Analysis of Sewing Operations, Line layout, and SMV

Estimation for Woven Shirts and Dress Pants: A Strategic Approach to Enhancing Efficiency

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Abstract: The apparel industry is changing its manufacturing to new techniques and procedures to boost productivity and maintain consistency with swift changes in customer behavior and fashion trends. This study aims to determine how to improve the process breakdown, line layout, and SMV calculation of woven shirts and dress Pants to increase the efficiency of the sewing process.

The study commences by analyzing the sewing process and breaking it down into its fundamental elements. By carefully analyzing every step, the main goal of this research is to identify potential bottlenecks and areas of improvement from pattern making to final stitching. In addition, the study closely monitors the layout of the sewing line, focusing on the importance of the ergonomic setup. The main benefit of this study is to increase overall efficiency by rearranging machinery, workstations, and personnel and minimizing downtime.

The main aspect of the study contains the calculation of standard minute value (SMV). The researchers meticulously measured the SMV for the sewing of woven shirts and dress trousers. The results provide valuable insights into the time and materials required to make each garment.

Finally, the research recommends a guideline for boosting efficiency in woven shirts and dress Pants manufacturing and provides pragmatic roadmaps based on true data and industrial best practices. The findings of this study provide some proposals to reduce manufacturing costs and maintain continuous improvement of the sewing floor in the garment industry.

The proposed revisions in shirts result in a 7.7% reduction in labor costs and a 5.89% decrease in SMV, while dress Pants see a 1.97% decrease in SMV.

Introduction

A dress shirt is a clothing item for the upper part of the body, opening at the front, which is fastened by using buttons or shirt studs. Typically, it is made with woven fabric and often accompanied by ties, formal wear, and suits. However, dress shirts may be used as casual wear as well.

In 1913, the Egyptologist Sir Flinders Petrie discovered one of the oldest shirts in an Egyptian tomb, and it was the most primitive Egyptian apparel and dates from around 3500 BC. [1] With this information, we can assume that the shirt is one of the oldest clothes in history.

In addition, from the middle Ages to the Renaissance, the shirt was treated as an undergarment that provided a cleanable barrier between the body and main outerwear. [2] Nowadays, this undergarment idea is still apparent in our regular formal situations, for instance, weddings, corporate dinners, race meetings (think royal ascot), and so on. [3]

On the other hand, Pants are an outer clothing that is worn on the lower half of the body, it is made in various shapes, such as narrow, slim fit, baggy Pants, and many others. However, Pants are an item of underwear, it is not considered in the categories of Pants.

In the sixth century BC, Pants were first made in Greece, and it was also found in Persian, eastern, and central Asia at that time, especially among horse riders who wore them as riding attire. Moreover, we can find pictures of Pants in ancient ceramics. In the 14th century, the military used to wear snug shorts or loose-fitting Pants that ended at the ankles. At the end of the 14th century, tight Pants evolved with foot-covering elements. Regular Pants like the ones we wear nowadays were introduced in the 19th century. Consequently, the eldest son of Queen Victoria, the first British Kaiser, introduced these Pants as like our current trendy Pants. [4]

Currently, these two items are very captivating in global fashion, people have been using these goods regularly. Many western apparel brands are entrenched in their business based on these products, and due to high labor costs, they are sourcing these from different countries such as China, Bangladesh, Vietnam, Pakistan, and so on.

However, these apparel-exporting countries have been surviving with higher manufacturing costs for the last decade, and they are always searching for the best operating procedure to decrease this cost. Calculating the correct SMV is one of the fundamental steps to deal with this problem precisely. SMV means standard minute value, which determines the required time to complete the specific operation in the manufacturing process. In the context of

industrial sewing, SMV is the amount of time needed to finish a particular sewing task, and it is a crucial part of estimating the cost, allocating the resources, and planning the production accurately.

Furthermore, manufacturers can detect inefficiencies, optimize manufacturing processes, and set realistic production targets by precisely calculating SMV. In the apparel sector, effective SMV management assures enhanced profitability, increased production, and streamlined workflow. It also aids producers in remaining competitive in the market and satisfying customers by allowing them to meet delivery schedules and maintain quality standards.

SMV includes many variables, for instance, the intricacy level of the sewing procedure, the operator's skills, the types of machine being used, and the kind of fabric being sewn. In addition, it assists the maker in setting pragmatic production targets, estimating the production time, and allocating the resources effectively.

In the mid-20th century, SMV became popular in the apparel manufacturing arena. The work of Frederick W. Taylor, who is frequently referred to as the father of scientific management, is where SMV first emerged. [5] His ideas created the foundation for further advances in industrial engineering, such as the introduction of the SMV concept. A significant turning point in the history of SMV use in the apparel industry was the 1940s launch of the "method-time measurement" (MTM) system by H.B. Maynard and colleagues. [6] One of the first techniques for creating regular timeframes for manual operations based on predefined motion features was motion tracking.

Methodology

SMV is the time required for a qualified operator working at "standard performance" to perform a given process. This paper's method starts with collecting a layout plan for measuring and improving the plan. The layout plans have been collected from different garment production units and sorted out to improve. After that, the operations have been selected from this layout. Each operation has been observed meticulously to research the work procedures in every process. The required time of every operation has been carefully calculated, and the time consumption of each operation. Then, the workers and co-workers gave their opinions about productivity and time consumption. After discussing the process, proposed layout plans have been suggested to save time, minimize cost, and upturn productivity, and there is a bottleneck in the process.

Steps for Calculating SMV

SMV is a very crucial activity within the operation process in garment manufacturing. It acts as a standard for determining production time, fixing the goals, and assigning the resources accordingly. However, some fundamental formulas are mentioned below to calculate this SMV,

