Faculty of Engineering

Department of Textile Engineering

Comparative Study Between Automated Spreading and Manual Spreading in Cutting Section

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A thesis submitted in partial fulfillment of the requirements for the degree of
Bachelor of Science in Textile Engineering
Advance in Apparel Manufacturing Technology

March, 2023

LETTER OF APPROVAL

January 13, 2023

To

The Head

Department of Textile Engineering

Daffodil International University

Daffodil Smart City, Birulia, Ashulia, Savar, Dhaka-1216

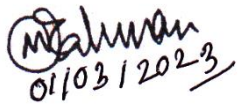
Subject: Approval of Project Report for B.Sc. in TE Program

Dear Sir

We are just writing to let you know that this report titled as **"Comparative Study Between Automated Spreading and Manual Spreading in Cutting''** has been prepared by the students bearing ID 191-23-5529, 191-23-5546 and 191-23-5604 is completed for final evaluation. The whole report is prepared based on the factory data with required belongings. The students were directly involved in their thesis activities and the report became vital to spark of much valuable information for the readers.

Therefore, it will highly be appreciated if you kindly accept this report and consider it for final evaluation.

Sincerely Yours,



Md. Mominur Rahman

Assistant Professor

Department of Textile Engineering

Faculty of Engineering,

Daffodil International University

DECLARATION

We hereby declare that the work which is being presented in this report entitled, **"Comparative Study Between Automated Spreading and Manual Spreading in Cutting"** is original work of our own, has not been presented for a degree of any other university and all the resources of materials used for this thesis have been duly acknowledged.

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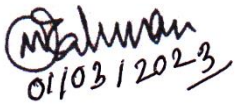
This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

Supervisor:



_____

Md. Mominur Rahman

Assistant Professor, TE, FE, DIU

ACKNOWLEDGEMENT

Above all, we praise the almighty Allah who gave me His enabling grace to successfully complete this research work.

With sincerity, we extend our warm and deep appreciation and gratitude to our supervisor, Associate Prof. Md. Mominur Rahman Head of the Textile Engineering Department for his guidance and support to come up with this research work. Being working with him, we have not only earned valuable knowledge but have also been inspired by his innovativeness which helped to enrich our experience to a greater extent. His ideas and way of working were truly remarkable. We believe that this research could not be finished if he did not help us continuously.

We are thankful to Mr. Md. Abdullah Al Mamun, Assistant Professor, Department of Textile Engineering, Daffodil International University and some of our classmates of DIU for their kind help.

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We are grateful to all our group members for their encouragement for this research work.

Finally, we express our sincere gratitude to our family members for their continuous support, ideas and love during our studies.

Sayem Chowdhury

Md Fayad Noor Shagor

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ABSTRACT

This thesis report presents Comparative study Between Automated Spreading and Manual Spreading. Has worked on this report because of the comparison of these two as which one is efficient or useful. It has been observed 1 hours each day and also observed 1-4 week to collect some non-productive time data, Productive time data, Efficiency % data and wastage % data and identified the major differences between automated spreading and manual spreading. This thesis report it has been found one month analysis of productive time, nonproductive time, wastages and Efficiency % between automated spreading and manual spreading. The major differences of this analysis between automated spreading and manual spreading is their wastage % and manpower capabilities. In automated Spreading nonproductive time is lesser than manual spreading and after one month of analysis manual spreading is more efficient due to their manpower than automated spreading. So last but not the least we can say that both the processes are very important in our textile industry. This process should be done under expert supervision and more efficiency will come after that.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

LIST OF GRAPH

CHAPTER 1
INTRODUCTION

1.1 Background of The Study

Fabric spreading means before cutting a selected number of lays of fabric are spread at a big cutting table. Fabric spreading is a process by which piles of fabric are spread in order to get required length and width as per marker dimension. This is a preparatory operation for cutting and consists of laying. It means the smooth laying out of the fabric in superimposed layers (plies) of specified length. This can be done by automated process or manual process.

In spreading, one cutting order may require several markers to achieve optimum material utilization as well as production efficiency. The actual process of spreading involves laying out fabric in the desired number of layers, and the fabric must be kept flat, smooth, and tension- free on the spreading surface. Such processes may be done manually or by spreading and cutting machines. A spread or lay may consist of a single ply or multiple plies of fabric that is the total amount of the fabric prepared for a single marker. The height of a lay or spread is limited by the vertical capacity of the spreading equipment, cutting method, fabric characteristics, and the size of the order to be cut. Another main consideration in the spreading is the spreading mode; that is the manner in which fabric plies are laid out for cutting. In some cases, fabric is laid out continuously as the spreader moves over the spreading table. Sometimes the fabric roll must be cut at each end of the spread and the new end is repositioned.

In this project we are basically stating the comparison between automated process and manual process. The manual spreading process is suitable for small-scale production. Manual spreading may be used for all kinds of fabrics, including those with complex structures and intricate patterns. In large-scale production, manual cutting is often used for working with intricately patterned and high-cut pile fabrics.

When compared to automated spreading, the cost of technical equipment in manual spreading is low, but the productivity is poor. The fabric spreading process is carried out by one/two workers

at each side of the spreading table who move the fabric ply to the beginning of a spread. The spreading process is repeated until the desired number of fabric plies are laid down.

1.2 Objectives

- To find out the differences between Productive and Non-productive time of Manual and Automated fabric spreading process
- To find out the amount of fabric wastage and wastage percentage in Manual and Automated fabric spreading process.
- To analyze Efficiency percentage and required man-power in Manual and Automated fabric spreading process.

So, in this project we have mainly the purpose of comparing the two processes of spreading which are automated process and manual process and measuring the wastage percentage.

CHAPTER 2

LITARATURE REVIEW

2.1 Fabric Spreading:

Spreading is widely used in garments where all the fabric plies are laid for cutting different parts of a different sizes of the garment. There are lot of techniques which has been used in garments for spreading to utilize the time and the worker. During Spreading a lot of problems occurred such as- Uneven Roll, Pattern match etc.

This Book has contributed to the understanding of fabric spreading and cutting. It provides an overview of how fabrics are spread out on a flat surface, cut into pieces according to patterns or designs, and then sewn together for use in clothing production. The Book also discusses various techniques used by professionals when it comes to fabric spreading and cutting as well as some common problems that can arise during this process. Finally, the authors provide recommendations for improving efficiency while still maintaining quality standards in garment manufacturing processes involving these activities.

The Book uses data from a variety of sources, including fabric samples and measurements taken in garment factories. The authors also conducted experiments to test the accuracy of their proposed techniques for spreading and cutting fabrics. They used computer simulations as well as physical tests with actual fabric pieces to measure how accurately they could spread out or cut different types of materials according to patterns or designs.

This Book provides a comprehensive overview of fabric spreading and cutting techniques, as well as the common problems that can arise during this process. It also offers recommendations for improving efficiency while still maintaining quality standards in garment manufacturing processes involving these activities. Additionally, it uses data from various sources to conduct experiments testing the accuracy of its proposed methods for spreading and cutting fabrics using computer simulations and physical tests with actual fabric pieces.

The main approaches discussed in the Book include: - Manual fabric spreading and cutting, which involves laying out fabrics on a flat surface by hand and then using scissors or other tools to cut them into pieces according to patterns or designs. - Automated fabric spreading and cutting, which uses machines such as computerized spreaders that can accurately lay out large amounts of material quickly with minimal human intervention. - Computer aided design (CAD) systems for creating precise digital models of garments before they are produced so that any errors made during fabrication can be identified early on.[1]

This Book discusses the changes that have taken place in garment manufacturing, specifically within cutting rooms. It looks at how manual processes and equipment used to be employed for fabric spreading and cutting but could not ensure high productivity or quality of work. The Book then goes on to discuss how automated systems such as die-cutting presses, numerically controlled machines with specialized cutters, laser technology and water jetting are increasingly being adopted by garment industries due to their increased efficiency compared with traditional methods. The results of this research suggest that automation is becoming more important than ever before when it comes to producing garments efficiently while maintaining a good level of quality control over production lines. Automated tools can help reduce labor costs associated with manually performing tasks like fabric spreading and cutting which require skilled workers who may also experience physical strain from repetitive motions during long shifts in the factory environment. Additionally, these technologies allow for greater flexibility when dealing with frequently changing styles since they do not need constant retooling or reprogramming each time there is an alteration made in design specifications - something which would take much longer if done manually instead! The main approaches discussed in this paper are: - Traditional manual spreading and cutting equipment, which cannot ensure high productivity or work quality. - Mass production techniques such as simple fabric spreading machines to reduce human resource importance in the cutting room. - Die cutting presses for increased efficiency and flexibility but limited adaptability with changing styles. - Numerically controlled machines that perform a continuous cut by means of specialized devices moving around an object's profile. - H Joseph Gerber’s invention of the first fully automated multi ply textile system (the GERBERcutter S 70). - Laser Cutting & Water Jet Cutting technologies used due to their increased accuracy, speed & quality compared to traditional methods [2]

The data used for experiments in this paper includes the classical standard sizes, fabric-cutting markers (regarding marker length and cutting length), garment fit evaluation of target population, costs associated with fabric spreading operation and cutting operations.[3]

2.2 Marker Efficiency

This paper discusses the application of machine learning techniques, such as multiple linear regression (MLR) and radial basis function neural network (RBF NN), to estimate marker lengths used in various garment production modes. The practical implications are that these methods can be used for making an accurate prediction of unit cutting costs in both mass production and mass customization scenarios with relatively regular sizes. Additionally, it provides a more sustainable sizing system which satisfies fit requirements while also providing better accuracy when predicting marker length.

The results of this paper show that the proposed approach leads to a good performance in estimating marker lengths of different types of markers (mixed marker and group marker) with diverse size combinations taken from various sets of garment sizes in both mass production and mass customization conditions. Additionally, it was found that RBF NN slightly outperforms MLR when predicting the overall marker length for more complex scenarios such as those involving irregular garment sizes or group markers.

This paper has contributed to the understanding of how machine learning techniques can be used for marker length estimation in garment production. It provides evidence that these methods are capable of providing accurate predictions with relatively regular sizes, and suggests a more sustainable sizing system which satisfies fit requirements while also providing better accuracy when predicting marker lengths.

The main drawback of using machine learning techniques for marker length estimation is that the data sample size used in this study was relatively small, which could lead to inaccurate predictions. Additionally, there may be a negative bias when predicting unit cutting costs with additional sizes in mass customization scenarios due to the complexity of these problems.[4]

2.3 Waste Management

The practical implications of this paper include the development of a line balancing algorithm for cutting department. • This algorithm applies genetic algorithms to reduce effort and time spent by technicians in ready-to-wear companies, as it automates the preparation process which was previously done manually based on technician experience. • It also helps improve fabric usage from 80.88% to 83.5%, reduces number of spreading layers from 56 to 25, and reduces markers required from 6 markers down to 3 markers - all resulting in cost savings for garment industry production processes.

This paper has contributed a new scheduling method which includes the movement of orders when compared to the original process, resulting in reduced fabric waste by 2.62%. It also reduces number of spreading layers from 56 to 25 and markers required from 6 down to 3 - all helping reduce cost and time spent on production processes for garment industry.

This paper is unique in that it uses artificial intelligence algorithms to find the optimal distribution of higher investment of raw materials. It also applies genetic algorithms as a powerful optimization technique, which helps reduce fabric waste by 2.62%, number of spreading layers from 56 to 25 and markers required from 6 down to 3 - all resulting in cost savings for garment industry production processes.

