Analysis of Wastage Caused by Fabric Defects

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The garment manufacturers are hard pressed with continuously reducing product lead-time and improving productivity and quality of their products. To satisfy these requirements fabric should conform to the specification and the standard developed by the industry. But in reality it is difficult to find perfect fabric that exactly sticks to the standard. In spite of the huge advancements made in textile manufacturing technology during last several centuries, textile industry is not able to produce 100% perfect textile materials that constitute 65% - 70% of the cost of the garments. Industries, which utilize the textile materials, are to face difficulties to control the impact of the defects in the fabric.

For proper costing of a garment, and cost reduction, it is necessary to have good understanding of the fabric quality and various fabric losses that occur during garment production. It is possible to find a lot of papers and research works based on improving the marker efficiency to minimize the fabric losses but very few work or research has been done to reduce the impact caused by fabric defects.

For evaluation of fabric quality that cannot be directly reviewed are to be tested at sophisticated textile testing laboratories. If the testing results are matched with the general acceptable standard of shrinkage, colour fastness, seam strength, tensile strength, colour fastness to crocking etc., which are known as Latent Defects, garment manufacturers can continue production with out difficulties. But the defects occurred in fabric weaving, dying and finishing which can be reviewed visually known as Patent Defects (knots, holes, slubs, stains, fly yarns, yarn fault etc.,) have different effect of the losses for different garment styles even though that fabric meet the quality standard of these defects.

The garment factory that purchases the fabric has the right to inspect the consignment to see whether that consignment complies with the standard agreed at the negotiation. They have the right to reject the consignment if that does not meet their standard. But the garment factory doesn't have any right to modify chemical or physical properties of the material they purchased and then to lodge a claim. If the inspection process affects the chemical or physical properties of the material purchased, that has to be discussed with the supplier and come to an agreement on how to conduct the inspection.

In the fabric cutting process, one of the physical properties of the fabric is changed from roll to cut form. Factory should understand that cutting the fabric destroys the physical evidence in the fabric that support the claim. Hence, any complaint has to be made and resolved before cutting the fabric after inspecting the fabric.

Several authors have discussed various types of fabric inspection methods that are useful to textile and apparel industry to evaluate the quality status of the fabric. (Graniteville Company 1975; Powderly, 1987; Mehta 1988; Mehta and Bharadwaj, 1998; Tyler,1991; Alan Newton 1993; Glock and Kunz, 1995; Kulatunga 2001, Kulatunga 2010).

These systems include:

a. The American Society for Quality Control's (ASQC) Four Point System
b. Four Point British Standard (BS6395:1983)
c. Marks and Spencer Six Point System
d. Textile Distributors Institute System (1955), (Ten Point System)
e. Graniteville "78" System
f. Dallas System

Most of the garment factories and fabric suppliers agree to conduct inspection of 10% sample lot where original packing removed, defect samples are cut in that process. If there is any complaint to make, there is 90% of the fabric in original condition available for the claim verification. To handle the claim successfully, fabric purchaser should provide full assistance to the supplier to conduct his own investigation. If both parties could find a reliable method to estimate the losses caused by fabric defects before cutting, that will provide best solution to resolve quality issue.

Author observed large losses when garment manufacturer use the method of splicing off defects when laying the fabric in many occasions and he conducted study to reduce these losses. In this article, reliable methodology developed by the author that is published in book “Fabric Inspection and wastage Caused by Defects” in 2010 is briefly explained. Data gathered from marker details and using any of the above fabric inspection and grading systems will provide same estimation of the loss in this methodology.

1. Model developed to estimate garment wastage caused by fabric defects

If garment manufacturer do not inspect cut panels and do not remove damaged panels before stitching, finished garments will be rejected after final inspection. The model developed by the author to calculate this garment wastage (V) is described below.