SMV = basic time + allowance

Basic time = observe time × rating

Observe time = total cycle time ÷ total cycle

Rating = observe rating ÷ standard rating × 100

Observe rating = observe capacity ÷ standard capacity ×100

Sewing process breakdown

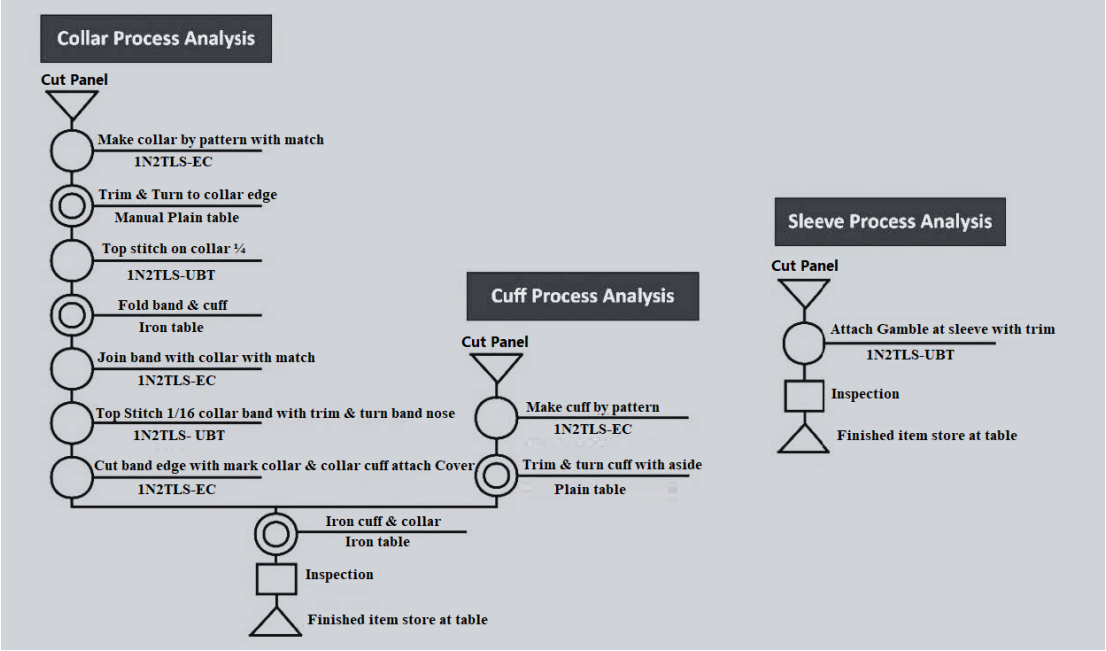

Diagram: Parts making (Shirts)

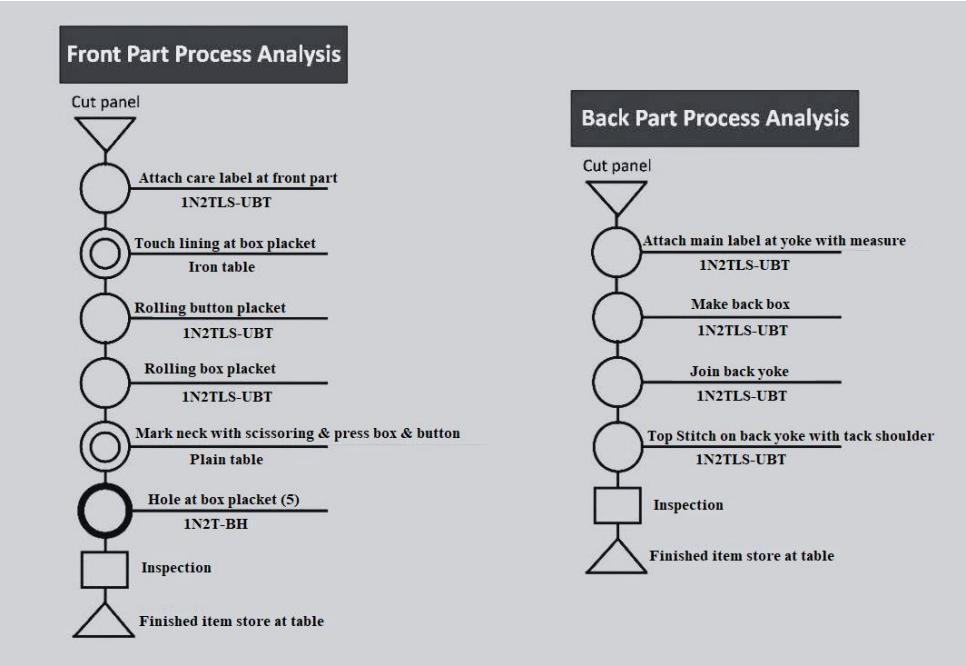

Diagram: Front and Back parts making

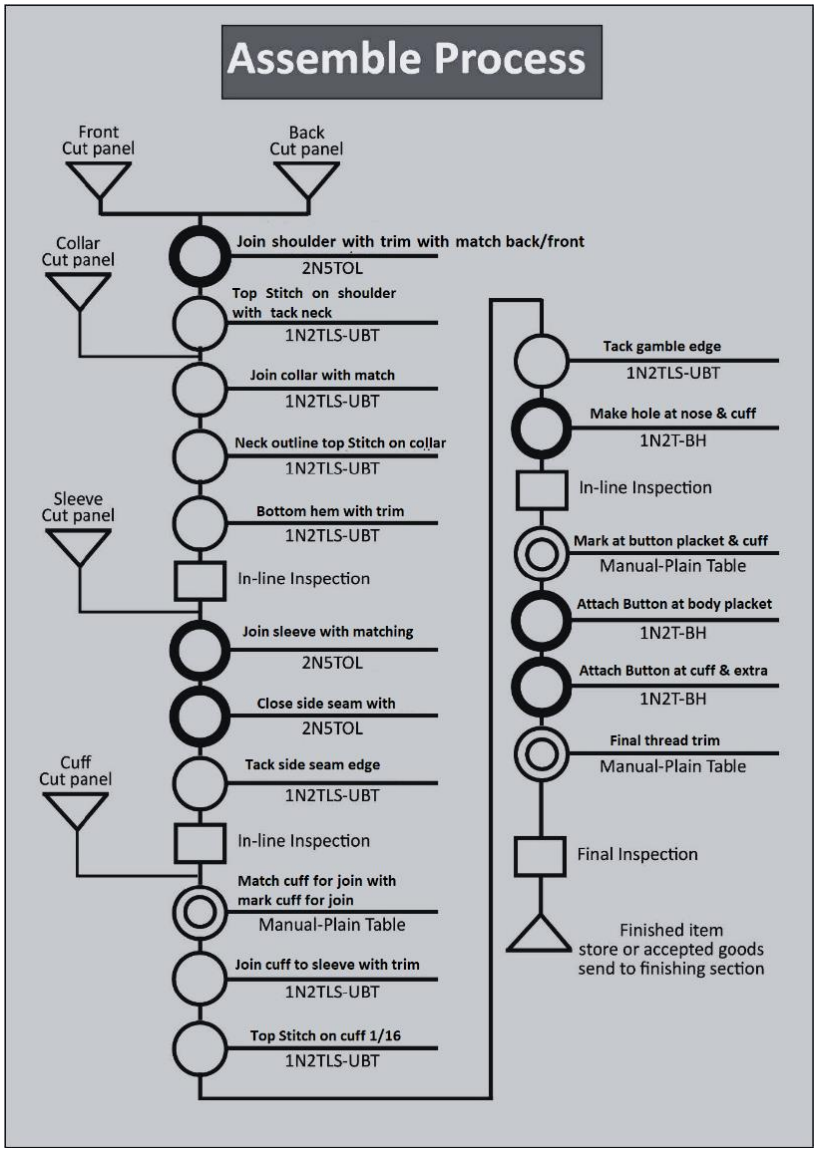

Diagram: Assembly (Shirt)