One of the drawbacks of this paper is that it requires a high level analysis and coding to express the problem, which can be time consuming. Additionally, since genetic algorithms are used for optimization techniques in this study, there may be some limitations when dealing with complex problems due to its nature as an evolutionary algorithm.[5]

CHAPTER 3

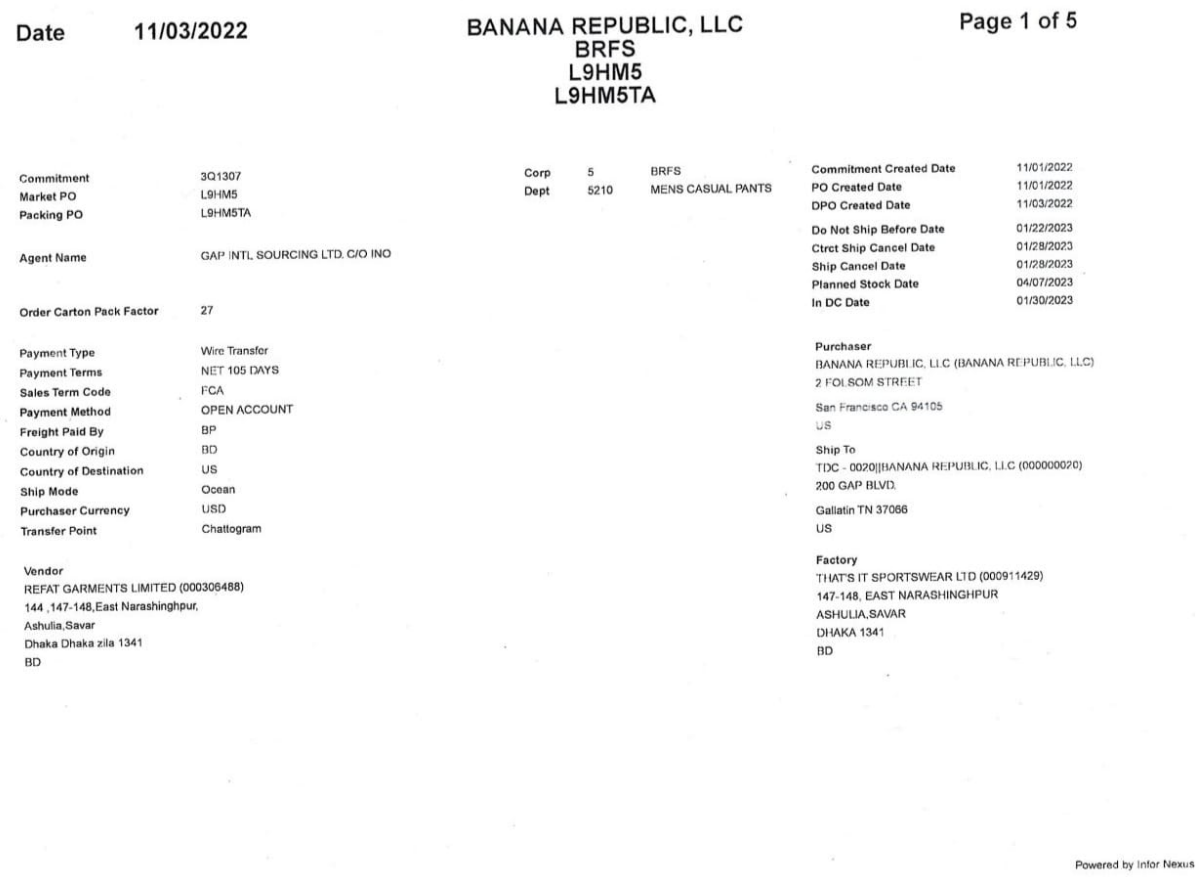
EXPERIMENTAL DETAILS/METHODOLOGY

In this chapter we have shown the experimental details of our thesis work. We have studied spreading time, manpower, 1 hour Production Studies. And observed productivity through calculation and comparison with the existing data from the cutting department. Calculating Productive Work and Nonproductive Work between Manual Spreading as well as automated spreading. This Data is given below

3.1 Data Collection for Manual Spreading

3.1.1 Order Details

Buyer:	: BANANA REPUBLIC, LLC (BRFS)
Style NO	: 529177
Marker Length	: 20 Yds 18 Inch = 20.5 yds
Size Ratio	: XS=1, S=2, M=5, L=4, XL=3
Garment pcs in Marker	:15 Pcs Marker
Pattern No	: 4



Date 11/03/2022

BANANA REPUBLIC, LLC
BRFS
L9HM5
L9HM5TA

Page 1 of 5

Commitment	3Q1307
Market PO	L9HM5
Packing PO	L9HM5TA
Agent Name	GAP INTL SOURCING LTD. C/O INO
Order Carton Pack Factor	27
Payment Type	Wire Transfer
Payment Terms	NET 105 DAYS
Sales Term Code	FCA
Payment Method	OPEN ACCOUNT
Freight Paid By	BP
Country of Origin	BD
Country of Destination	US
Ship Mode	Ocean
Purchaser Currency	USD
Transfer Point	Chattogram

Vendor
REFAT GARMENTS LIMITED (000306488)
144 ,147-148,East Narashinghpur,
Ashulia,Savar
Dhaka Dhaka zila 1341
BD

Corp	5	BRFS
Dept	5210	MENS CASUAL PANTS

Commitment Created Date	11/01/2022
PO Created Date	11/01/2022
DPO Created Date	11/03/2022
Do Not Ship Before Date	01/22/2023
Ctrct Ship Cancel Date	01/28/2023
Ship Cancel Date	01/28/2023
Planned Stock Date	04/07/2023
In DC Date	01/30/2023

Purchaser
BANANA REPUBLIC, LLC (BANANA REPUBLIC, LLC)
2 FOLSOM STREET
San Francisco CA 94105
US

Ship To
TDC - 0020||BANANA REPUBLIC, LLC (000000020)
200 GAP BLVD.
Gallatin TN 37066
US

Factory
THAT'S IT SPORTSWEAR LTD (000911429)
147-148, EAST NARASHINGHPUR
ASHULIA,SAVAR
DHAKA 1341
BD

Powered by Infor Nexus

Figure 1 Order Sheet

3.1.2 Productive and Nonproductive Time of Manual Spreading

Table 1 Weekly Day wise hourly Table of Productive time in Manual Spreading

Manpower: 10 persons

Observation Time: 1 hour each day.

Week 1 (Day 1)

Lay No	Per Lay Time (seconds)
1	26
2	25
3	27
4	23
5	25
6	28
7	24
8	25
9	26
10	25
11	27
12	23
13	25
14	28
15	24
16	26
17	25
18	27
19	23
20	25
21	28
22	24
23	26
24	25
25	27
26	23
27	25
28	28
29	24

30	26
31	25
32	27
33	23
34	25
35	28
36	24
37	26
38	25
39	27
40	23
41	25
42	28
43	24
44	26
45	25
46	27
47	23
48	25
49	28
50	24
51	28
52	24
53	26
54	25
55	27
56	23
57	25
58	28
59	24
60	25

Here,

60 layers take total productive time = 1526 seconds

= (1526/60) Minutes

= 24.43 Minutes

HA-MEEM GROUP

LAYER REPORT

BUYER : BANANA
STYLE # : 52.9147
COLOUR : black
SIZE :
RATIO : XS/1, S/2, M/5, L/4, XL/3

COTT./NO. 3
INSEAM
PTN -No : 04

DATE : 17.12.22
M/LENGTH : 10.5 yds + 1"
M/WIDTH : 59.5"
LAY QTY : 60

SL. NO.	Roll No	Yds.	Lay	Total Lay	Shade	Balance	+	-	REMARKS	
1	2303	83	04	4	A	1				
2	2305	90	04	8	A	8				
3	2302	95	04	12	A	13				
4	2307	88	04	16	A	5				
5	2309	87	04	20	A	5				
6	2312	90	04	24	A	8				
7	2324	85	04	28	A	2				
8	2321	84	04	32	A	1				
9	2315	91	04	36	B	9				
10	2313	96	04	40	B	14				
11	2317	92	04	44	B	12				
12	2322	84	04	48	B	1				
13	2328	86	04	52	B	3				
14	2330	97	04	56	C	15				
15	2326	85	04	60	C	2				

Prepared By | Cutting Incharge | Q. Incharge | G.P.O | C.M

Figure 2 layer Report of Ha-Meem Group

Figure 3 Manual Spreading Operation Scenario 1

Day-02

Lay No	Per Lay Time (seconds)
1	26
2	25
3	27
4	23
5	25
6	28
7	24
8	25
9	26
10	25
11	27
12	23
13	25
14	28
15	24
16	25
17	26

18	29
19	24
20	22
21	27
22	24
23	26
24	26
25	27
26	23
27	25
28	28
29	24
30	26
31	25
32	24
33	23
34	25
35	28
36	24
37	26
38	25
39	24
40	23
41	25
42	28
43	24
44	26
45	25
46	27
47	23
48	25
49	28
50	24
51	28
52	24
53	26
54	25
55	27
56	28
Total	1423

Here,

56 layers take total productive time = 1423 seconds

= (1423/60) Minutes

= 23.71 Minutes

Figure 4 Manual Spreading Operation Scenario 2

Day-03

Lay No	Per Lay Time (seconds)
1	26
2	25
3	27
4	23
5	25
6	28
7	24
8	25
9	26
10	25
11	27
12	23
13	25
14	28
15	24
16	26
17	25
18	27
19	23
20	25
21	28
22	24
23	26
24	25
25	27
26	23
27	25
28	28
29	24
30	26
31	25
32	27
33	23
34	25
35	28
36	24
37	26
38	25
39	27
40	23

41	25
42	28
43	24
44	26
45	25
46	27
47	23
48	25
49	28
50	24
51	28
52	24
53	26
54	25
55	27
56	23
57	25
58	28
59	24
60	25
61	23
62	22
63	24
Total	**1595**

Here,

63 layers take total productive time = 1595 seconds

= (1595/60) Minutes

= 26.58 Minutes

Figure 5 Manual Spreading Operation Scenario 3

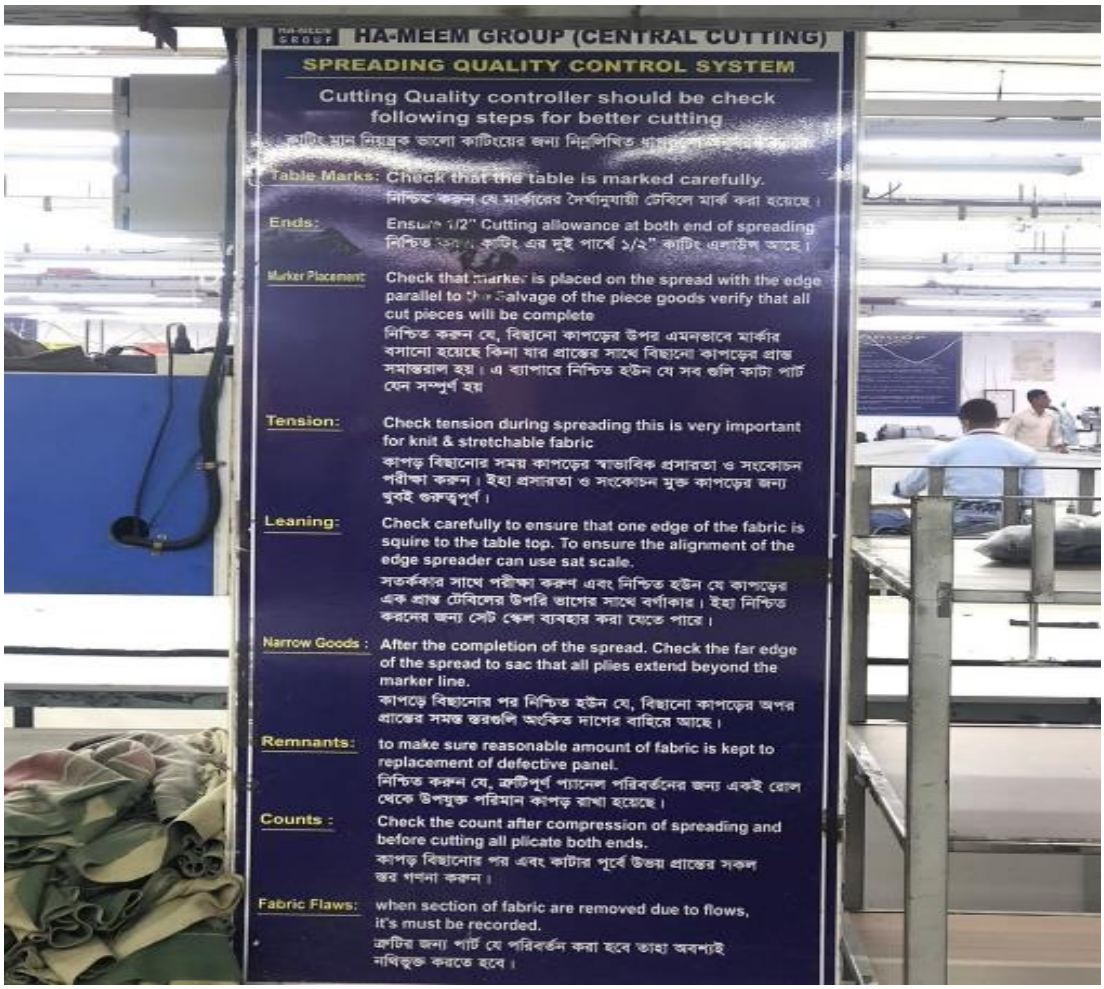


Figure 6 Spreading Quality Control Chart

Day-04

Lay No	Per Lay Time (seconds)
1	23
2	24
3	27
4	23
5	25
6	28
7	23
8	25
9	26
10	25
11	26
12	20
13	25
14	26
15	24
16	24
17	26
18	24
19	24
20	25
21	26
22	24
23	26
24	25
25	27
26	23
27	25
28	28
29	24
30	23
31	25
32	27
33	24
34	25
35	28
36	24
37	25
38	25
39	27

