this graph, technological operations and controls were highlighted, including self-control and in-chain control, fixed-term and final inspection (Figure 1).

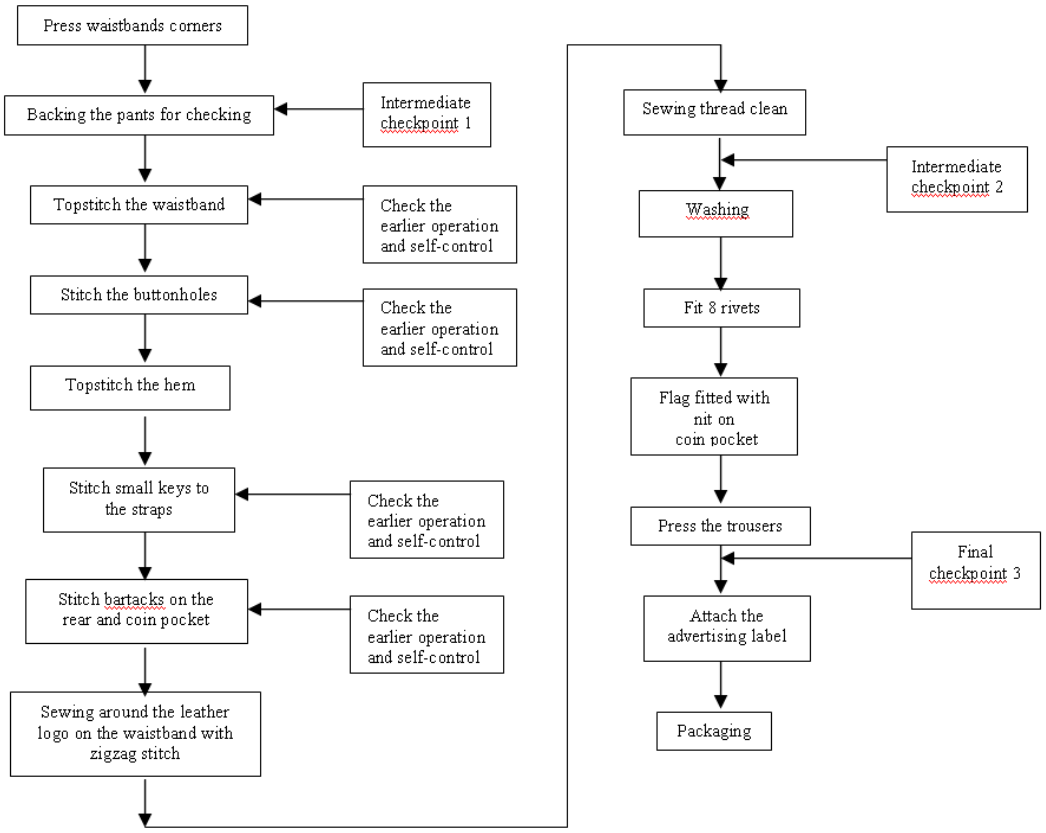


Figure 1. Flow chart for manufacturing process

Control procedures and inspections instruction for each point were established [2]. Detected nonconformities were grouped and recorded using specific check sheets:

- For the first inspection point:
  Fiber content label – conformity with model card, Outseam – seaming, topstitching, Inseam –

seaming, topstitching, Frontside pockets – seaming, topstitching, smallkeys, Back pockets – seaming, topstitching, small keys, Slit – seaming, topstitching, smallkeys, Waistband + berltloops – waistband pressing, loops manufacturing, waistband corners, pressed waistband seaming, Inside the pants – overlocking, bording, seam wideness, Back cross seam – processing, pressing, Dimensions – length, waist, hip, Fabric defects, Contaminations, Shading.