Sewing line layout and SMV calculation:

Section: Collar											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
1	CPU	Make collar by pattern with match	M	1N2TLS-EC	Plain Foot	Use Pattern	0.4	150	1.35	1	1
2	CPU	Trim & Turn to collar edge	H	Plain table			0.23	261	0.77	0.5	1
3	CPU	Top stitch on collar ¼	M	1N2TLSUBT	CR 1/16”		0.38	158	1.28	1.5	2
4	CPU	Fold band & cuff	I	Iron table		Pattern	0.36	167	1.21	2	2
5	CPU	Join band with collar with match	M	1N2TLS-EC		Pattern	0.42	143	1.41	1.5	2
6	CPU	Top stitch 1/16 collar band with trim & turn band nose	M	1N2TLS-UBT	CR 1/16”		0.44	136	1.48	1.5	2
7	CPU	Cut band edge with mark collar & collar cuff attach Cover	M	1N2TLS-EC			0.44	136	1.48	1.5	2
Section: Cuff											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
8	CPU	Make cuff by pattern	M	1N2TLS-EC	Plain Foot	Use Pattern	0.42	143	1.41	1	1
9	CPU	Trim & turn cuff with aside	H	Plain table			0.22	273	0.74	0.5	1
10	CPU	Iron cuff & collar	I	Iron table			0.38	158	1.28	2	2
Section: Front											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
11	CPU	Attach care label at front part	M	1N2TLS-UBT	Plain Foot		0.33	182	1.11	1	1
12	CPU	Touch liling at box placket	I	Iron table			0.42	143	1.41	2	2
13	CPU	Rolling btn placket	M	1N2TLS-UBT	CR 1/16”	Use folder	0.34	176	1.14	1	1
14	CPU	Rolling box placket	M	1N2TLS-UBT	CR 1/16”		0.34	176	1.14	1	1
15	CPU	Mark neck wt scissoring & press box & button	H	Plain table		Use folder	0.35	171	1.18	1	1
16	CPU	Hole at box placket (5 times)	M	1N2T-BH			0.38	158	1.28	1	1
Section: Back											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
17	CPU	Attach main label at yoke with measure	M	1N2TLS-UBT	Plain Foot		0.36	167	1.21	1	1
18	CPU	Make back box	M	1N2TLS-UBT	Plain Foot		0.32	188	1.08	1	1
19	CPU	Join back yoke	M	1N2TLS-UBT	Plain Foot		0.38	158	1.28	1.5	2
20	CPU	Top stitch on back yoke with tack shoulder	M	1N2TLS-UBT	CR 1/16”		0.38	158	1.28	1.5	2

Section: Sleeve											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
21	CPU	Attach Gamble at sleeve with trim	M	1N2TLS-UBT	CR 1/16"	Folder	0.52	115	1.75	2	2
Section: Assemble											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
22	Assembly	Join shoulder with trim with match back/front	M	2N5TOL	Plain Foot		0.6	100	2.02	2	2
23	Assembly	Top stitch on shoulder with tack neck	M	1N2TLS-UBT	CL 1/16"		0.34	176	1.14	1	1
24	Assembly	Join collar with match	M	1N2TLS-UBT	Plain Foot		0.42	143	1.41	1.5	2
25	Assembly	Neck outline top stitch on collar	M	1N2TLS-UBT	CR 1/16"		0.54	111	1.82	2	2
26	Assembly	Bottom hem with trim	M	1N2TLS-UBT	CL 1/16"		0.42	143	1.41	2	2
27	Assembly	Join sleeve with matching	M	2N5TOL			0.65	92	2.19	2	2
28	Assembly	Close side seam with trim	M	2N5TOL			0.6	100	2.02	2	2
29	Assembly	Tack side seam edge	M	1N2TLS-UBT	Plain Foot		0.36	167	1.21	1	1
30	Assembly	Match cuff for join with mark cuff for join	H	Plain table			0.32	188	1.08	1	1
31	Assembly	Join cuff to sleeve with trim	M	1N2TLS-UBT	CL 1/16"	Folder	0.53	113	1.78	2	2
32	Assembly	Top stitch on cuff 1/16	M	1N2TLS-UBT	CR 1/16"		0.32	188	1.08	1	1
33	Assembly	Tack gamble edge	M	1N2TLS-UBT	Plain Foot		0.28	214	0.94	1	1
34	Assembly	Make hole at nose & cuff	M	1N2T-BH			0.38	158	1.28	1	1
35	Assembly	Mark at Button placket & cuff	H	Plain table			0.43	140	1.41	1	1
36	Assembly	Attach Button at body placket	M	1N2T-BS			0.48	125	1.61	1.5	2
37	Assembly	Attach Button at cuff & extra	M	1N2T-BS			0.38	158	1.28	1	1
38	Assembly	Final thread trim	H	Plain table			0.6	100	2.02	2	2
									Total SMV:	**15.46**	
									Allotted Man Power:	**52**	
									Planned Workstation:	**57**	

Proposals based on process breakdown, line layout, and SMV calculation of woven shirt:

- Critical Processes of the Cuff and Collar can be done in a section.
- Process 1 and Process 8 can be done in parallel.
- Processes 2 and 9 can be combined.
- Process 10 can be done after process 7 (Cut band edge with mark collar and collar cuff attach Cover), so that cut panels of both collar and cuff can be prepared.