40	27
41	25
42	29
43	24
44	26
45	22
46	26
47	23
48	24
49	22
50	24
51	29
52	24
53	26
54	25
55	27
Total	1377

Here,

55 layers take total productive time = 1377 seconds

= (1377/60) Minutes

= 22.95 Minutes

Figure 7 Manual Spreading Operation Scenario 4

Day-05

Lay No	Per Lay Time (seconds)
1	24
2	25
3	27
4	23
5	25
6	28
7	24
8	25
9	26
10	25
11	27
12	23
13	25
14	28
15	24
16	26
17	25
18	27
19	23
20	25
21	28
22	24
23	26
24	25
25	27
26	23
27	25
28	28
29	24
30	26
31	25
32	27
33	23
34	25
35	28
36	24
37	26
38	25

39	27
40	23
41	25
42	28
43	24
44	26
45	25
46	27
47	23
48	25
49	28
50	24
51	27
52	24
53	26
54	25
55	27
56	23
57	25
58	28
Total	1474

Here,

58 layers take total productive time = 1474 seconds

= (1474/60) Minutes

= 24.57 Minutes

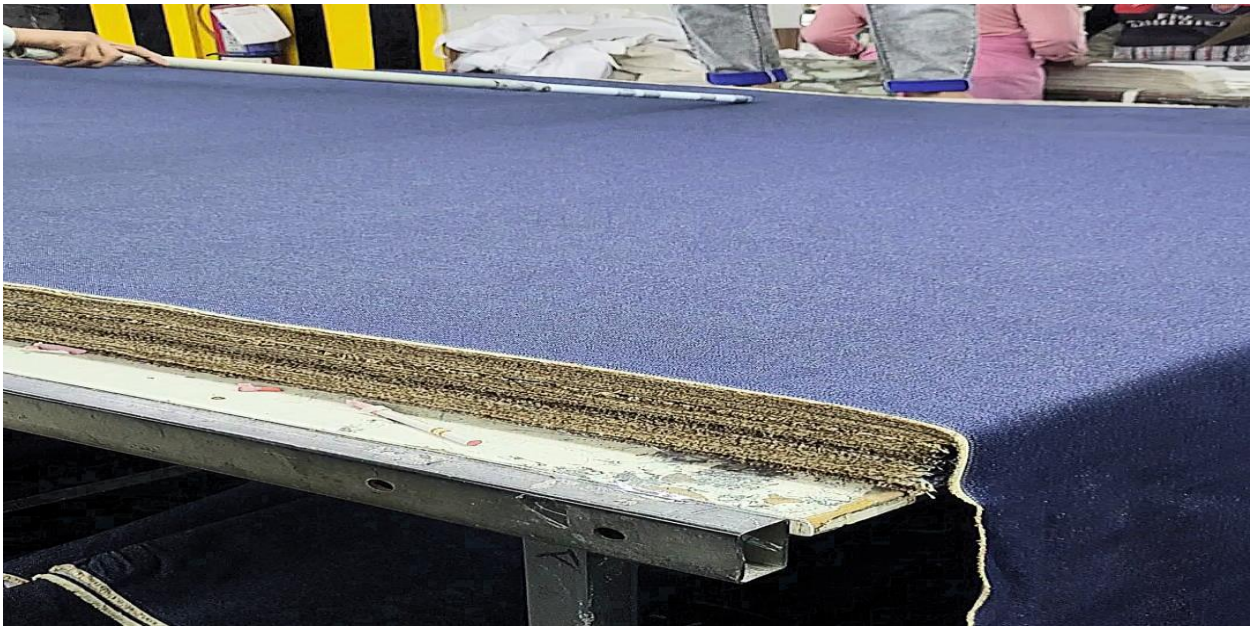


Figure 8 Fabric lay Height

Table 2 Summary of 4 weeks

Data was taken for 4 weeks as per the week 1 tables of 5 working days and summarized below week wise:

Week 1

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	17.12.2022	1	60	24.43 min
2	18.12.2022	1	56	23.71 min
3	19.12.2022	1	63	26.58 min
4	20.12.2022	1	55	22.95 min

5	21.12.2022	1	58	24.57 min
Total	**Total**	**5 hours**	**292**	**122.24 min**

Here,

Total Observed Time For 5 days= 5 Hours

Total Layers = 292

Total productive time for 292 layers = 122.24 Min

= (122.24/60) Hours

= 2.03 Hour

Week 2

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	24.12.2022	1	61	25.53 min
2	25.12.2022	1	54	24.50 min
3	26.12.2022	1	62	27.94 min
4	27.12.2022	1	57	22.20 min
5	28.12.2022	1	59	25.75 min
Total		**5 Hours**	**293**	**125.92**

Here,

Total Observed Time For 5 days= 5 Hours

Total Layers = 293

Total productive time for 293 layers = 125.92 Min

= (125.92/60) Hours

= 2.09 Hours

Week 3

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	01.12.2022	1	65	26.43 min
2	02.12.2022	1	70	27.50 min
3	03.12.2022	1	61	26.94 min
4	04.12.2022	1	60	27.20 min
5	07.12.2022	1	61	26.75 min
Total		**5**	**317**	**134.82**

Here,

Total Observed Time For 5 days= 5 Hours

Total Layers = 317

Total productive time for 317 layers = 134.82 Min

= (134.82/60) Hours

= 2.24 Hours

Week 4

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	08.12.2022	1	56	23.43 min
2	09.12.2022	1	58	22.50 min
3	10.12.2022	1	65	29.94 min
4	11.12.2022	1	61	25.20 min
5	14.12.2022	1	57	21.75 min
Total		**5 Hours**	**297**	**122.82**

Here,

Total Observed Time For 5 days= 5 Hours

Total Layers = 297

Total productive time for 297 layers = Min

= (122.82/60) Hours

= 2.04 Hour

Table 3 Area Wise 1-hour Nonproductive Time for Manual Spreading

Week 1- Day 1

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Power Failure (Min)
01	1	.5	0
02	1.5	.6	0
03	2	.5	0
04	1.5	.4	0
05	2	.7	2
06	2	.4	0
07	3	.5	0
08	2	.7	0
09	1.8	.5	0
10	2	.4	0
11	2	.6	0
12	1.5	.4	0
13	1	.5	0
14	2.5	.5	0
15	1.2	.3	0
Total	**27**	**7.5**	**2**

Here,

Total Non- Productive time in 1 hour for 15 roll = (27+ 7.5+ 2) Min

= 36.5 Min

Figure 9 Manual Nonproductive Time Scenario 1

Day 2

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Power Failure (Min)
01	1.2	.4	0
02	2.5	.5	0
03	2.2	.5	0
04	2	.8	0
05	1.9	.7	0
06	2	.4	0
07	1.8	.5	0
08	2	.3	0
09	1.8	.5	0
10	2.4	.4	0
11	3	.6	0
12	2	.4	0
13	2	.5	0

14	2.5	.5	0
Total	**29.3**	**7.6**	**0**

Here,

Total Non- Productive time in 1 hour = (29.9+ 7.6) Min

= 36.9 Min

Day 3

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Power Failure (Min)
01	1.2	0.4	0
02	1.5	0.5	0
03	2.2	0.5	0
04	1.5	0.8	0
05	1.9	0.6	0
06	1	0.4	0
07	1.7	0.5	0
08	2	0.3	0
09	1.8	0.5	0
10	2.3	0.4	0
11	1	0.2	0
12	1.6	0.3	0
13	1	0.6	0
14	2.5	0.5	0

15	1.5	0.6	0
16	1.5	0.4	0
Total	**26.2**	**7.5**	**0**

Here,

Total Non- Productive time in 1 hour = (26.2+ 7.5) Min

= 33.7 Min

Day 4

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Power Failure (Min)
01	1.2	.5	0
02	2.5	.5	0
03	2.7	.5	0
04	1.5	.8	1
05	2	.7	0
06	2	.6	0
07	1.7	.5	0
08	2	.4	0
09	2.8	.5	0
10	2.3	.4	0
11	2	.6	0
12	1.6	.4	0
13	2	.5	0

14	2.5	.5	0
Total	**28.8**	**7.4**	**1**

Here,

Total Non- Productive time in 1 hour = (28.8+ 7.4) Min

= 37.2 Min

Day 5

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Power Failure (Min)
01	1.2	0.7	0
02	1.5	0.9	0
03	2.2	0.5	0
04	1.5	0.8	0
05	1.9	0.6	0
06	2	0.8	0
07	1.7	0.5	0
08	1	0.6	0
09	1.8	0.4	0
10	2.3	0.7	0
11	2	0.6	0
12	1.5	0.4	0
13	2	0.9	0

14	1.5	0.7	0
15	1.5	0.8	0
Total	25.6	9.9	0

Here,

Total Non- Productive time in 1 hour = (25.6+ 9.9) Min

= 35.5 Min

Table 4 Summary of 4 weeks for nonproductive time

Data was taken for 4 weeks as per the week 1 tables of 5 working days and summarized below week wise:

Week 1

Date	Observation Time (Hour)	Total Roll	Total nonproductive Time for Lays
17.12.22	1	15	36.5
18.12.22	1	14	36.9
19.12.22	1	16	33.7
20.12.22	1	14	37.2
21.12.22	1	15	35.5
Total	**5**	**74**	**179.8**

Here,

Total Observation time in 5 days = 5 hours

Total Roll = 74 roll

Total nonproductive time for 75roll = 179.8 Min

= 179.8/60 Hour

= 2.99 Hour

Week 2

Date	Observation Time (Hour)	Total Roll	Total nonproductive Time for Lays
24.12.22	1	16	35
25.12.22	1	14	35.5
26.12.22	1	15	32.2
27.12.22	1	15	37.9
28.12.22	1	15	34.3
Total	**5**	**75**	**174.9**

Here,

Total Observation time in 5 days = 5 hours

Total Roll = 75 roll

Total nonproductive time for 75roll = 174.9 Min

= 174.9/60 Hour

= 2.91 Hour

Figure 10 Manual Nonproductive Time Scenario 2

Week 3

Date	Observation Time (Hour)	Total Roll	Total Nonproductive Time
01.12.2022	1	16	33.58
02.12.2023	1	18	32.5
03.01.2023	1	15	33.06
04.01.2023	1	15	32.8
07.01.2023	1	16	3.3
Total	5 Hours	80	135.24

Here,

Total Observation time in 5 days = 5 hours

Total Roll = 80 roll

Total nonproductive time for 75roll = 135.24 Min

= 135.24/60 Hour

= 2.25 Hour

Figure 11 Manual Nonproductive Time Scenario 3

Week 4

Date	Observation Time (Hour)	Total Roll	Total Nonproductive Time
08.12.2023	1	14	36.58
09.01.2023	1	15	37.5
10.01.2023	1	17	30.06
11.01.2023	1	16	34.81
14.01.2033	1	17	38.25
Total	**5 Hours**	**79**	**177.2 Min**

Here,

Total Observation time in 5 days = 5 hours

Total Roll = 79 roll

Total nonproductive time for 75roll = 177.2 Min

= 177.2/60 Hour

= 2.95 Hour

3.1.3 Amount of Wastage for Manual Spreading

Table 5 Weekly Day wise hourly Table of wastage in Manual Spreading

Week 1 (Day 1)