$$V = \eta \frac{AYY}{C} \frac{1}{\sum N_i} \qquad for\ i = 1\ to\ r \qquad (1)$$

where i = type of garment

η = marker efficiency

N_i = no. of “ i ” type garments in the marker

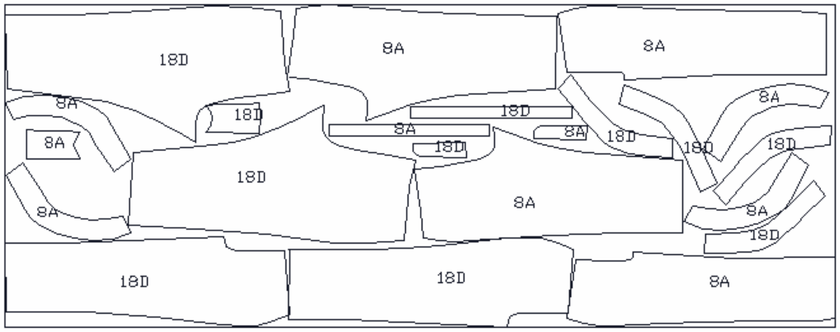
r = no. of different types of garments in the marker

YY = yardage yield of the marker

A = Average defect point count per 100 square yards or square meters

C= defect point category

This model is tested with computer simulation using 10 different garment styles using 20 markers prepared with the width of 48 inches and 60 inches. In this example, data collected in one marker of a garment style Pant A is discussed. Number of fabric defects <3 inches in length (defects 5, 13, 20, 26,33 and 40) spread randomly over 10 fabric rolls with the length of 100 yards in this simulation and this marker is pasted along the roll and reviewed the garments contain defects. Copy of the marker (48 inches width) and the values with the garment wastage computed with the simulation results and theoretical wastage values calculated using the model is added in the table 1. Figure 1 illustrates the theoretical garment wastage and the simulated garment wastage.



Pant A- marker 3a,
Marker length -123.8. Layer length - 125.8 inches

Number of defects per 100 linear yards (A/C)	Number of defects /100 square yards	Simulated Garment Wastage %	Theoretical Garment wastage %
5	3.75	5.18	6.51
13	9.75	18.75	16.93
20	15.00	28.39	26.04
26	19.50	34.11	33.86
33	24.75	41.25	42.97
40	30.00	49.46	52.09

Table 1: Simulation and theoretical garment wastage calculated with new model for different defect points (pant A - marker 3a)

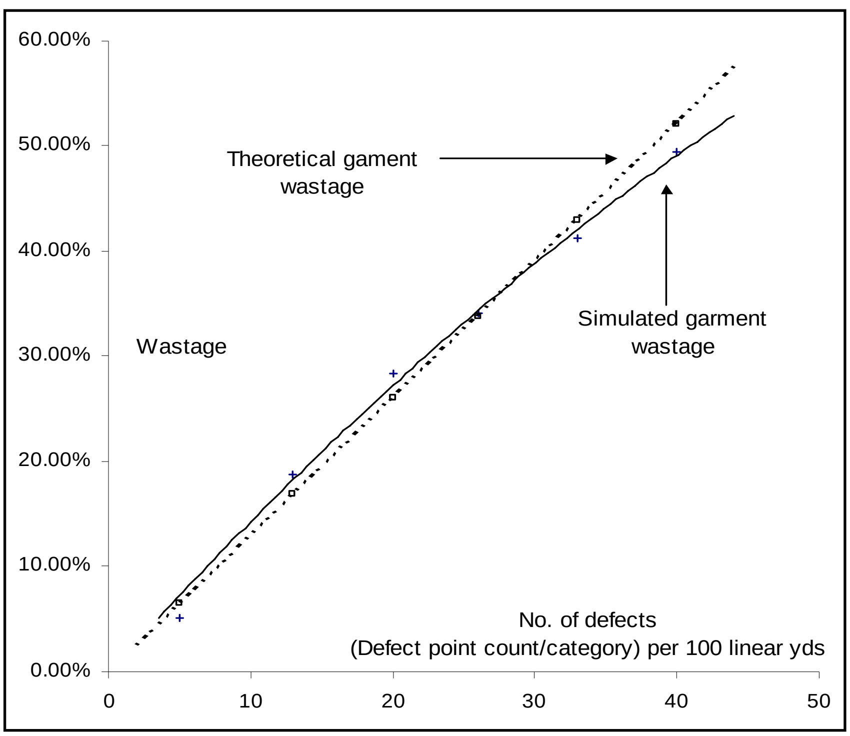


Figure 1: Theoretical and simulated garment wastage for different defect points for pant A – marker 3a

Figure 1 shows the theoretical garment wastage calculated by employing the equation 1 is much closer to the simulated garment wastage. According to these results, maximum possible garment wastage is closer to 50% (49.46% and 52.09%) when 40 defects are randomly spread on 100 yards rolls. It should be noted that this wastage is in garment form. However, if panel inspection is done prior to sewing garment, wastage could be substantially reduced in fabric form and much money could be saved as explained in next section.