Revised sewing process breakdown of woven shirt

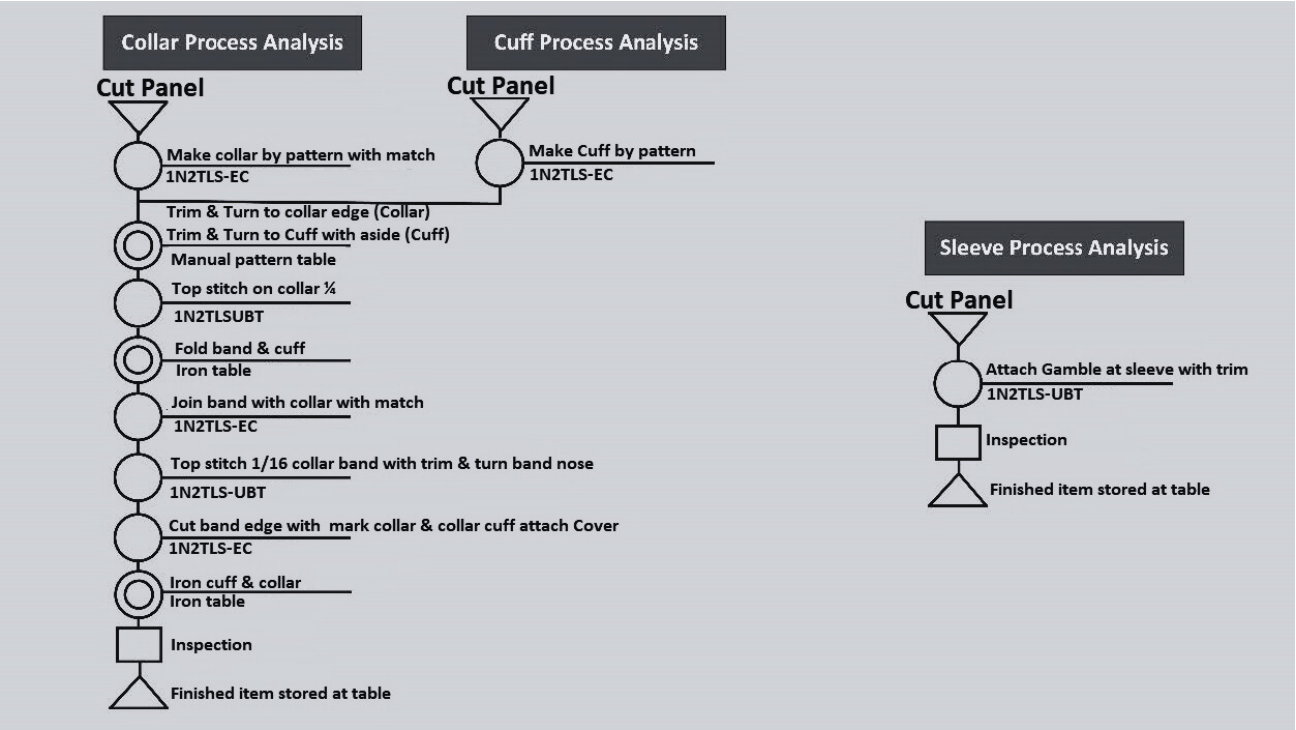

Diagram: Parts making (Shirts)