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.542	1.512
2	20.544	1.584
3	20.542	1.512
4	20.539	1.404
5	20.536	1.296
6	20.539	1.404
7	20.542	1.512
8	20.544	1.584
9	20.544	1.584
10	20.542	1.512
11	20.544	1.584
12	20.539	1.404
13	20.536	1.296
14	20.542	1.512
15	20.544	1.584
16	20.542	1.512
17	20.542	1.512
18	20.542	1.512
19	20.539	1.404
20	20.539	1.404
21	20.544	1.584
22	20.539	1.404
23	20.539	1.404
24	20.539	1.404
25	20.536	1.296
26	20.539	1.404
27	20.539	1.404
28	20.542	1.512
29	20.542	1.512
30	20.544	1.584
31	20.539	1.404

32	20.542	1.512
33	20.544	1.584
34	20.544	1.584
35	20.542	1.512
36	20.544	1.584
37	20.539	1.404
38	20.536	1.296
39	20.542	1.512
40	20.544	1.584
41	20.544	1.584
42	20.536	1.296
43	20.542	1.512
44	20.542	1.512
45	20.542	1.512
46	20.539	1.404
47	20.539	1.404
48	20.539	1.404
49	20.536	1.296
50	20.536	1.296
51	20.539	1.404
52	20.536	1.296
53	20.539	1.404
54	20.536	1.296
55	20.536	1.296
56	20.539	1.404
57	20.542	1.512
58	20.542	1.512
59	20.542	1.512
60	20.539	1.404
Total	**1232.427**	**87.372**

Here, Total yds for 60 lays = 1232.427 yds

Total Wastage = 87.372/36

=2.427 yds

So, wastage % = 2.427/1232.427*100= 0.19%

Day 2

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.539	1.404
2	20.544	1.584
3	20.542	1.512
4	20.539	1.404
5	20.536	1.296
6	20.539	1.404
7	20.544	1.584
8	20.544	1.584
9	20.543	1.548
10	20.537	1.332
11	20.539	1.404
12	20.535	1.260
13	20.538	1.368
14	20.546	1.656
15	20.541	1.476
16	20.542	1.512
17	20.534	1.224
18	20.536	1.296
19	20.542	1.512
20	20.539	1.404
21	20.544	1.584
22	20.539	1.404
23	20.539	1.404

24	20.539	1.404
25	20.536	1.296
26	20.539	1.404
27	20.545	1.620
28	20.546	1.656
29	20.542	1.512
30	20.546	1.656
31	20.534	1.224
32	20.543	1.548
33	20.538	1.368
34	20.534	1.224
35	20.537	1.332
36	20.540	1.440
37	20.539	1.404
38	20.536	1.296
39	20.540	1.440
40	20.542	1.512
41	20.544	1.584
42	20.539	1.404
43	20.541	1.476
44	20.544	1.512
45	20.545	1.620
46	20.538	1.368
47	20.539	1.404
48	20.534	1.224
49	20.535	1.260

50	20.539	1.404
51	20.536	1.296
52	20.538	1.368
53	20.547	1.692
54	20.536	1.296
55	20.536	1.296
56	20.546	1.656
Total	**1150.234**	**80.352**

Here, Total yds for 56 lays = 1150.234 yds

Total Wastage = 80.352/36

=2.232 yds

So, wastage % = 2.232/1150.234*100= 0.19%

Day 3

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.543	1.548
2	20.537	1.332
3	20.539	1.404
4	20.535	1.260
5	20.538	1.368
6	20.546	1.656
7	20.545	1.620

8	20.546	1.656
9	20.542	1.512
10	20.546	1.656
11	20.534	1.224
12	20.544	1.584
13	20.544	1.584
14	20.536	1.296
15	20.542	1.512
16	20.542	1.512
17	20.542	1.512
18	20.539	1.404
19	20.539	1.404
20	20.539	1.404
21	20.536	1.296
22	20.536	1.296
23	20.544	1.584
24	20.544	1.584
25	20.536	1.296
26	20.542	1.512
27	20.542	1.512
28	20.542	1.512
29	20.539	1.404
30	20.539	1.404
31	20.539	1.404
32	20.536	1.296
33	20.536	1.296

34	20.544	1.584
35	20.539	1.404
36	20.541	1.476
37	20.535	1.260
38	20.539	1.404
39	20.536	1.296
40	20.539	1.404
41	20.544	1.584
42	20.542	1.512
43	20.539	1.404
44	20.536	1.296
45	20.539	1.404
46	20.544	1.584
47	20.542	1.512
48	20.542	1.512
49	20.542	1.512
50	20.539	1.404
51	20.542	1.512
52	20.544	1.584
53	20.542	1.512
54	20.539	1.404
55	20.536	1.296
56	20.539	1.404
57	20.542	1.512
58	20.544	1.584
59	20.542	1.512

60	20.542	1.512
61	20.542	1.512
62	20.544	1.584
63	20.539	1.404
Total	**1294.048**	**91.728**

Here, Total yds for 63 lays = 1294.048 yds

Total Wastage = 91.728/36

=2.548 yds

So, wastage % = 2.427/1294.048*100= 0.20%

Day 4

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.544	1.584
2	20.544	1.584
3	20.536	1.296
4	20.542	1.512
5	20.544	1.584
6	20.542	1.512
7	20.542	1.512
8	20.536	1.296
9	20.536	1.296
10	20.539	1.404

11	20.536	1.296
12	20.539	1.404
13	20.541	1.476
14	20.542	1.512
15	20.534	1.224
16	20.536	1.296
17	20.542	1.512
18	20.539	1.404
19	20.544	1.584
20	20.539	1.404
21	20.539	1.404
22	20.539	1.404
23	20.536	1.296
24	20.539	1.404
25	20.539	1.404
26	20.541	1.476
27	20.544	1.512
28	20.545	1.620
29	20.538	1.368
30	20.539	1.404
31	20.534	1.224
32	20.539	1.404
33	20.545	1.620
34	20.546	1.656
35	20.547	1.692
36	20.536	1.296

37	20.536	1.296
38	20.546	1.656
39	20.539	1.404
40	20.544	1.584
41	20.542	1.512
42	20.542	1.512
43	20.542	1.512
44	20.539	1.404
45	20.542	1.512
46	20.539	1.404
47	20.536	1.296
48	20.539	1.404
49	20.544	1.584
50	20.542	1.512
51	20.542	1.512
52	20.542	1.512
53	20.539	1.404
54	20.539	1.404
55	20.541	1.476
Total	**1129.718**	**79.776**

Here, Total yds for 55 lays = 1129.718 yds

Total Wastage = 87.372/36

=2.216 yds

So, wastage % = 2.216/1129.718 *100= 0.20%

Day 5

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.545	1.620
2	20.546	1.656
3	20.547	1.692
4	20.536	1.296
5	20.536	1.296
6	20.546	1.656
7	20.539	1.404
8	20.544	1.584
9	20.542	1.512
10	20.542	1.512
11	20.542	1.512
12	20.539	1.404
13	20.542	1.512
14	20.539	1.404
15	20.536	1.296
16	20.539	1.404
17	20.544	1.584
18	20.542	1.512
19	20.539	1.404
20	20.542	1.512
21	20.542	1.512
22	20.542	1.512

23	20.539	1.404
24	20.539	1.404
25	20.539	1.404
26	20.536	1.296
27	20.546	1.656
28	20.545	1.620
29	20.546	1.656
30	20.542	1.512
31	20.546	1.656
32	20.534	1.224
33	20.544	1.584
34	20.544	1.584
35	20.536	1.296
36	20.542	1.512
37	20.542	1.512
38	20.542	1.512
39	20.539	1.404
40	20.536	1.296
41	20.536	1.296
42	20.544	1.584
43	20.539	1.404
44	20.541	1.476
45	20.545	1.620
46	20.538	1.368
47	20.539	1.404
48	20.534	1.224

49	20.539	1.404
50	20.545	1.620
51	20.535	1.260
52	20.538	1.368
53	20.546	1.656
54	20.541	1.476
55	20.542	1.512
56	20.534	1.224
57	20.536	1.296
58	20.542	1.512
Total	**1191.362**	**85.032**

Here, Total yds for 58 lays = 1191.362 yds

Total Wastage = 85.032/36

=2.362 yds

So, wastage % = 2.362/1191.362*100= 0.20%

Table 6 Summary of 4 weeks wastage

Data was taken for wastage in 4 weeks as per the week 1 tables of 5 working days and summarized below week wise:

Week 1 Wastages for Manual Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
17.12.22	1	60	1232.427	87.372
18.12.22	1	56	1150.234	80.352
19.12.22	1	63	1294.048	91.728
20.12.22	1	55	1129.718	79.776
21.12.22	1	58	1191.362	85.032
Total	**5**	**292**	**5997.789**	**424.26**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 5997.789 yds

Total Wastage in 1st week = 424.26 inches

= 11.785 yds

Week 2 Wastages for Manual Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
24.12.2022	1	65	1335.126	95.372
25.12.2022	1	56	1156.426	79.365
26.12.2022	1	68	1396.747	99.456
27.12.2022	1	55	1136.569	79.025
28.12.2022	1	58	1195.562	86.032
Total	**5**	**302**	**6220.430**	**439.25**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 6220.430 yds

Total Wastage in 2nd week = 439.25 inches

= 12.201 yds

Week 3 Wastages for Manual Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
01.01.2023	1	66	1355.669	96.874
02.01.2023	1	60	1238.334	89.023
03.01.2023	1	61	1250.233	98.036
04.01.2023	1	59	1210.305	85.092
07.01.2023	1	57	1169.221	82.212
Total	**5**	**303**	**6223.762**	**451.237**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 6223.762 yds

Total Wastage in 3rd week = 451.237 inches

= 12.534 yds

Week 4 Wastages for Manual Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
08.01.2023	1	62	1270.354	91.230
09.01.2023	1	56	1153.854	80.052
10.01.2023	1	63	1292.850	90.764
11.01.2023	1	58	1198.562	86.032
14.01.2023	1	58	1196.954	85.523
Total	**5**	**297**	**6112.574**	**433.601**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 6112.574 yds

Total Wastage in 4th week = 433.601 inches

=12.044 yds

3.1.4 Efficiency % Of Manual Spreading

In this Section it was observed by us how much efficient or productive manual spreading was throughout the week and this data was given below

We know, Efficiency % = Total Productive time/Total Hour * 100

Table 7 Weekly Table of Efficiency % for Manual Spreading

Week	Time of Observation (Hour)	Total Productive Time	Efficiency %
1st	5 hours	2.03 Hours	40.8 %
2nd	5 Hours	2.09 Hours	41 %
3rd	5 hours	2.24 Hours	44.8%
4th	5 Hours	2.04 Hours	40.8%

3.2 Data Collection for Automated Spreading

3.2.1 Order Details

Buyer:	: BANANA REPUBLIC, LLC (BRFS)
Style NO	: 529177
Marker Length	: 20 Yds 18 Inch = 20.5 yds
Size Ratio	: XS=1, S=2, M=5, L=4, XL=3
Garment pcs in Marker	:15 Pcs Marker
Pattern No	: 4
Machine Name	:IMA
Model	:890 13 0180B

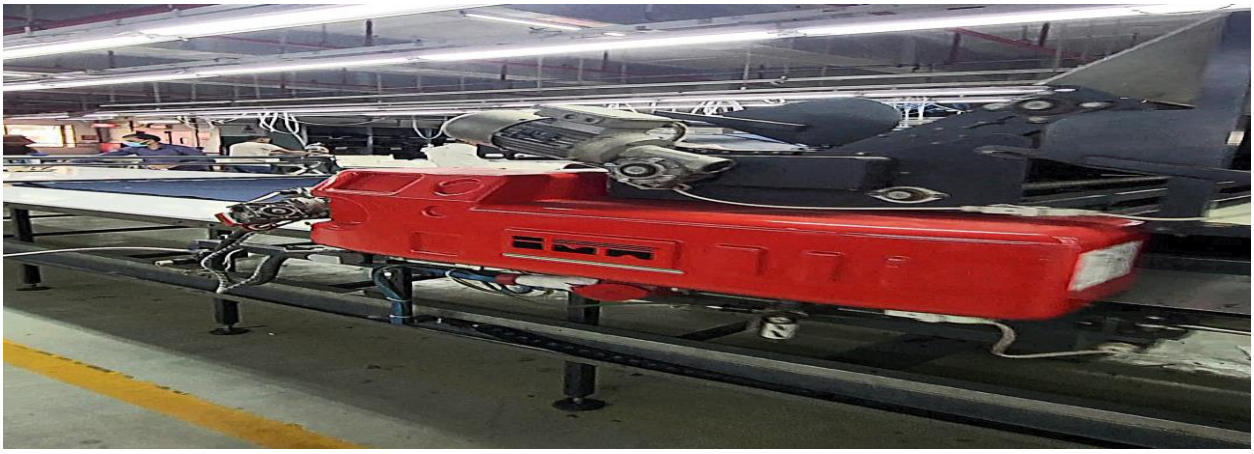


Figure 12 Automated Spreading Machine

3.2.2 Productive and Nonproductive Time for Automated Spreading

Table 8 Weekly Day wise hourly Table of Productive time in Automated Spreading

Manpower: 3 persons

Observation Time: 1 hour each day.