- For the second inspection point:
  Belt loops – pozition, processing, smallkeys, length, Buttonholes – pozition, processing, Buttons - pozition, processing, Nits + rivets, Waistband topstitching, Brand label, Smallkeys on slit and backpockets, Hem – topstitch, Seam wideness, Seam threads, Dimensions – length, waist, hip, Fabric defects, Contaminations, Shading, Undetected defects at the first inspection point.
- For the third inspection point:
  Hem finishing, Sideseam finishing, Inseam finishing, Hip finishing, Slit finishing, Back crossseam finishing, Waistband and belt loops finishing, Inside pants finishing, Main dimensions, Fabric defects, Twist, Contaminations, Shading, Undetected defects at the first and the second inspection point.

Based on data collected in each check point on manufacturing process in a month, histograms and proportions of defects in each checking were achieved for five defects types, as seen in Figures 2 and 3.

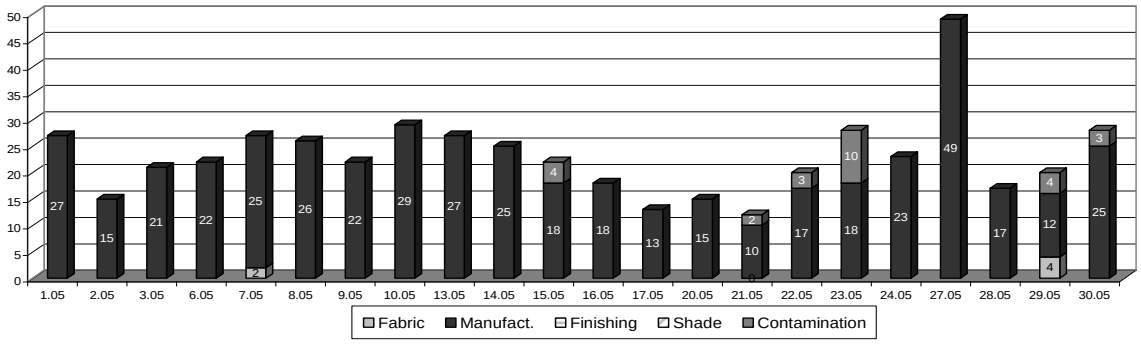
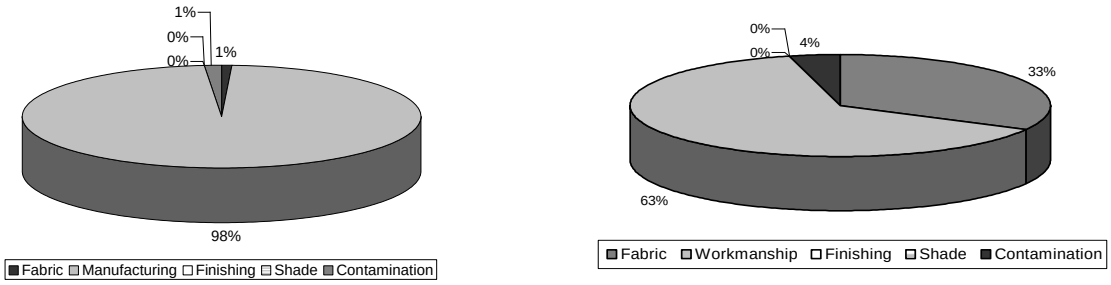


Figure 2. Histogram for the first checkpoint



a) b)

Figure 3. Proportion of defects in a) checkpoint 1 and b) checkpoint 3

At the first stage, the majority of nonconformities, about 98%, are workmanship defects, followed by contaminations and fabrics defects. The identifying of contamination in first checkpoint is mainly due to loss of fabrics inspection process from spreading, where the operator has to check them. All the nonconformities recorded in the second stage of checking refer to manufacturing, including undetected defects in the first control point. The control section 3, due to the washing process of pants in which the used aspect is done, many fabrics and workmanship defects were prevailed. The causes of defects in this stage have two reasons: first inefficiency of the flow control system that allowed unobserved defects and the pre-washing process that causes destruction, stain and seams damaging.