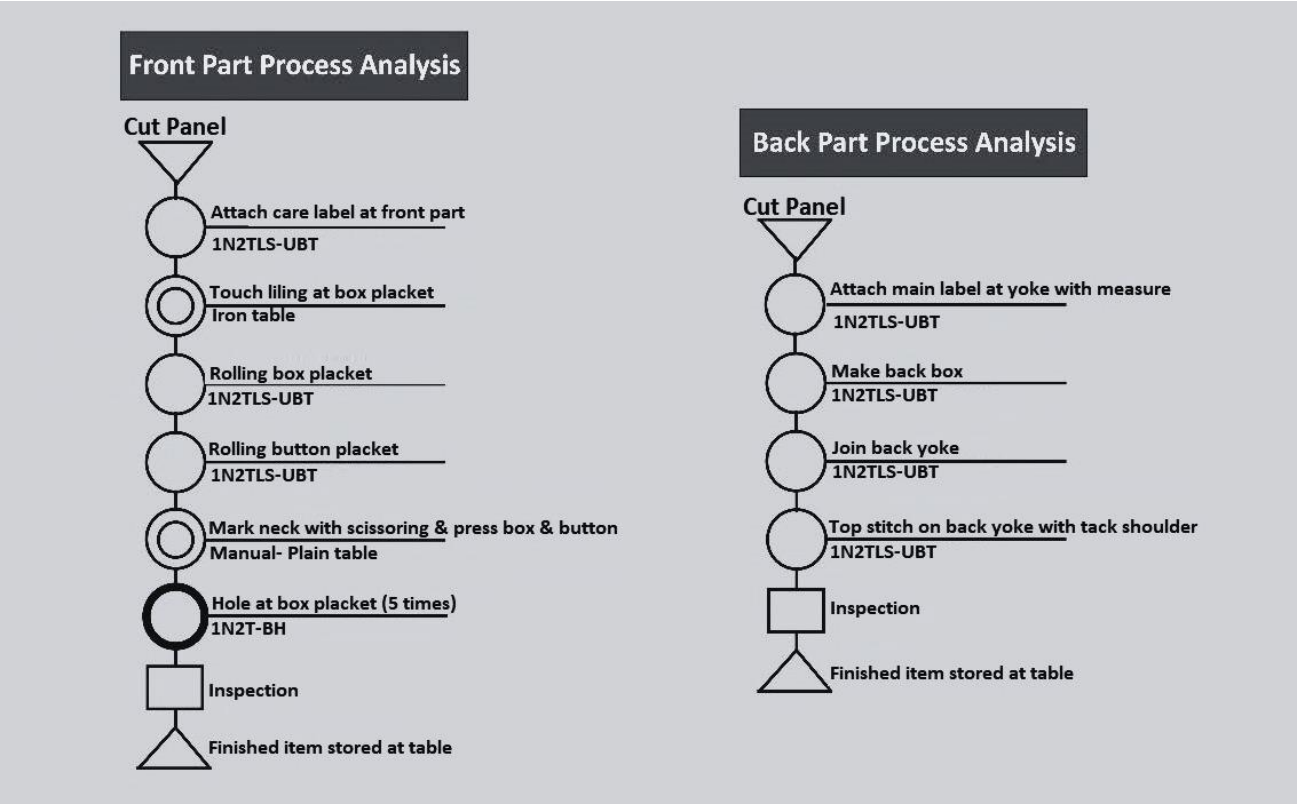

Diagram: Front and Back parts making

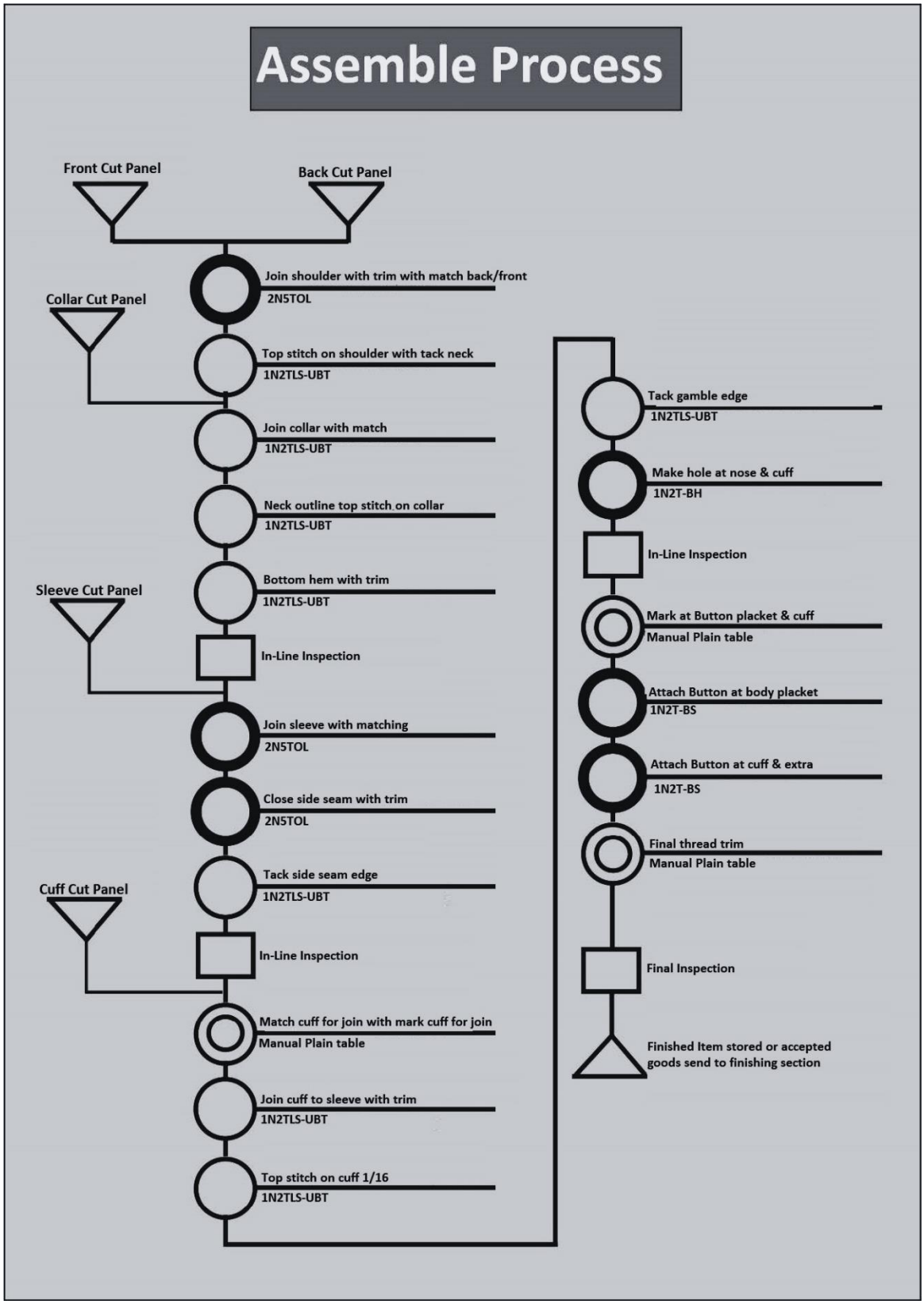

Diagram: Assembly (Shirt)

Revised layout sewing SMV calculation:

Section: Collar & Cuff											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
1	CPU	(1A) Make collar by pattern with match (1B) Make cuff by pattern	M	1N2TLS-EC	Plain Foot	Use Pattern	0.45	93	1.35	1	1
2	CPU	(2A) Trim & Turn to collar edge. (2B) Trim & turn cuff with aside	H	Plain table			0.25	168	1.2	1	1
3	CPU	Top stitch on collar ¼	M	1N2TLS-UBT	CR 1/16”		0.38	158	1.28	1.5	2
4	CPU	(4A) Fold band & cuff (4B) Iron cuff & collar	I	Iron table		Pattern	0.4	105	1.21	1	1
5	CPU	Join band with collar with match	M	1N2TLS-EC		Pattern	0.42	143	1.41	1.5	2
6	CPU	Top stitch 1/16 collar band with trim & turn band nose	M	1N2TLS-UBT	CR 1/16”		0.44	136	1.48	1.5	2
7	CPU	Cut band edge with mark collar & collar cuff attach Cover	M	1N2TLS-EC			0.44	136	1.48	1.5	2
Section: Front											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
8	CPU	Attach care label at front part	M	1N2TLS-UBT	Plain Foot		0.33	182	1.11	1	1
9	CPU	Touch liling at box placket	I	Iron table			0.42	143	1.41	2	2
10	CPU	Rolling button placket	M	1N2TLS-UBT	CR 1/16”	Use folder	0.34	176	1.14	1	1
11	CPU	Rolling box placket	M	1N2TLS-UBT	CR 1/16”		0.34	176	1.14	1	1
12	CPU	Mark neck with scissoring & press box & button	H	Plain table		Use folder	0.35	171	1.18	1	1
13	CPU	Hole at box placket (5 times)	M	1N2T-BH			0.38	158	1.28	1	1
Section: Back											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
14	CPU	Attach main label at yoke with measure	M	1N2TLS-UBT	Plain Foot		0.36	167	1.21	1	1
15	CPU	Make back box	M	1N2TLS-UBT	Plain Foot		0.32	188	1.08	1	1
16	CPU	Join back yoke	M	1N2TLS-UBT	Plain Foot		0.38	158	1.28	1.5	2
17	CPU	Top stitch on back yoke with tack shoulder	M	1N2TLS-UBT	CR 1/16”		0.38	158	1.28	1.5	2
Section: Sleeve											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
18	CPU	Attach Gamble at sleeve with trim	M	1N2TLS-UBT	CR 1/16”	Folder	0.52	115	1.75	2	2

Section: Assemble											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
19	Assembly	Join shoulder with trim with match back/front	M	2N5TOL	Plain Foot		0.6	100	2.02	2	2
20	Assembly	Top stitch on shoulder with tack neck	M	1N2TLS-UBT	CL 1/16”		0.34	176	1.14	1	1
21	Assembly	Join collar with match	M	1N2TLS-UBT	Plain Foot		0.42	143	1.41	1.5	2
22	Assembly	Neck outline top stitch on collar	M	1N2TLS-UBT	CR 1/16”		0.54	111	1.82	2	2
23	Assembly	Bottom hem with trim	M	1N2TLS-UBT	CL 1/16”		0.42	143	1.41	2	2
24	Assembly	Join sleeve with matching	M	2N5TOL			0.65	92	2.19	2	2
25	Assembly	Close side seam with trim	M	2N5TOL			0.6	100	2.02	2	2
26	Assembly	Tack side seam edge	M	1N2TLS-UBT	Plain Foot		0.36	167	1.21	1	1
27	Assembly	Match cuff for join with mark cuff for join	H	Plain table			0.32	188	1.08	1	1
28	Assembly	Join cuff to sleeve with trim	M	1N2TLS-UBT	CL 1/16”	Folder	0.53	113	1.78	2	2
29	Assembly	Top stitch on cuff 1/16	M	1N2TLS-UBT	CR 1/16”		0.32	188	1.08	1	1
30	Assembly	Tack gamble edge	M	1N2TLS-UBT	Plain Foot		0.28	214	0.94	1	1
31	Assembly	Make hole at nose & cuff	M	1N2T-BH			0.38	158	1.28	1	1
32	Assembly	Mark at Button placket & cuff	H	Plain table			0.43	140	1.41	1	1
33	Assembly	Attach Button at body placket	M	1N2T-BS			0.48	125	1.61	1.5	2
34	Assembly	Attach Button at cuff & extra	M	1N2T-BS			0.38	158	1.28	1	1
35	Assembly	Final thread trim	H	Plain table			0.6	100	2.02	2	2
									Total SMV:	**14.55**	
									Allotted Man Power:	**48**	
									Planned Workstation:	**52**	