Week 1 (Day 1)

Lay No	Per Lay Time (seconds)
1	45
2	46
3	44
4	45
5	45
6	44
7	43
8	42
9	44
10	45
11	44
12	42
13	43
14	45
15	42
16	46
17	44
18	43
19	44
20	42
21	45
22	44
23	44
24	43
25	45
26	44
27	45
28	45
29	44

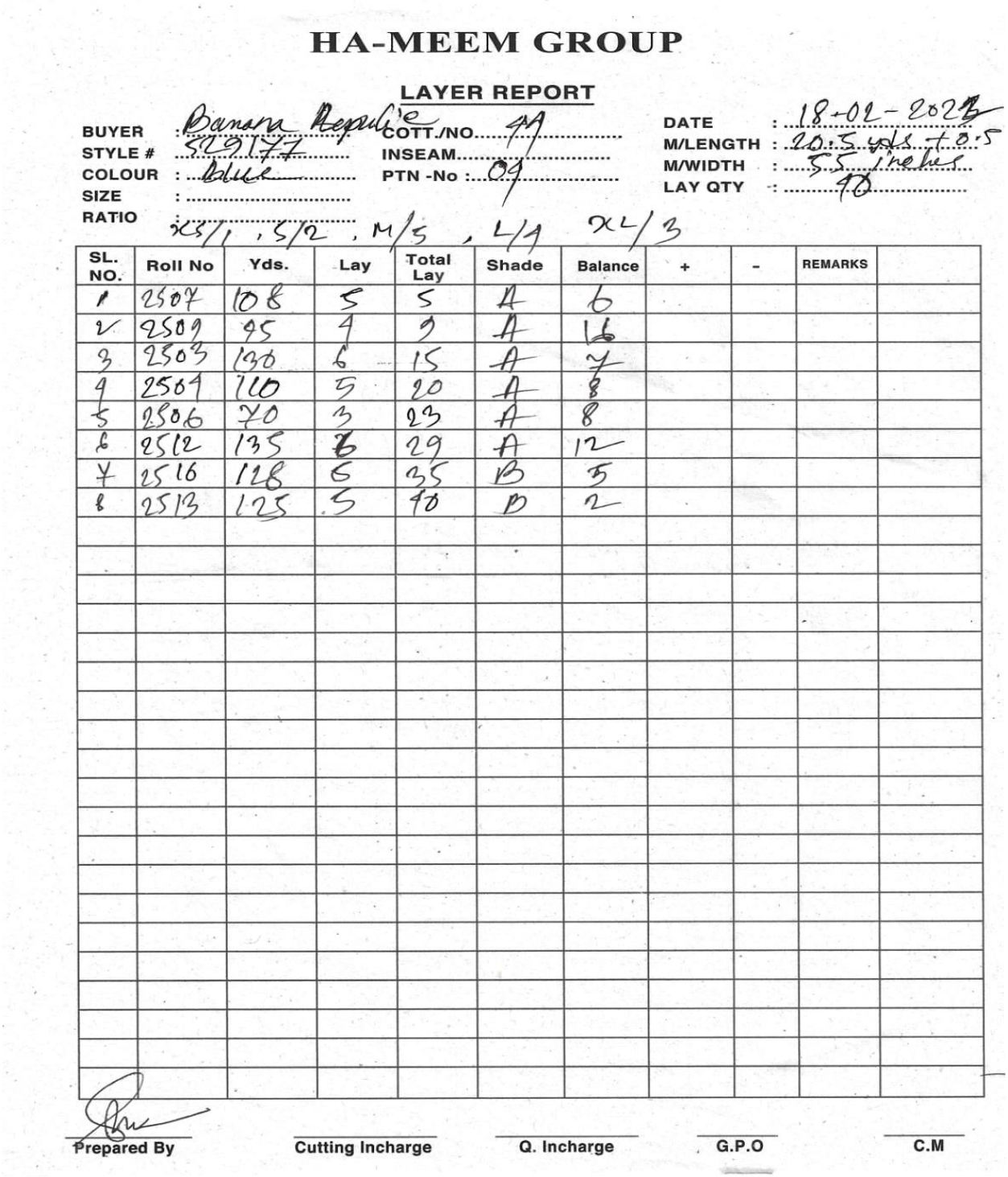
30	43
31	45
32	44
33	44
34	43
35	45
36	44
37	42
38	44
39	44
40	45
41	45
Total	1805

Here,

41 layers take total productive time = 1805 seconds

= (1805/60) Minutes

= 30.08 Minutes



HA-MEEM GROUP

LAYER REPORT

BUYER : Banana Republic
STYLE # : 529177
COLOUR : blue
SIZE :
RATIO : XS/1, S/2, M/5, L/1, XL/3

COTT./NO. 44
INSEAM
PTN -No : 09

DATE : 18-02-2022
M/LENGTH : 20.5 yds + 0.5
M/WIDTH : 55 inches
LAY QTY : 90

SL. NO.	Roll No	Yds.	Lay	Total Lay	Shade	Balance	+	-	REMARKS	
1	2507	108	5	5	A	6				
2	2509	95	4	9	A	16				
3	2503	130	6	15	A	7				
4	2504	110	5	20	A	8				
5	2506	70	3	23	A	8				
6	2512	135	6	29	A	12				
7	2516	128	6	35	B	5				
8	2513	125	5	40	D	2				

Prepared By | Cutting Incharge | Q. Incharge | G.P.O | C.M

Figure 13 Automated Spreading Layer Report of Ha-Meem Group

Figure 14 Automated Spreading Operation Scenario 1

Day 2

Lay No	Per Lay Time (seconds)
1	45
2	44
3	44
4	45
5	42
6	45
7	44
8	43
9	42
10	43
11	44
12	45
13	44
14	46
15	45
16	44
17	45
18	45

19	44
20	44
21	43
22	45
23	44
24	46
25	43
26	42
27	45
28	44
29	44
30	43
31	43
32	44
33	45
34	44
35	43
36	45
37	45
38	46
39	44
40	45
Total	**1766**

Here,

40 layers take total productive time = 1766 seconds

= (1766/60)

= 29.433 Minutes

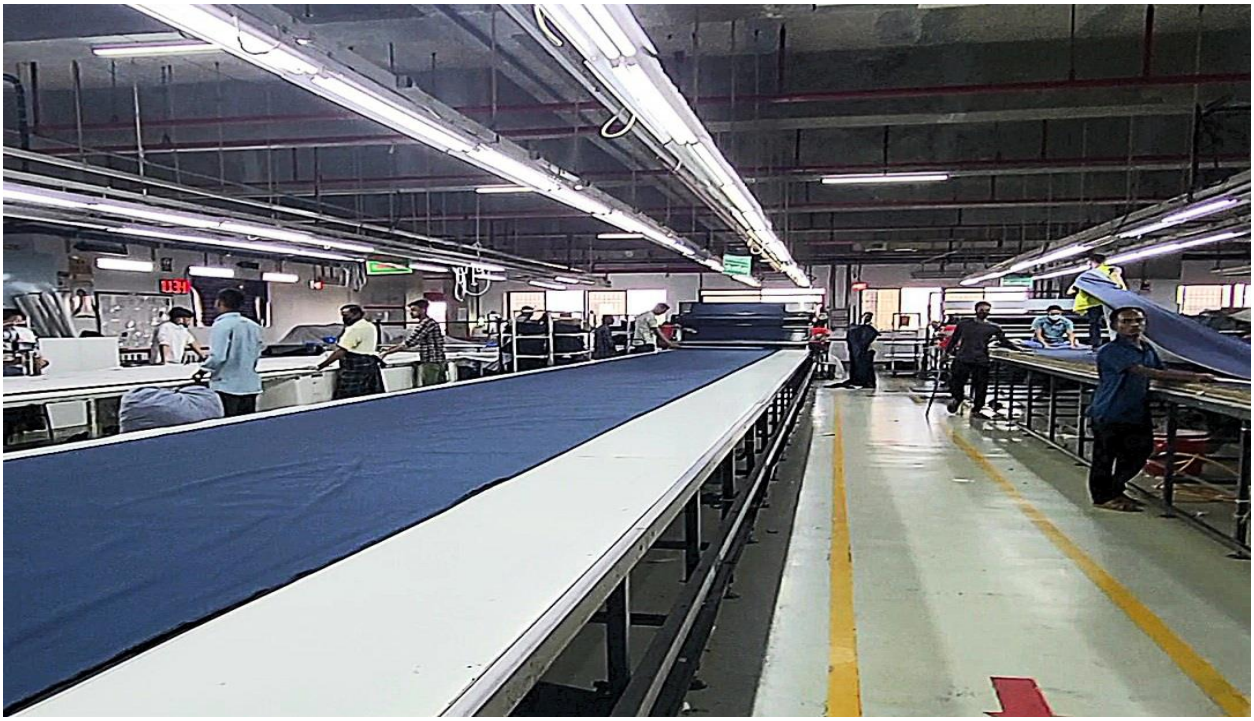


Figure 15 Automated Spreading Operation Scenario 2

Day 3

Lay No	Per Lay Time (seconds)
1	44
2	44
3	45
4	42
5	45
6	44
7	44
8	44
9	45
10	42
11	45
12	44
13	44
14	44

15	45
16	44
17	45
18	45
19	42
20	44
21	45
22	43
23	43
24	45
25	42
26	46
27	44
28	45
29	43
30	42
31	44
32	45
33	43
34	43
35	43
36	45
37	45
38	46
39	44
40	43
41	45
42	42
43	42
Total	1890

Here,

43 layers take total productive time = 1890 seconds

= (1890/60) Minutes

= 31.50 Minutes

Figure 16 Automated Spreading Operation Scenario 3

Day 4

Lay No	Per Lay Time (seconds)
1	43
2	45
3	44
4	43
5	44
6	45
7	43
8	45
9	45
10	42
11	45
12	43
13	45
14	44
15	45
16	44

17	45
18	45
19	42
20	44
21	45
22	43
23	43
24	45
25	42
26	46
27	44
28	45
29	43
30	42
31	44
32	45
33	43
34	43
35	43
36	45
37	45
38	46
Total	**1716**

Here,

38 layers take total productive time = 1716 seconds

= (1716/60) Minutes

= 28.6 Minutes

Figure 17 Automated Spreading Operation Scenario 4

Day 5

Lay No	Per Lay Time (seconds)
1	44
2	44
3	45
4	42
5	43
6	46
7	44
8	44
9	45
10	42
11	45
12	43
13	45
14	44
15	45
16	44
17	45
18	45

19	42
20	44
21	45
22	43
23	43
24	45
25	42
26	46
27	44
28	45
29	43
30	42
31	44
32	45
33	43
34	43
35	43
36	45
37	45
38	46
39	42
40	44
Total	**1802**

Here,

40 layers take total productive time = 1802 seconds

= (1802/60) Minutes

= 30.03 Minutes

Figure 18 Automated Spreading Operation Scenario 5

Table 9 Summary of 4 weeks

Data was taken for 4 weeks as per the week 1 tables of 5 working days and summarized below week wise:

Week 1

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	17.12.2022	1	41	30.08 min
2	18.12.2022	1	40	29.43 min
3	19.12.2022	1	43	31.50 min
4	20.12.2022	1	38	28.60 min
5	21.12.2022	1	40	30.03 min
Total		**5 hours**	**202**	**149.64 min**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total Layers = 40+ 41+ 43+ 38+ 40 = 202

Total productive time for 202 layers = (30.08+29.43+ 31.50+ 28.60+ 30.03) Min

= 149.64 Min

= (149.64/60) Hours

= 2.50 Hour

Week 2

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	24.12.2022	1	40	29.90 min
2	25.12.2022	1	42	31.20 min
3	26.12.2022	1	38	29.55 min
4	27.12.2022	1	39	30.02 min
5	28.12.2022	1	42	31.05 min
Total			**201**	**151.72**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total Layers = 40+42+38+39+42 = 201 lays