Finally Pareto charts had applied in case of trousers process manufacturing, as seen in Figure 4. The first grade defects that give 80% of defects detected in CP 1 were: waistband + belt loops – pressed waistband seaming, side front pockets – processing, side seam - topstitch, slit – processing, back pockets - topstitch, side seam – seaming, waistband + belt loops – belt loops processing, and contaminations. The recommended measures that prevent these types of nonconformities were to automate the fitted waistband operations, slits processed and back pockets processing, but also creating a new checkpoint after slits preparation and pockets processing. Also, statistical control

techniques might be applied in this supplementary control point for faster detection and remedying defects, with minimal costs.

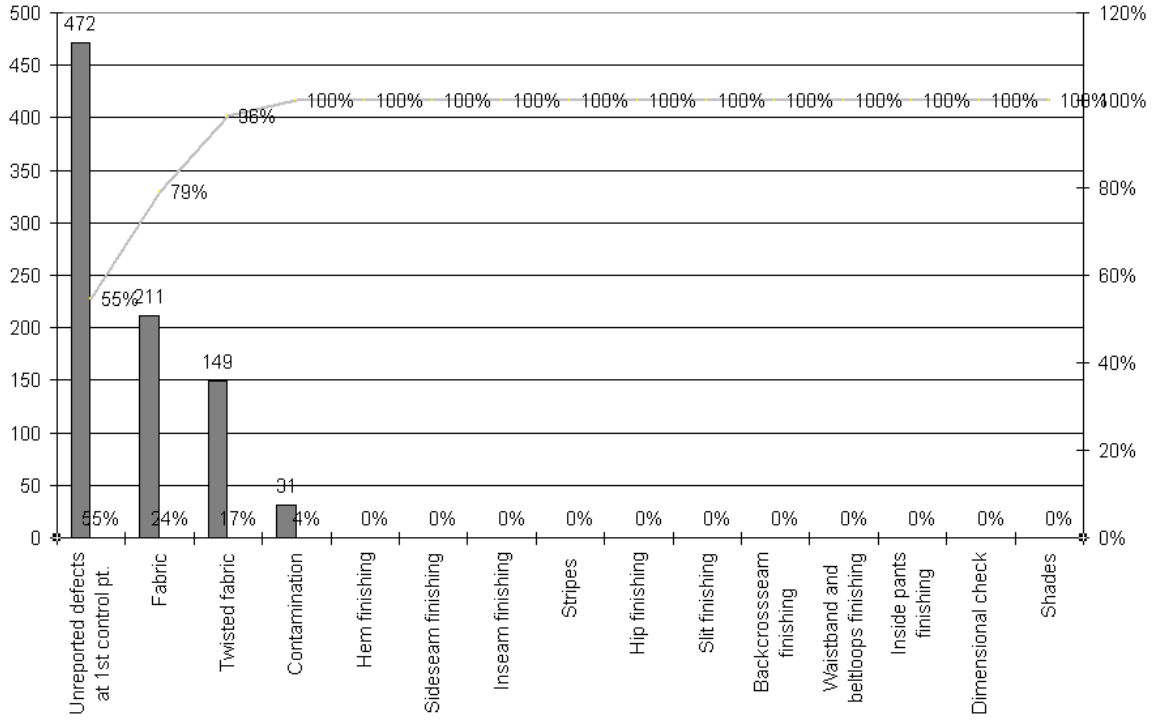


Figure 4. Pareto chart for the third checkpoint

From Pareto chart applied in Control Point 2, the main defects were bartacking, leather logo sewing and waistband topstitching. The main cause that manages to bartacks defects was physical and moral usage of bartacking sewing machines, required new acquisitions. Leather logo stitch operators had to be trained or replaced. Using automatic waistband equipment, the number of faults in this operation could decrease. In the main defects class, a Fishbone diagram was created, emphasizing the potential causes which can be managed to nonconformity. The most important quality problem detected in CP2, bartacking errors (slit and backpockets), was analysed and solved using Fishbone chart in Figure 5 [1].