Study on sewing process breakdown, sewing line layout, and sewing SMV calculation of dress Pants

Sewing process breakdown

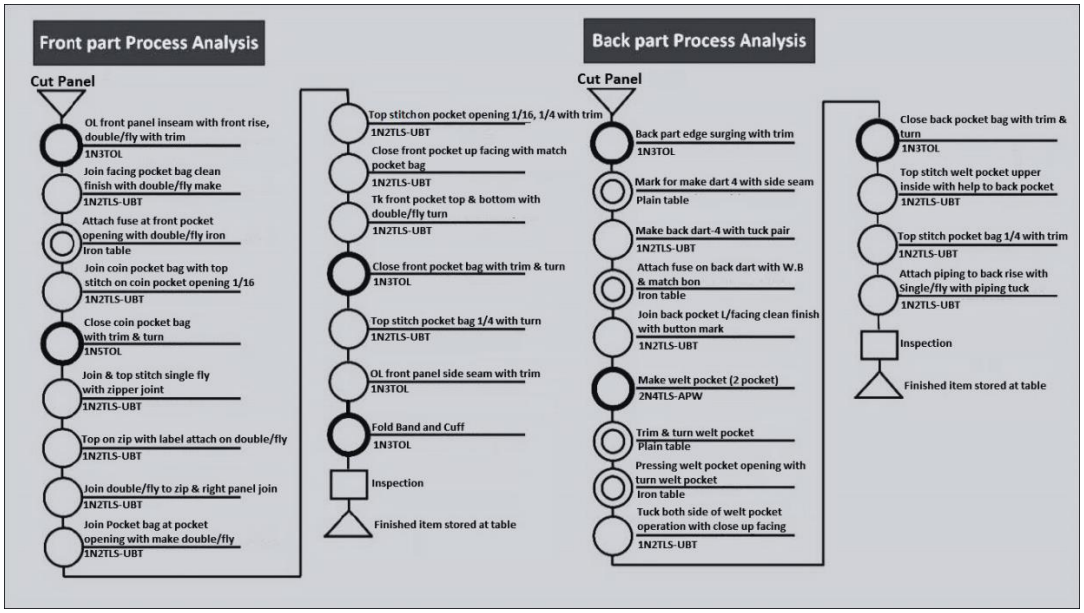

Diagram: Front and back making (Dress Pants)

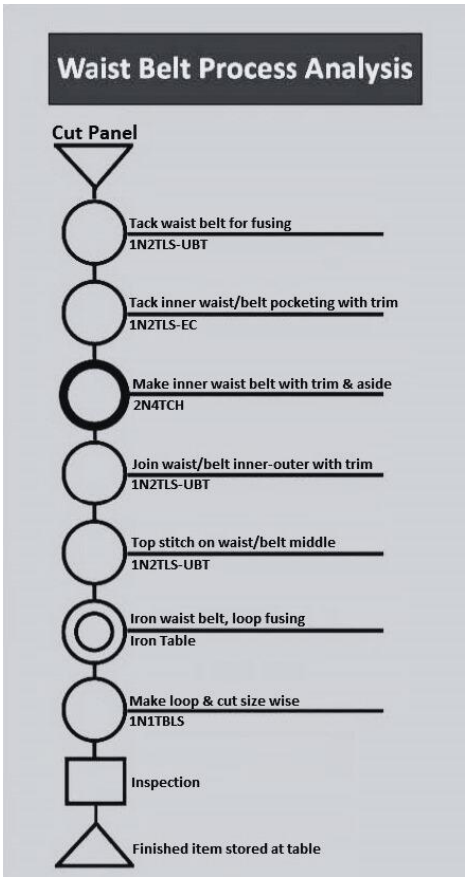

Diagram: Front and back making (Dress Pants)