Total productive time for 201 layers = (24.25+ 24.50+ 26.74+ 25.20+ 25.75) Min

= 151.72 Min

= (151.72/60) Hours

= 2.53 Hour

Week 3

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	01.12.2022	1	45	32.20 min
2	02.12.2022	1	42	31.43 min
3	03.12.2022	1	40	30.35 min
4	04.12.2022	1	43	31.65 min
5	07.12.2022	1	42	31.37 min
Total		**5**	**212**	**157 min**

Here,

Total Layers = 45+42+40+43+42= 212 lays

Total productive time for 212 layers = (32.20+31.43+30.35+31.65+31.37) Min

= 157 Min

= (157/60) Hours

= 2.62 Hour

Week 4

Day	Date	Time of Observation (Hour)	Total Number of Lay	Total Productive Time for Lays
1	08.12.2022	1	38	28.82
2	09.12.2022	1	40	29.60
3	10.12.2022	1	42	31.03
4	11.12.2022	1	41	30.15
5	14.12.2022	1	39	29.40
Total		**5 Hours**	**200**	**149**

Here,

Total Layers = 38+40+42+41+39 = 200 lays

Total productive time for 200 layers = (28.82+29.60+31.03+30.15+29.40) Min

= 149 Min

= (149/60) Hours

= 2.483 Hour

Table 10 Area Wise 1-hour Nonproductive Time for Automated Spreading

Week 1 (Day 1)

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Total lay loss Time	Power Failure (Min)	Machine Adjusting	Machine Set Up	Personal Allowance (Min)
01	2	0.33	0.23	0	0.28	2	0.5
02	2.5	0.44	0.22	0	0	.75	0
03	1.5	0.32	0.24	0	0	1	1.50
04	2	0.35	0.23	0	0.38	0	1
05	2.5	0.40	0.22	0	0	0	0
06	2	0.32	0.21	0	0	0	0.75
07	1.6	0.32	0.25	0	0	0	0
08	2	0.25	0.24	0	0.25	.35	1
Total	**16.1**	**2.73**	**1.84**	**0**	**0.91**	**1.75**	**4.75**

Total Non- Productive time in 1 hour for 08 roll = (16.1+1.98+1.84) Min

= 30.43 Min

Day 2

Per Roll	**Loading And Unloading (Min)**	**Cut piece Changing (Min)**	**Total lay loss Time (Min)**	**Power Failure (Min)**	**Machine Adjusting**	**Machine Set Up**	**Personal Allowance (Min)**
01	2.5	0.25	0.20	0	0.28	1	0
02	2	0.35	0.21	0	0	.75	0
03	1.75	0.20	0.15	0	0	0	1.75
04	1.75	0.35	0.24	0	0	0	1
05	2.5	0.30	0.25	0	0.47	0	0
06	1.9	0.39	0.18	2	0	2	0.50
07	1.5	0.34	0.20	0	00	0	1
08	2.5	0.25	0.29	0	0	0	1
Total	**16.4**	**2.43**	**1.72**	**2**	**0.75**	**2.75**	**5.25**

Total Non- Productive time in 1 hour for 08 roll = (16.4+2.43+1.72+2+0.75+2.75+5.25) Min

= 31.3 Min

Day 3

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Total lay loss Time (Min)	Power Failure (Min)	Machine Adjusting	Machine Set Up	Personal Allowance (Min)
01	1.25	0.30	0.15	0	0.28	1.50	2
02	2	0.40	0.25	0	0	0	0
03	1.70	0.20	0.15	0	0	0	1.75
04	1.80	0.32	0.30	0	0	0	1
05	2	0.30	0.25	0	0.47	0	0
06	1.85	0.35	0.20	0	0	0.75	1.35
07	1.20	0.28	0.25	0	0	.15	0
08	1.95	0.25	0.14	0	0	0	0

09	1	0.20	0.30	0	0.50	0.30	0
Total	**14.75**	**2.6**	**1.99**	**0**	**1.25**	**2.7**	**6.1**

Total Non- Productive time in 1 hour for 08 roll = (14.75+ 2.6+1.99+ 1.25+ 2.7+6.1) Min

= 29.39 Min

Day 4

Per Roll	**Loading And Unloading (Min)**	**Cut piece Changing (Min)**	**Total lay loss Time (Min)**	**Power Failure (Min)**	**Machine Adjusting**	**Machine Set Up**	**Personal Allowance (Min)**
01	1.75	0.33	0.16	0	0	2	2
02	1.90	0.25	0.22	3	0.35	0	0
03	1.50	0.26	0.20	0	0	0.75	0
04	1.75	0.30	0.35	0	0	0	2
05	2	0.27	0.18	0	0.	0	0

06	1.9	0.34	0.20	0	0	1	0
07	2.20	0.15	0.25	0	0.65	0	1
08	1.95	0.35	0.14	0	0	0	0
Total	**14.95**	**2.25**	**1.7**	**2**	**1**	**3.75**	**5**

Total Non- Productive time in 1 hour for 08 roll = (14.95+ 2.25+1.7+2+1+3.75+5) Min

= 31.65 Min

Day 5

Per Roll	Loading And Unloading (Min)	Cut piece Changing (Min)	Total lay loss Time	Power Failure (Min)	Machine Adjusting	Machine Set Up	Personal Allowance (Min)
01	2.25	0.33	0.23	0	0.28	2	0
02	2	0.44	0.22	0	0	.75	0.75
03	1.75	0.32	0.24	0	0	1	1.50
04	1.75	35	0.23	0	0.40	0	0.75
05	2.75	.40	0.22	0	0	1	0
06	1.75	0.32	0.21	0	0.25	0	0.50
07	1.6	0.32	0.25	0	0	0	0
08	1.75	0.25	0.24	0	0	.35	1
Total	**15.6**	**2.73**	**1.84**	**0**	**0.93**	**5.1**	**4.50**

Total Non- Productive time in 1 hour for 08 roll = (15.6+2.73+ 1.84+0.93+ 5.1+ 4.50) Min

= 30.70 Min

Table 11 Summary of 4 weeks for Nonproductive time

Data was taken for 4 weeks as per the week 1 tables of 5 working days and summarized below week wise:

Week 1

Day	Date	Time of Observation (Hour)	Total Number of Lay	Number of Roll	Total Nonproductive Time for Lays
1	17.12.2022	1	41	8	30.43 Min
2	18.12.2022	1	40	8	31.30 Min
3	19.12.2022	1	43	9	29.39 Min
4	20.12.2022	1	38	8	31.65 Min
5	21.12.2022	1	40	8	30.70 Min
	Total	**5 hours**	**202**	**41**	**153.47 min**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total Layers = 40+ 41+ 43+ 38+ 40 = 202

Total Nonproductive time for 202 layers = (30.43+31.30+ 29.39+ 31.65+ 30.70) Min

= 153.47 Min

= (153.47/60) Hours

= 2.56 Hour

Week 2

Day	Date	Time of Observation (Hour)	Total Number of Lay	Number of Roll	Total Nonproductive Time for Lays
1	24.12.2022	1	40	8	30.75 min
2	25.12.2022	1	42	9	29.02 min
3	26.12.2022	1	38	8	30.70 min
4	27.12.2022	1	39	8	30.10 min
5	28.12.2022	1	42	9	29.50 min
	Total	**5 Hours**	**201**	**42**	**150.07 Min**

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total Layers = 40+42+38+39+42 = 201 lays

Total Nonproductive time for 201 layers= (30.75+29.02+30.70+30.10+29.50) Min= 150.07 Min = (150.07/60) Hours = 2.50 Hour

Figure 19 Automated Nonproductive Time Scenario 1

Week 3

Day	Date	Time of Observation (Hour)	Total Number of Lay	Number of Roll	Total Nonproductive Time for Lays
1	01.12.2022	1	45	8	28.79 Min
2	02.12.2022	1	42	9	29.45 Min
3	03.12.2022	1	40	9	30.94 Min
4	04.12.2022	1	43	9	29.04 Min
5	07.12.2022	1	42	8	28.97 Min
	Total	**5**	**212**	**42**	**147.19 Min**

Here,

Total Layers = 45+42+40+43+42= 212 lays

Total productive time for 212 layers = (28.79+29.45+30.94+29.04+28.97) Min = 147.19 Min

= (147/60) Hours = 2.45 Hour

Figure 20 Automated Nonproductive Time Scenario 2

Week 4

Day	Date	Time of Observation (Hour)	Total Number of Lay	Number of Roll	Total Non Productive Time for Lays
1	08.12.2022	1	38	8	31.24 Min
2	09.12.2022	1	40	8	31.78 Min
3	10.12.2022	1	42	9	30.09 Min
4	11.12.2022	1	41	8	30.56 Min
5	14.12.2022	1	39	8	31.45 Min
	Total	**5 hours**	**200**	**41**	**155.12 Min**

Here,

Total Layers = 38+40+42+41+39 = 200 lays

Total productive time for 200 layers = (31.24+31.78+30.09+30.56+31.45) Min

= 155.12 Min = 2.585 Hours

Figure 21 Automated Nonproductive Time Scenario 3

3.2.3 Amount of Wastage for Automated Spreading

Table 12 Weekly Day wise hourly Table of wastage in Automated Spreading

Week 1 (Day 1)

Lay No	Total Yds (Including 0.5" Allowance)	Wastage of Ends (inch)
1	20.514	0.504
2	20.514	0.504
3	20.514	0.504
4	20.514	0.504
5	20.514	0.504
6	20.514	0.504
7	20.514	0.504
8	20.514	0.504
9	20.514	0.504
10	20.514	0.504
11	20.514	0.504
12	20.514	0.504
13	20.514	0.504
14	20.514	0.504
15	20.514	0.504
16	20.514	0.504
17	20.514	0.504

18	20.514	0.504
19	20.514	0.504
20	20.514	0.504
21	20.514	0.504
22	20.514	0.504
23	20.514	0.504
24	20.514	0.504
25	20.514	0.504
26	20.514	0.504
27	20.514	0.504
28	20.514	0.504
29	20.514	0.504
30	20.514	0.504
31	20.514	0.504
32	20.514	0.504
33	20.514	0.504
34	20.514	0.504
35	20.514	0.504
36	20.514	0.504
37	20.514	0.504
38	20.514	0.504
39	20.514	0.504
40	20.514	0.504
41	20.514	0.504
Total	841.074	20.664

Here, Total yds for 41 lays = 841.074 yds

Total Wastage = 20.664/36

=0.574 yds

So, wastage % = 0.574/841.074*100= 0.07%

Day 2

Lay No	**Total Yds (Including 1" Allowance)**	**Wastage of Ends (inch)**
1	20.514	0.504
2	20.514	0.504
3	20.514	0.504
4	20.514	0.504
5	20.514	0.504
6	20.514	0.504
7	20.514	0.504
8	20.514	0.504
9	20.514	0.504
10	20.514	0.504
11	20.514	0.504
12	20.514	0.504
13	20.514	0.504
14	20.514	0.504
15	20.514	0.504
16	20.514	0.504
17	20.514	0.504
18	20.514	0.504
19	20.514	0.504

20	20.514	0.504
21	20.514	0.504
22	20.514	0.504
23	20.514	0.504
24	20.514	0.504
25	20.514	0.504
26	20.514	0.504
27	20.514	0.504
28	20.514	0.504
29	20.514	0.504
30	20.514	0.504
31	20.514	0.504
32	20.514	0.504
33	20.514	0.504
34	20.514	0.504
35	20.514	0.504
36	20.514	0.504
37	20.514	0.504
38	20.514	0.504
39	20.514	0.504
40	20.514	0.504
Total	820.514	20.160

Here, Total yds for 40 lays = 820.514 yds

Total Wastage = 20.16/36

=0.56 yds

So, wastage % = 0.56/820.514*100= 0.07%

Day 3

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.514	0.504
2	20.514	0.504
3	20.514	0.504
4	20.514	0.504
5	20.514	0.504
6	20.514	0.504
7	20.514	0.504
8	20.514	0.504
9	20.514	0.504
10	20.514	0.504
11	20.514	0.504
12	20.514	0.504
13	20.514	0.504
14	20.514	0.504
15	20.514	0.504
16	20.514	0.504
17	20.514	0.504
18	20.514	0.504
19	20.514	0.504