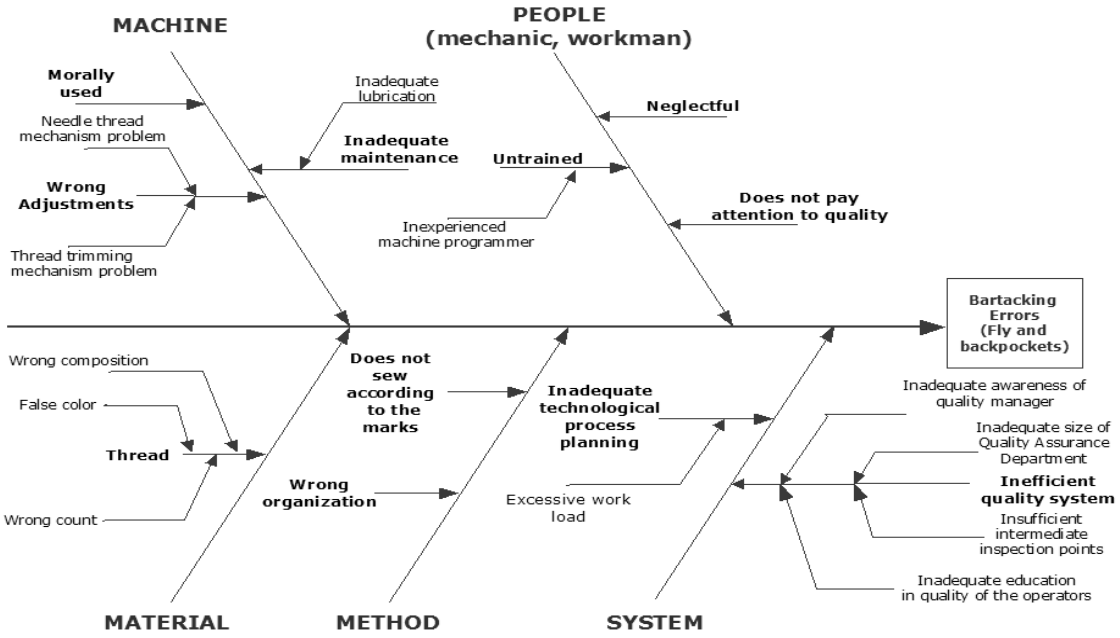


Figure 5. Cause-and-effect chart for the second checking point

A new interim checkpoint between intermediate checkpoints 1 and 2 was sustained by Pareto chart performed for control point 3, made after finishing stage. In this point, 55% of defects were unreported defects on the first control point, indicating an ineffective inspection. In stage 3, a large defects proportion was occupied by fabric defects. For product quality improving, an automatic defect detection system could be recommended. Also, the next nonconformity was twisted leg, with main cause as lack of spreading and inspection after cutting stage.