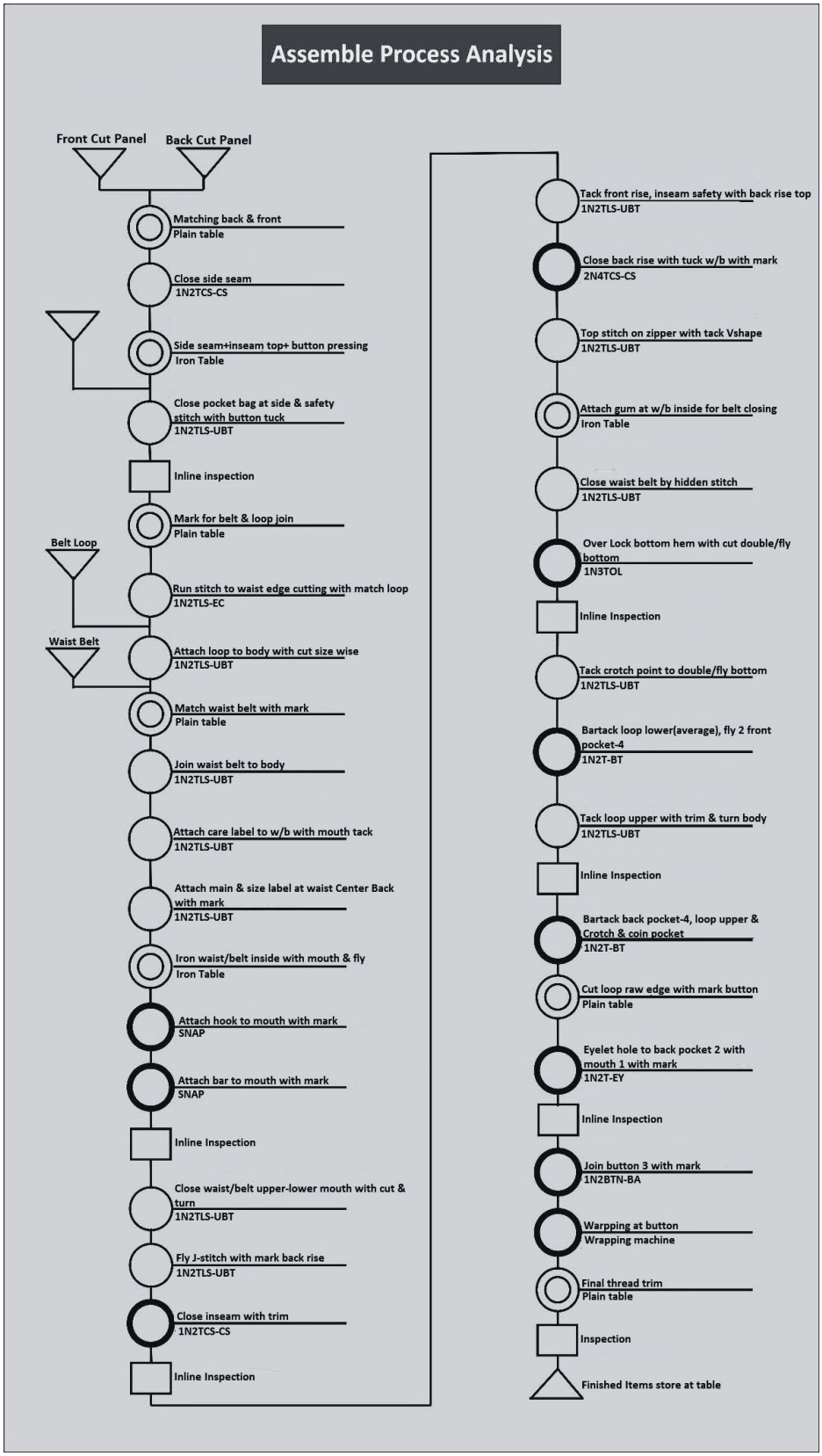

Diagram: Assembly (Dress Pants)

Sewing line layout and SMV:

Section: Front											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
1	CPU	OL front panel inseam with front rise, double/fly with trim	M	1N3TOL			0.5	120	1.02	1	1
2	CPU	Join facing pocket bag clean finish with double/fly make	M	1N2TLS-UBT	R 1/16"		0.48	125	0.98	1	1
3	CPU	Attach fuse at front pocket opening with double/fly iron	I	IRON TABLE			0.45	133	0.91	1	1
4	CPU	Join coin pocket bag with top stitch on coin pocket opening 1/16	M	1N2TLS-UBT	R 1/16"		0.52	115	1.06	1	1
5	CPU	Close coin pocket bag with trim & turn	M	1N5TOL			0.45	133	0.91	1	1
6	CPU	Join & top stitch single fly with zipper joint	M	1N2TLS-UBT	R 1/16"		0.36	167	0.73	1	1
7	CPU	Top on zip with label attach on double/fly	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
8	CPU	Join double/fly to zip & right panel join	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
9	CPU	Join Pocket bag at pocket opening with make double/fly	M	1N2TLS-UBT	Plain foot		0.5	120	1.02	1	1
10	CPU	T/S on pocket opening 1/16, 1/4 with trim	M	1N2TLS-UBT	R 1/4"		0.48	125	0.98	1	1
11	CPU	Close front pocket up facing with match pocket bag	M	1N2TLS-UBT			0.46	130	0.93	1	1
12	CPU	Tk front pocket top & bottom with double/fly turn	M	1N2TLS-UBT	Plain foot		0.48	125	0.98	1	1
13	CPU	Close front pocket bag with trim & turn	M	1N3TOL			0.52	115	1.06	1	1
14	CPU	Top stitch pocket bag 1/4 with turn	M	1N2TLS-UBT	R 1/4"		0.5	120	1.02	1	1
15	CPU	OL front panel side seam with trim	M	1N3TOL			0.5	120	1.02	1	1

Section: Back											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
16	CPU	Back part edge surging with trim	M	1N3TOL			0.55	109	1.12	1	1
17	CPU	Mark for make dart 4 with side seam	H	Plain table			0.4	150	0.81	1	1
18	CPU	Make back dart-4 with tuck pair	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
19	CPU	Attach fuse on back dart with W.B & match bon	I	Iron table			0.48	125	0.98	1	1
20	CPU	Join back pocket L/facing clean finish with button mark	M	1N2TLS-UBT	R 1/16"		0.48	125	0.98	1	1
21	CPU	Make welt pocket (2 pocket)	M	2N4TLS-APW			0.48	125	0.98	1	1
22	CPU	Trim & turn welt pocket	H	Plain table			0.46	130	0.93	1	1
23	CPU	Pressing welt pocket opening with turn welt pocket	I	Iron table			0.45	133	0.91	1	1
24	CPU	Tuck both side of welt pocket operation with close up facing	M	1N2TLS-UBT	Plain foot		0.55	109	1.12	1	1
25	CPU	Close back pocket bag with trim & turn	M	1N3TOL			0.55	109	1.12	1	1
26	CPU	Top stitch welt pocket upper inside with help to back pocket	M	1N2TLS-UBT	Zip guide		0.5	120	1.02	1	1
27	CPU	Top stitch pocket bag 1/4 with trim	M	1N2TLS-UBT	R 1/4"		0.6	100	1.22	1	1
28	CPU	Attach piping to back rise with Single/fly with piping tuck	M	1N2TLS-UBT		Folder	0.59	102	1.2	1	1
Section: Waist Belt											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
29	CPU	Tack waist belt for fusing	M	1N2TLS-UBT	Plain foot		0.25	240	0.51	0.5	1
30	CPU	Tack inner w/belt pocketing with trim	M	1N2TLS-EC			0.38	158	0.77	0.5	1
31	CPU	Make inner waist belt with trim & aside	M	2N4TCH		Folder	0.48	125	0.98	0.5	1
32	CPU	Join w/b inner-outer with trim	M	1N2TLS-UBT	Plain foot	Folder	0.36	167	0.73	0.5	1
33	CPU	Top stitch on w/b middle	M	1N2TLS-UBT	R 1/16"		0.34	176	0.69	0.5	1
34	CPU	Iron waist belt, loop fusing	I	Iron Table			0.58	103	1.18	1	1
35	CPU	Make loop & cut size wise	M	1N1TBLS		Folder	0.28	214	0.57	0.5	1

Section: Assemble											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
36	Assembly	Matching back & front	H	Plain table			0.4	150	0.81	1	1
37	Assembly	Close side seam	M	1N2TCS-CS			0.65	92	1.32	1	1
38	Assembly	Side seam+inseam top+ button pressing	I	Iron Table			0.5	120	1.02	1	1
39	Assembly	Close pocket bag at side & safety stitch with button tuck	M	1N2TLS-UBT	Plain foot		0.75	80	1.52	2	2
40	Assembly	Mark for belt & loop join	H	Plain table			0.48	125	0.98	1	1
41	Assembly	Run stitch to waist edge cutting with match loop	M	1N2TLS-EC			0.5	120	1.02	1	1
42	Assembly	Attach loop to body with cut size wise	M	1N2TLS-UBT	Plain foot		0.48	125	0.98	1	1
43	Assembly	Match waist belt with mark	H	Plain table			0.45	133	0.91	1	1
44	Assembly	Join waist belt to body	M	1N2TLS-UBT	Plain foot		0.85	71	1.73	2	2
45	Assembly	Attach care label to waist/belt with mouth tack	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
46	Assembly	Attach main & size label at waist center back with mark	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
47	Assembly	Iron waist/belt inside with mouth & fly	I	Iron Table			0.45	133	0.91	1	1
48	Assembly	Attach hook to mouth with mark	M	SNAP			0.34	176	0.69	1	1
49	Assembly	Attach bar to mouth with mark	M	SNAP			0.4	150	0.81	1	1
50	Assembly	Close waist/belt upper-lower mouth with cut & turn	M	1N2TLS-UBT			0.65	92	1.32	1	1
51	Assembly	Fly J-stitch with mark back rise	M	1N2TLS-UBT	R 1/16"		0.56	107	1.14	2	2
52	Assembly	Close inseam with trim	M	1N2TCS-CS	Plain foot		0.54	111	1.1	1	1
53	Assembly	Tack front rise, inseam safety with back rise top	M	1N2TLS-UBT			0.75	80	1.52	1	1