20	20.514	0.504
21	20.514	0.504
22	20.514	0.504
23	20.514	0.504
24	20.514	0.504
25	20.514	0.504
26	20.514	0.504
27	20.514	0.504
28	20.514	0.504
29	20.514	0.504
30	20.514	0.504
31	20.514	0.504
32	20.514	0.504
33	20.514	0.504
34	20.514	0.504
35	20.514	0.504
36	20.514	0.504
37	20.514	0.504
38	20.514	0.504
39	20.514	0.504
40	20.514	0.504
41	20.514	0.504
42	20.514	0.504
43	20.514	0.504
Total	882.102	21.672

Here, Total yds for 43 lays = 882.102 yds

Total Wastage = 21.672/36

=0.602 yds

So, wastage % = 0.602/882.102*100= 0.07%

Day 4

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.514	0.504
2	20.514	0.504
3	20.514	0.504
4	20.514	0.504
5	20.514	0.504
6	20.514	0.504
7	20.514	0.504
8	20.514	0.504
9	20.514	0.504
10	20.514	0.504
11	20.514	0.504
12	20.514	0.504
13	20.514	0.504
14	20.514	0.504
15	20.514	0.504
16	20.514	0.504
17	20.514	0.504

18	20.514	0.504
19	20.514	0.504
20	20.514	0.504
21	20.514	0.504
22	20.514	0.504
23	20.514	0.504
24	20.514	0.504
25	20.514	0.504
26	20.514	0.504
27	20.514	0.504
28	20.514	0.504
29	20.514	0.504
30	20.514	0.504
31	20.514	0.504
32	20.514	0.504
33	20.514	0.504
34	20.514	0.504
35	20.514	0.504
36	20.514	0.504
37	20.514	0.504
38	20.514	0.504
Total	779.532	19.152

Here, Total yds for 38 lays = 779.532 yds

Total Wastage =19.152/36

=0.532 yds

So, wastage % = 0.532/779.532*100= 0.07%

Day 5

Lay No	Total Yds (Including 1" Allowance)	Wastage of Ends (inch)
1	20.514	0.504
2	20.514	0.504
3	20.514	0.504
4	20.514	0.504
5	20.514	0.504
6	20.514	0.504
7	20.514	0.504
8	20.514	0.504
9	20.514	0.504
10	20.514	0.504
11	20.514	0.504
12	20.514	0.504
13	20.514	0.504
14	20.514	0.504
15	20.514	0.504
16	20.514	0.504
17	20.514	0.504
18	20.514	0.504
19	20.514	0.504
20	20.514	0.504

21	20.514	0.504
22	20.514	0.504
23	20.514	0.504
24	20.514	0.504
25	20.514	0.504
26	20.514	0.504
27	20.514	0.504
28	20.514	0.504
29	20.514	0.504
30	20.514	0.504
31	20.514	0.504
32	20.514	0.504
33	20.514	0.504
34	20.514	0.504
35	20.514	0.504
36	20.514	0.504
37	20.514	0.504
38	20.514	0.504
39	20.514	0.504
40	20.514	0.504
Total	820.514	20.16

Here, Total yds for 40 lays = 820.514 yds

Total Wastage = 20.16/36

=0.56 yds

So, wastage % = 0.56/820.514*100= 0.07%

Table 13 Summary of 4 weeks wastage for automated Spreading

Week 1 Wastages for Automated Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
17.12.22	1	41	841.074	20.664
18.12.22	1	40	820.514	20.160
19.12.22	1	43	882.102	21.672
20.12.22	1	38	779.532	19.152
21.12.22	1	40	820.514	20.664
Total	**5 Hours**	**202**	4143.828	101.808

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 54143.828yds

Total Wastage in 1st week = 101.808 inches

= 2.828 yds

Week 2 Wastages for Automated Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
24.12.2022	1	40	820.514	20.160
25.12.2022	1	42	861.588	21.168
26.12.2022	1	38	779.532	19.152
27.12.2022	1	39	800.046	19.656
28.12.2022	1	42	861.588	21.168
Total	**5 Hours**	**201**	4123.314	101.304

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 4123.314 yds

Total Wastage in 1st week = 101.304 inches

= 2.814 yds

Week 3 Wastages for Automated Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
01.01.2023	1	45	923.130	22.680
02.01.2023	1	42	861.588	21.168
03.01.2023	1	40	820.514	20.160
04.01.2023	1	43	882.102	21.672
07.01.2023	1	42	861.588	21.168
Total	**5 Hours**	**212**	4348.968	106.848

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 4348.968 yds

Total Wastage in 1st week = 106.848 inches

= 2.968 yds

Week 4 Wastages for Automated Spreading

Date	Observation Time (Hour)	Total Number of Lay	Total yds	Wastage of Ends (inch)
08.01.2023	1	38	779.532	19.152
09.01.2023	1	40	820.514	20.160
10.01.2023	1	42	861.588	21.168
11.01.2023	1	41	841.074	20.664
14.01.2023	1	39	800.046	19.656
Total	**5 Hours**	**200**	4102.8	100.8

Here,

Total Observation time in 5 days = (1*5) = 5 hours

Total yds = 4102.8 yds

Total Wastage in 1st week = 100.8 inches

= 2.8 yds

3.2.4 Efficiency % of Automated Spreading

Simultaneously it was observed by us how much efficient or productive automated spreading was throughout the week and this data was given below

We know, Efficiency % = Total Productive time/Total Hour * 100

Table 14 Weekly Table of Efficiency % for Automated Spreading

Week	Time of Observation (Hour)	Total Productive Time	Efficiency %
1st	5 hours	2.50 Hours	50 %
2nd	5 Hours	2.53 Hours	50.6%
3rd	5 hours	2.62 Hours	52.4 %
4th	5 Hours	2.483 Hours	49.66%

CHAPTER 4
DISCUSSION AND CALCULATION

From the above data we have made Analysis of the result of manual Spreading and automated spreading compared with their one Month Productive, nonproductive time and Amount of wastage as well as efficiency % of both manual and automated spreading. At first, we have compared monthly productive time for both manual spreading and automated spreading.

4.1 One Month Productive Time Analysis for Manual Spreading and Automated Spreading

Manpower for Manual Spreading: 10

Total Observed time in 5 days = 5 Hours

Table 15 One Month productive Time of Manual Spreading

Weeks	**Total Lays**	**Productive Time**
1st Week	292 lays	2.03
2nd Week	293 lays	2.09
3rd Week	317 lays	2.24
4th Week	297 lays	2.04

So, we have seen that between 5 hour observed time the average productive time and lays will be:

Here,

Average Productive Time =2.03+2.09+2.24+2.04 = 8.4 / 4

= 2.1 Hours

Average Lays in Productive Time =292+293+317+297 = 1199/ 4

= 299.75 = 300 Lays

So, we can say that between 5 Hours 300 lays can be done in 2.1 hours.

Manpower for Automated Spreading: 03

Table 16 One Month productive Time of Automated Spreading

Weeks	**Total Lays**	**Productive Time**
1st Week	202 lays	2.50
2nd Week	201 lays	2.53
3rd Week	212 lays	2.62
4th Week	200 lays	2.48

So, we have seen that between 5 hour observed time the average productive time and lays will be:

Here,

Average Productive Time =2.50+2.53+2.62+2.48 = 10.13 / 4

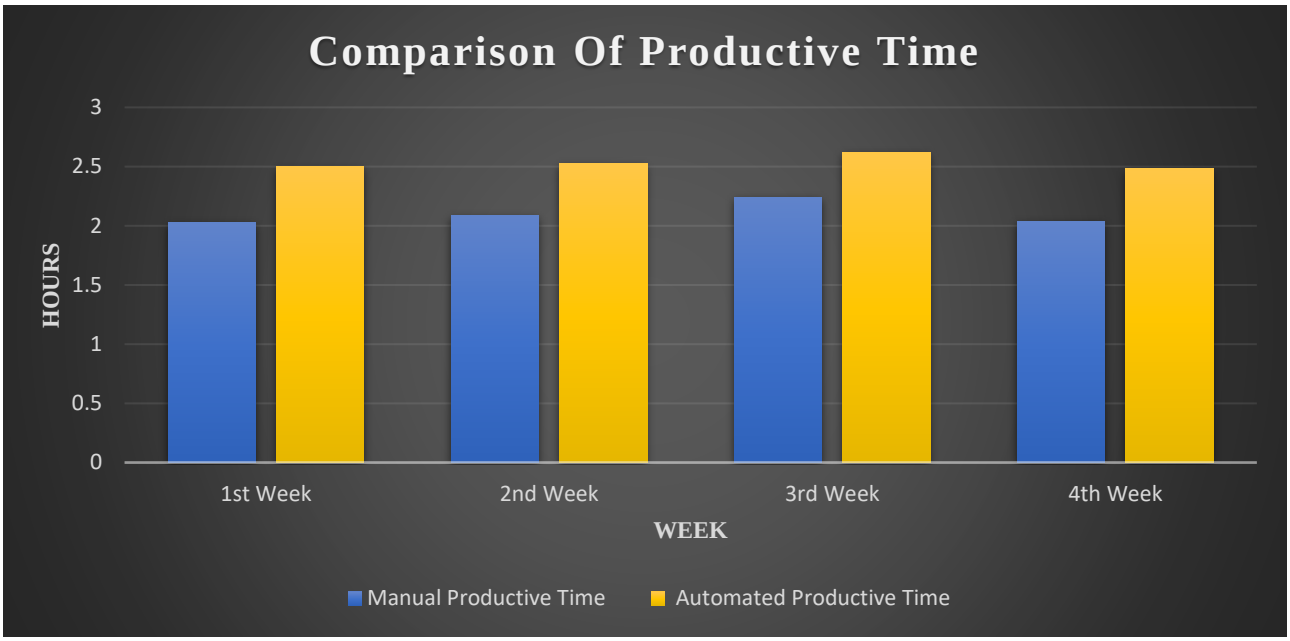
= 2.53 Hours

Average Lays in Productive Time =202+201+212+200 = 815/ 4

= 204 Lays

So, we can say that between 5 Hours 204 lays can be done in 2.53 hours.

Here We showed the Graph of Productive time between Automated and Manual Spreading



Graph 1 One Month Productive time

We have seen than in one month on average Automated Spreading have higher productive time compared to manual Spreading but we know gives less layers than manual spreading.

4.2 One Month Nonproductive Time Analysis for Manual Spreading and Automated Spreading

Manpower for Manual Spreading: 10

Table 17 One Month Nonproductive Time of Manual Spreading

Weeks	Total Lays	Productive Time
1st Week	292 lays	2.99
2nd Week	293 lays	2.91
3rd Week	317 lays	2.25
4th Week	297 lays	2.95

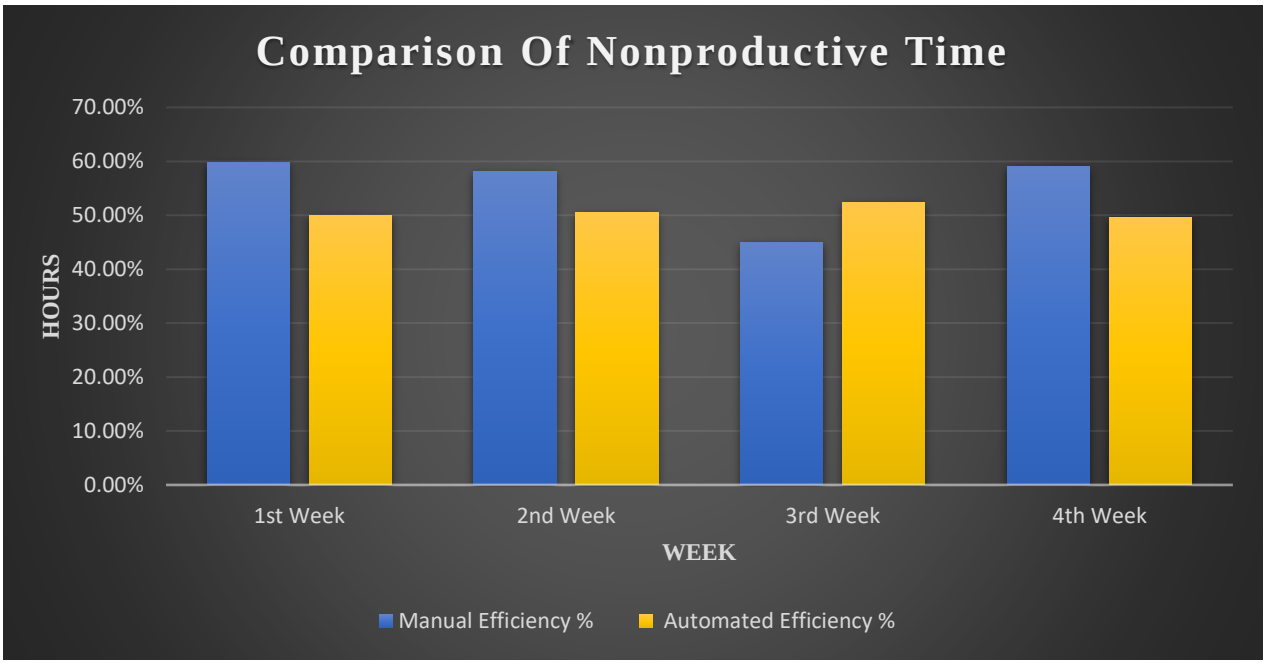
So, we can say that between 5 Hours, Nonproductive time for 300 lay is 2.9 hours.