2. Model to estimate wastage caused by fabric defects with cut panel inspection

If garment manufacturer inspect cut panels and remove damaged panels before stitching, the model developed by the author in a research project to calculate this fabric wastage percentage (V) is shown below. Logic and assumptions used to develop this model are explained in that book published.

$$V = \frac{A}{C.YY} \sum n_i . a_i^2 \qquad for\ i = 1\ to\ r \quad (2)$$

where i = type of panel

a_i = area of the particular type of panel

n_i = no. of " i " type panels in the marker

r = no. of different types of panels in the marker

Average simulated wastage computed by spreading 5 defects randomly over 10 fabric rolls is 0.86%. Theoretical wastage calculated using this model is 0.93%. These data are recorded in 1st row of the table 2 and the other data gathered after spreading 13, 20, 26, 33, and 40 defects also added to this table. Figure 2 illustrate the closeness of theoretical and simulated wastage values when cut panel inspection is conducted.

When cut panel inspection is continued with 40 defects spread over fabric roll, this results shows the simulate wastage 6.82% and theoretical wastage as 7.41%, but this wastage is in fabric form. If we consider cutting of 100 yards roll and continue cut panel inspection, then the loss will be closer to 7 yards (6.82 yards or 7.41 yards).

Number of defects /100 square yards	Number of defects/ 100 linear yards (A/C)	Simulated Wastage %	Theoretical wastage %
3.75	5	0.86	0.93
9.75	13	2.63	2.41
15.00	20	4.06	3.71
19.50	26	4.79	4.82
24.75	33	5.74	6.12
30.00	40	6.82	7.41

Table 2: Simulation and theoretical wastage calculated with new model for different defect points (pant A - marker 3a)

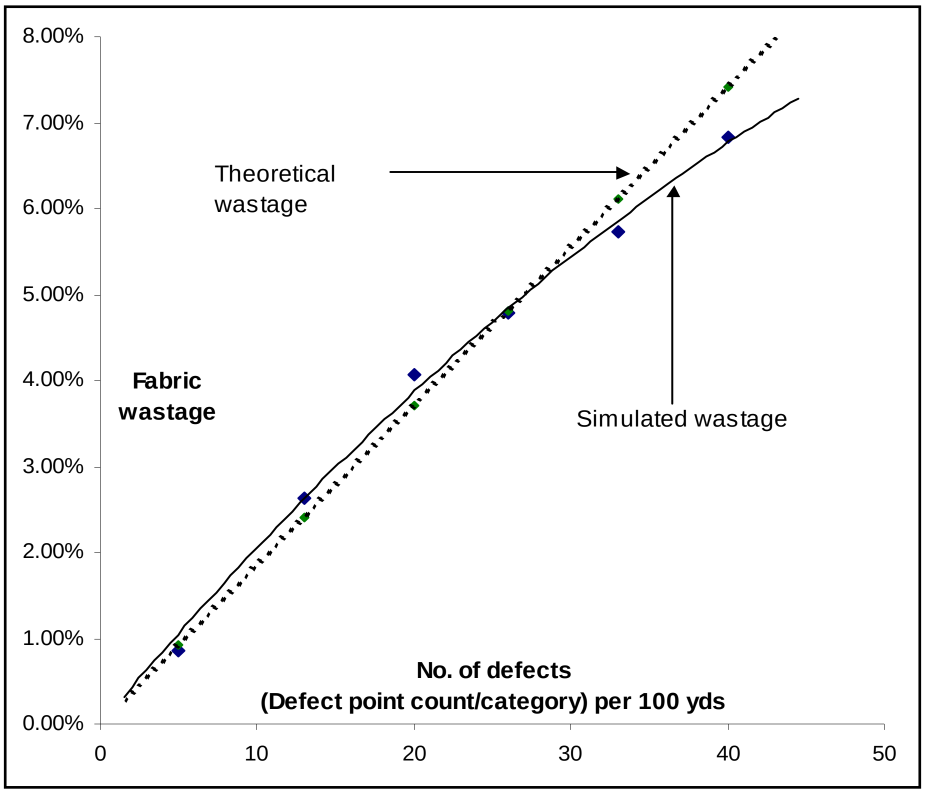


Figure 2: Comparison of simulated wastage and theoretical wastages for pant A - marker 3a.