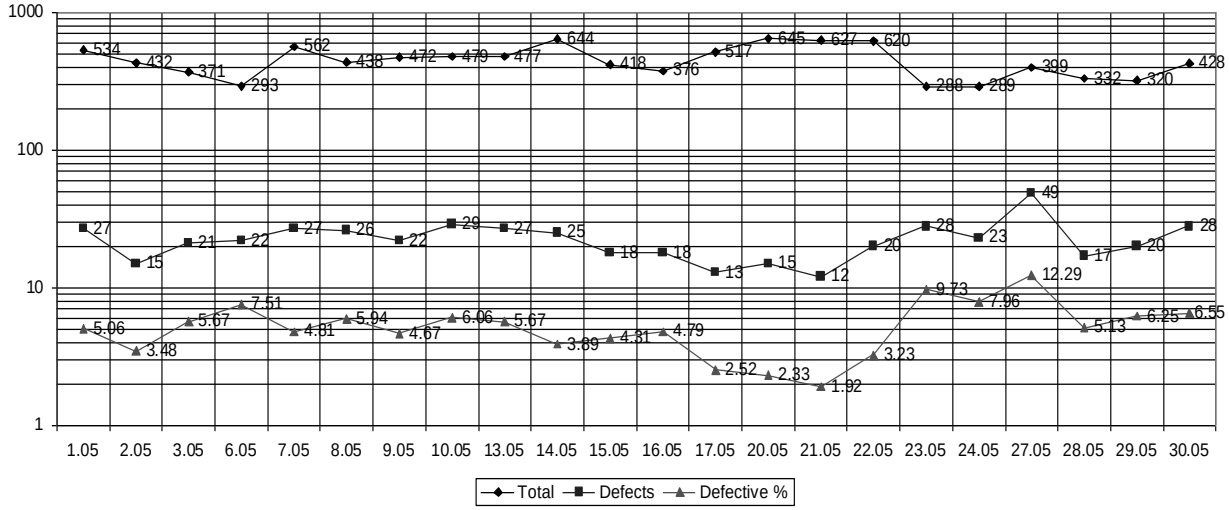


Figure 6. Production, defects and percent defective in CP 1

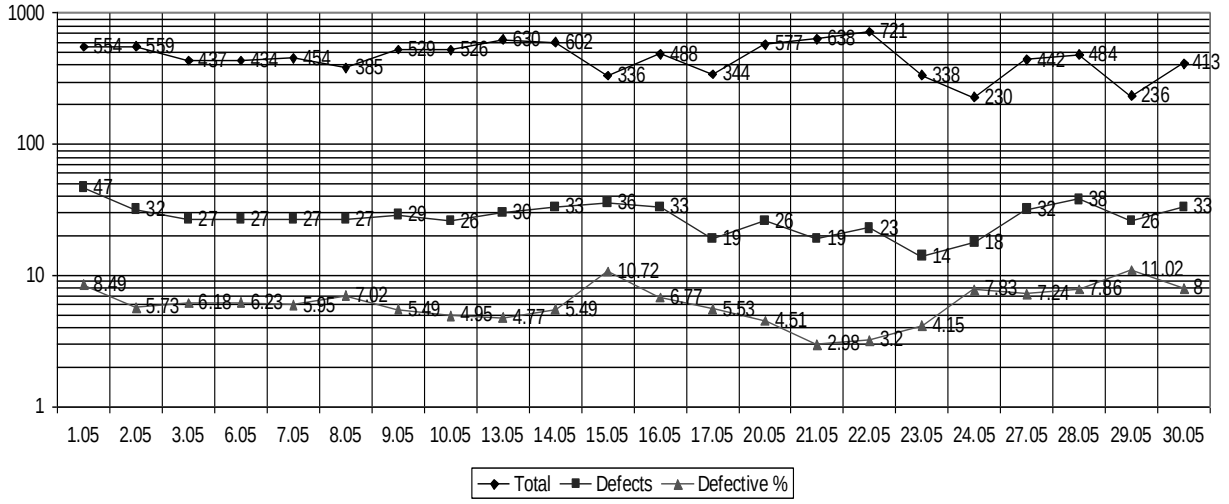


Figure 7. Production, defects and percent defective in CP 2

3. CONCLUSIONS

In order to have an overview of the control system and quality level, graphs with production level, defects and percent defective for trousers in each check point were drawn, during a month (Figures 6 and 7). Comparing these diagrams, a large proportion of defects that have passed undetected by the control points 1 and 2 were noted in the final inspection only, that which imposes definitely a quality improvement plan.

4. REFERENCES

[1]. Chuter, A. J. (2002). Quality Management in the Clothing and Textile Industries, Textile Institute, ISBN 1-870372-48-4, Oxford
[2]. Florea, A. (2001). Controlul calităţii produselor, Editura Gheorghe Asachi, Iaşi, 2001
[3]. Greasley, A. (2009). Operations Management 2nd Edition, Wiley, ISBN 978-0-470-99761-1
[4]. Kadolph, S. J. (2007). Quality Assurance for Textiles and Apparel, Fairchild Publications, ISBN 978-1-56367-554-6, New York
[5]. Kang, C.; Kvam, P., (2011). Basic Statistical Tools for Improving Quality, Wiley, ISBN 978-0-470-88949-7