Manpower for Automated Spreading: 03

Table 18 One Month Nonproductive Time of Automated Spreading

Weeks	Total Lays	Productive Time
1st Week	202 lays	2.56
2nd Week	201 lays	2.50
3rd Week	212 lays	2.45
4th Week	200 lays	2.48

So, we can say that between 5 Hours, Nonproductive time for 204 lay is 2.4 hours.



Graph 2 One Month Nonproductive time

4.3 One Month Wastage analysis for Manual Spreading and Automated Spreading

We Have Seen that in one month the wastage of manual spreading much higher than automated spreading it is just because of the workers accuracy when cutting any ends of the layers.

Table 19 One Month Wastage of Manual Spreading

Weeks	Total Yds	Total Wastage
1st Week	5997.789 yds	11.785 yds
2nd Week	6220.430 yds	12.201 yds
3rd Week	6223.762 yds	12.534 yds
4th Week	6112.574 yds	12.044 yds

We wastage percentage formula =Total wastage/Total yds*100

So, we can say that 1st week wastage % is= 0.19%

2nd week wastage % is= 0.19%

3rd week wastage % is= 0.20%

4th week wastage % is= 0.19%

Total Wastage % = 0.20 %

Table 20 One Month Wastage of Automated Spreading

Weeks	Total Yds	Total Wastage
1st Week	5414.828 yds	2.828 yds
2nd Week	4123.314 yds	2.814 yds
3rd Week	4348.968 yds	2.968 yds
4th Week	4102.8 yds	2.8 yds

We wastage percentage formula = Total wastage/Total yds*100

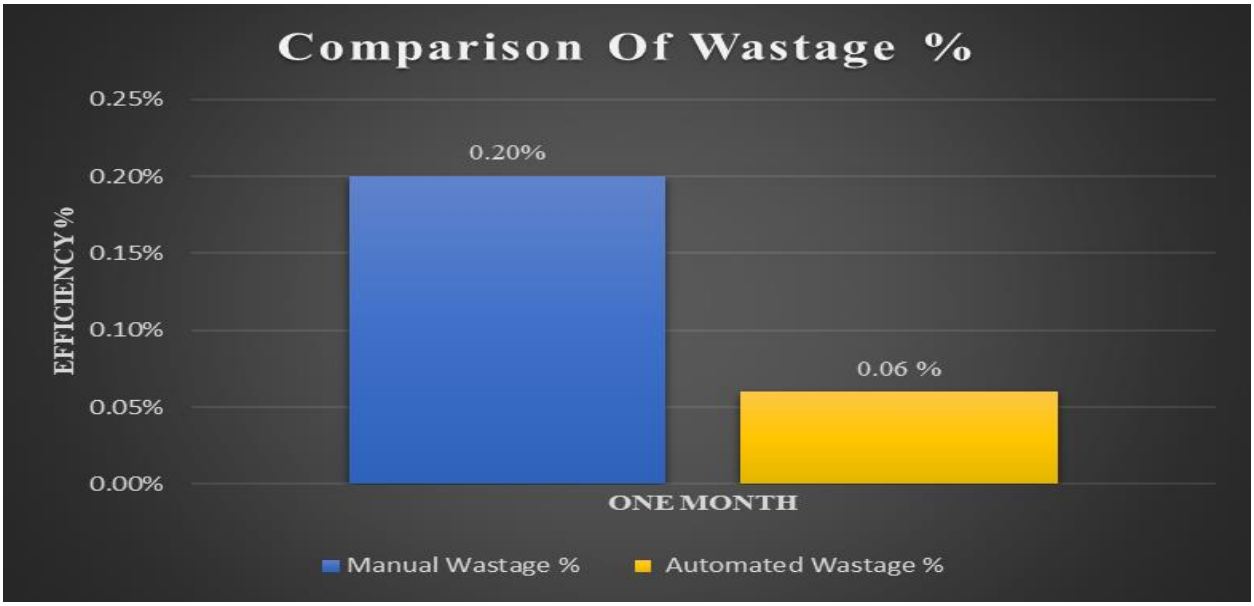
So, we can say that 1st week wastage % is= 0.05%

2nd week wastage % is= 0.06 %

3rd week wastage % is= 0.06 %

4th week wastage % is= 0.06 %

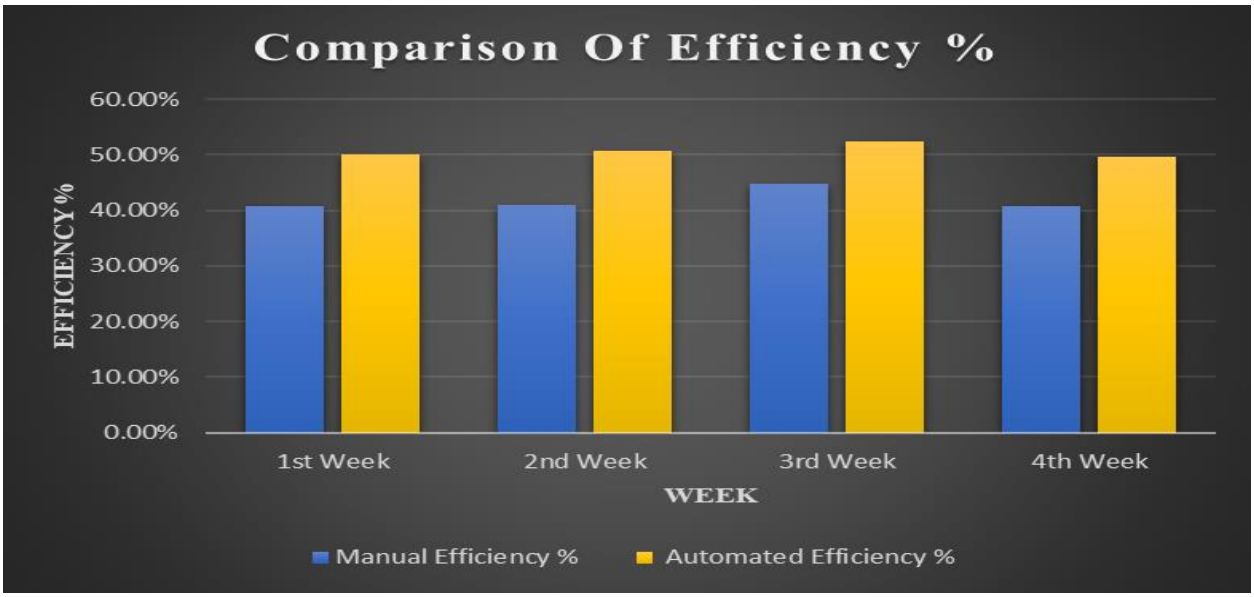
Total Wastage % = 0.06%



Graph 3 One Month Wastage %

4.4 One Month Analysis of Efficiency between Manual and Automated Spreading

In this segment we have calculate the efficiency % based on their productive time in 5 hours as how it can utilize the productive time during production. More production gives more efficiency as well as note that manual spreading have 10 manpower despite having 3 manpower automated spreading also gives good efficiency which is close to manual spreading . Here we have shown the Graph below



Graph 4 One Month Efficiency %

From the Above Analysis We have made a final conclusion of comparison between manual Spreading and Automated spreading and the table is given below

Table 21 Final Comparison of Manual Spreading and Automated Spreading

Manual Spreading	Automated Spreading
1. Manual Spreading takes less productive time	1. Automated Spreading takes more productive time
2. Manual spreading dependent on manpower	2. Automated Spreading dependent on the machine
3. manual Spreading Gives More Layers in Productive Time	3. Automated Spreading Gives less Layers in productive time
4. Manual Spreading takes More nonproductive time	4. Automated Spreading takes less nonproductive time
5. Manual Spreading gives more efficiency	5. Automated Spreading gives Less Efficiency
6. Manual Spreading Gives less Accuracy	6. Automated Spreading gives more Accuracy
7. Manual spreading have more wastage %	7. Automated Spreading Have less Wastage %

CHAPTER 5

PROFESSIONAL RESPONSIBILITIES, HEALTH, SAFETY, SOCIO- CULTURAL, AND ENVIRONMENTAL CONSIDERATION

In this section we will discuss whether the work done in our industries will not have any bad impact on the environment. And which aspects are better if we maintain such Health, Safety, and social responsibilities.

5.1 Codes and standards used

Ha-Meem Group is one of the reputed garment industries of Bangladesh. Most buyers of this industries are world-famous and conscious about the environment. Therefore, the precautions of their order is that all international codes of conduct must be maintained. BSCI & CSR rules and regulations must be followed. Zero tolerance for child labor, so that unusual problems can be avoided. Also, maintain ISO 9001 which defines the international standard for quality management. Must maintain the ETP process. So that, starting from sample production to bulk production, the amount of water required cannot have a bad effect on the environment.

5.2 Ethical principles and professional commitment

Main principle & commitment is to work ourselves in the right way keeping the environment healthy for the next generation. Try to produce sustainable products. There is a practice of using organic cotton yarn to make garments. Using good quality dye chemicals which do not harm the environment or the body. Avoid abuse & harassment during the working period. After the main duty and not forced to do part-time for a long time. Gender discrimination must be stopped.

Fire drill at least once every month and to ensure that all the workers leave the factory within 6 minutes.

5.3 Impact on society, health, safety, legal and cultural issues

Maintaining the code of conduct of international organizations has a positive impact on society. For example, by following the rules of BSCI, all the benefits of the workers are ensured. No workers can be added to overtime after specified duty. Paying wages on time, not taking child labor, and strictly monitoring the aspects of abuse or harassment of women workers fall under the norms of BSCI. Currently, most buyers have a must requirement to maintain BSCI principles. By doing this, workers are getting their fair benefits correctly, which is having a positive effect on society. CSR activities are another international organization's rules and regulations. Here all types of social issues are ensured. For example, ensure maternity leave and allowances for women workers. Make a mosque or school around the area where there are industries. As a result, it has a positive impact on society. As a result of maintaining ISO standards, customers are getting the right quality products. Safety issues of industries are monitored through social audits. As a result, industries are always prepared to extinguish the fire, with fire alarms installed everywhere, some emergency exits made, and some people always kept in the factory to extinguish the fire. Moreover, whether the workers have a standard washroom or not, and whether the workplace is proper or not, are observed in the social audit. Here, the safety of the workers is seen and on the other hand, and the working environment is also ensured.

5.4 Impact on Environment

Nowadays ETP is a common term in textile industries. We know that a lot of water is needed to produce garments and if these waters are released in the same condition as they are used, then it has a serious negative effect on the environment. ETP Process is introduced to get rid of this. Through this, the water is treated and discharged into the environment which does not harm the environment. This ETP process is having a good positive impact on the environment. On the other hand, the industry is trying to produce sustainable products. Dry wash is trying to make it usable. Using organic yarn. All these works are having a good impact on the environment.

CHAPTER 6
CONCLUSION

This project is actually about a very significant part in our cutting section of a textile factory. The comparison of automated spreading and manual spreading are two very vital processes in the cutting section. Both processes are equally needed. Automated process is needed for reducing the cost and managing the efficient number of lays. Manual process is needed for making more number of lays and doing it in less time. So, in this project we basically compared these two processes and evaluated all the possibilities of efficiency, waste of time, management of the sections etc. Here we have made some outcome of results from both the processes. We have also made some clear statements about the precautions to be taken. So last but not the least we can say that both the processes are very important in our textile industry. This process should be done under expert supervision and more efficiency will come after that.

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