When developing these models, author make an assumption that only one defect fall on one garment or one cut panel but in computer simulation, it is noted that multiple defects fall on a garment or a panel at higher number of defects spread on rolls. Additional defects fall on the garment or panel rejected due to first defect on its surface will not make any further losses and that reduce the wastage value than the theoretical values calculated. That may be the reason of moving simulated wastage value below the theoretical wastage value at higher number of defects.

While costing the garment at the time of order negotiation, some allowance is to be added to cover the losses such as 3% or 5% if garment wash involved to marker length. Waste caused at fabric laying and roll end piece that could not be used and also wastage caused by fabric defects has to be maintained within this allowance. If garment manufacturer needs to cover material losses below 3% allowance in this style, then they have to decide the fabric standard as 13 defects in 100 linear yards or 9.75 defects in 100 square yards as shown in 2^{nd} row of the table 2. If garment manufacturer accept 40 defects per 100 linear yards (40 points per 100 linear yards according to ASQC 4 point system) as the fabric standard, then they have to add about 7% wastage for marker length when costing the garment.

Author further observed that the fabric standard necessary to handle the wastage allowance below 3% vary in different garment styles in his research work, which is shown in appendices of his book with good accuracy for the defects below the size of 3 inches. Simulation results further shows the defects over 9 inches length that get 4 points when applying ASQC Four Point Fabric Inspection System do not increase wastage by 4 times but increases by less range between 1.4 and 1.8 times in his research project of Master of Philosophy.

Let's consider the fabric price as USD 3.00 /yards and garment price is USD 8.00/piece in this case. Cost of fabric consumption (1.7222 yds) per garment is about 65% of the garment cost. Since layer length is 125.8 inches and the marker contain 2 garments, 28 layers could be cut from 100 yards roll and can get 2 x 28 garments.

Value of fabric loss when panel inspection process continued = 7 yds x 3.00

= USD 21.00

If cut panel inspection is not implemented,

the value of damaged garments (50%) = USD 8.00 x 28

= USD 224.00

Hence, the loss reduction with cut panel inspection

$$= \frac{224 - 21}{224} \times 100 \quad \%$$

$$= \frac{203}{224} \times 100 \quad \%$$

$$= \underline{\underline{90.63\%}}$$

Author observed long ago in Sri Lanka that a worker could inspect average of 24 large cut panels per 1 minute and based on the labour cost, he worked out the cost of panel inspection and re-cutting defect panels of a garment is below USD 0.02. Data forwarded by a garment factory in another country recently (labour cost per day USD 10.00 for working 11 hours) worked out cut panel inspection and re-cutting defective panel cost per garment is below USD 0.016.

If we assume labour cost of panel inspection of a garment as USD 0.02, then the total cost for inspecting/re-cutting defective panels 56 garments (2x28) $= 56 \times 0.02$

$=$ USD 1.12

In this example garment manufacturer could save USD 201.88 (USD203-1.12) implementing this process for 100 yards. Garment manufacturer also can estimate the recovery of the losses using the labour cost of their country in this procedure but may find that cost is very low compare to the loss reduction and they will be able to enhance the productivity and quality by implementing this process.

These results show

- The importance of cut panel inspection
- The standard of the fabric defects acceptable for type of garment style could be decided before sourcing fabric. If fabric inspection results collected from fabric mill does not meet that standard, then garment factory can calculate the possible losses and can request mill to ship additional fabric to cover the loss. Also based on the data of fabric inspection conducted at garment factory, they can lodge claim prior to cut the fabric.
- Textile manufacturer can use this methodology to evaluate claim lodge by apparel manufacturer about the quality status of the fabric supplied to them.

The author holds M.Phil and is a freelance consultant

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