54	Assembly	Close back rise with tuck waist/belt with mark	M	2N4TCS-CS	Plain foot		0.56	107	1.14	1.5	2
55	Assembly	Top stitch on zipper with tack Vshape	M	1N2TLS-UBT			0.48	125	0.98	1	1
56	Assembly	Attach gum at waist/belt inside for belt closing	I	Iron Table	Zip guide		0.46	130	0.93	1	1
57	Assembly	Close waist belt by hidden stitch	M	1N2TLS-UBT	One side G.		0.6	100	1.22	1	1
58	Assembly	Over/Lock bottom hem with cut double/fly bottom	M	1N3TOL			0.37	162	0.75	1	1
59	Assembly	Tack crotch point to double/fly bottom	M	1N2TLS-UBT	Plain foot		0.48	125	0.98	1	1
60	Assembly	Bartack loop lower(average), fly 2 front pocket-4	M	1N2T-BT			0.55	109	1.12	1	1
61	Assembly	Tack loop upper with trim & turn body	M	1N2TLS-UBT	Plain foot		0.5	120	1.02	1	1
62	Assembly	Bartack back pocket-4, loop upper & Crotch & coin pocket	M	1N2T-BT			0.6	100	1.22	1	1
63	Assembly	Cut loop raw edge with mark button	H	Plain table			0.34	176	0.69	1	1
64	Assembly	Eyelet hole to back pocket 2 with mouth 1 with mark	M	1N2T-EY			0.4	150	0.81	1	1
65	Assembly	Join button 3 with mark	M	1N2BTN-BA			0.42	143	0.85	1	1
66	Assembly	Warpping at button	M	Wrapping machine			0.3	200	0.61	0.5	1
67	Assembly	Final thread trim	H	Plain table			0.95	63	1.93	1	1
									Total SMV:	**32.97**	
									Allotted Man Power:	**67**	
									Planned Workstation:	**71**	

Proposals based on process breakdown, line layout, and SMV calculation of dress Pants

- In step 10, two machines can be used.
- Steps 32 and 33 will be a combined process.
- Steps 48 and 49 will be combined process.
- In step 53, one-man power is more needed.

Revised sewing process breakdown

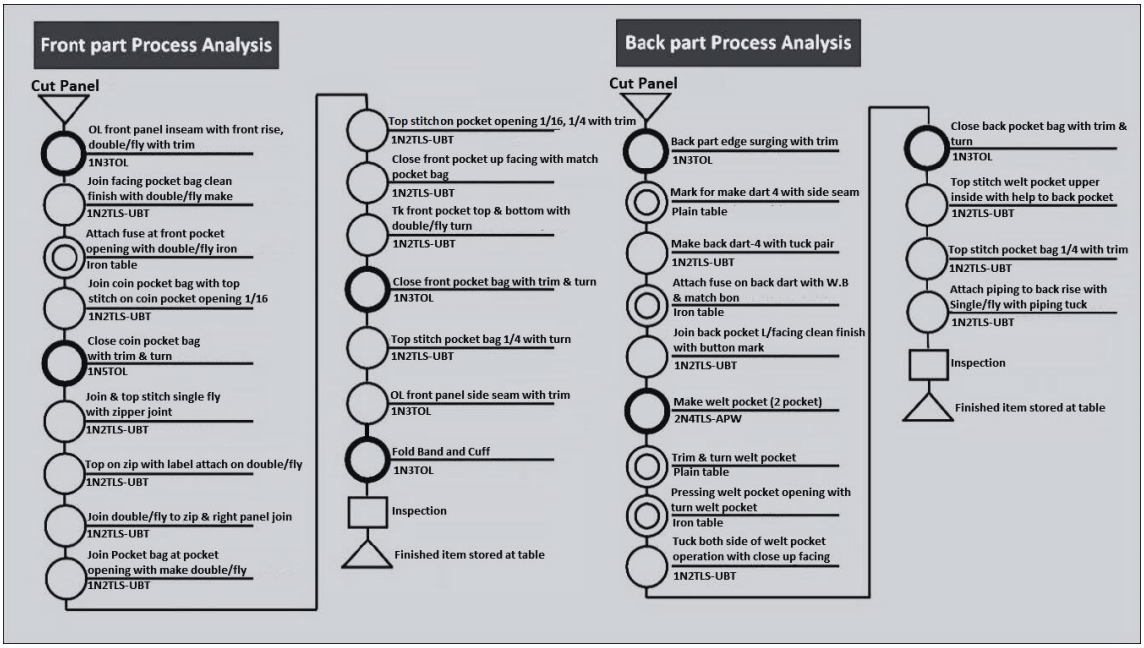

Diagram: Front and back making (Dress Pants)

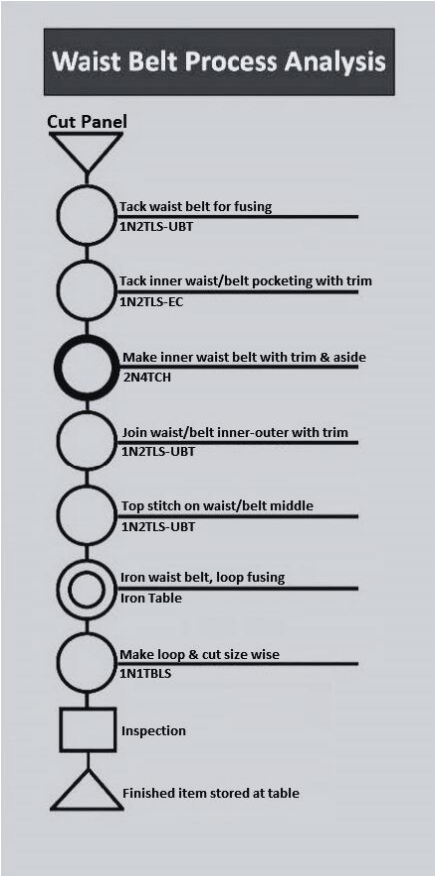

Diagram: Front and back making (Dress Pants)

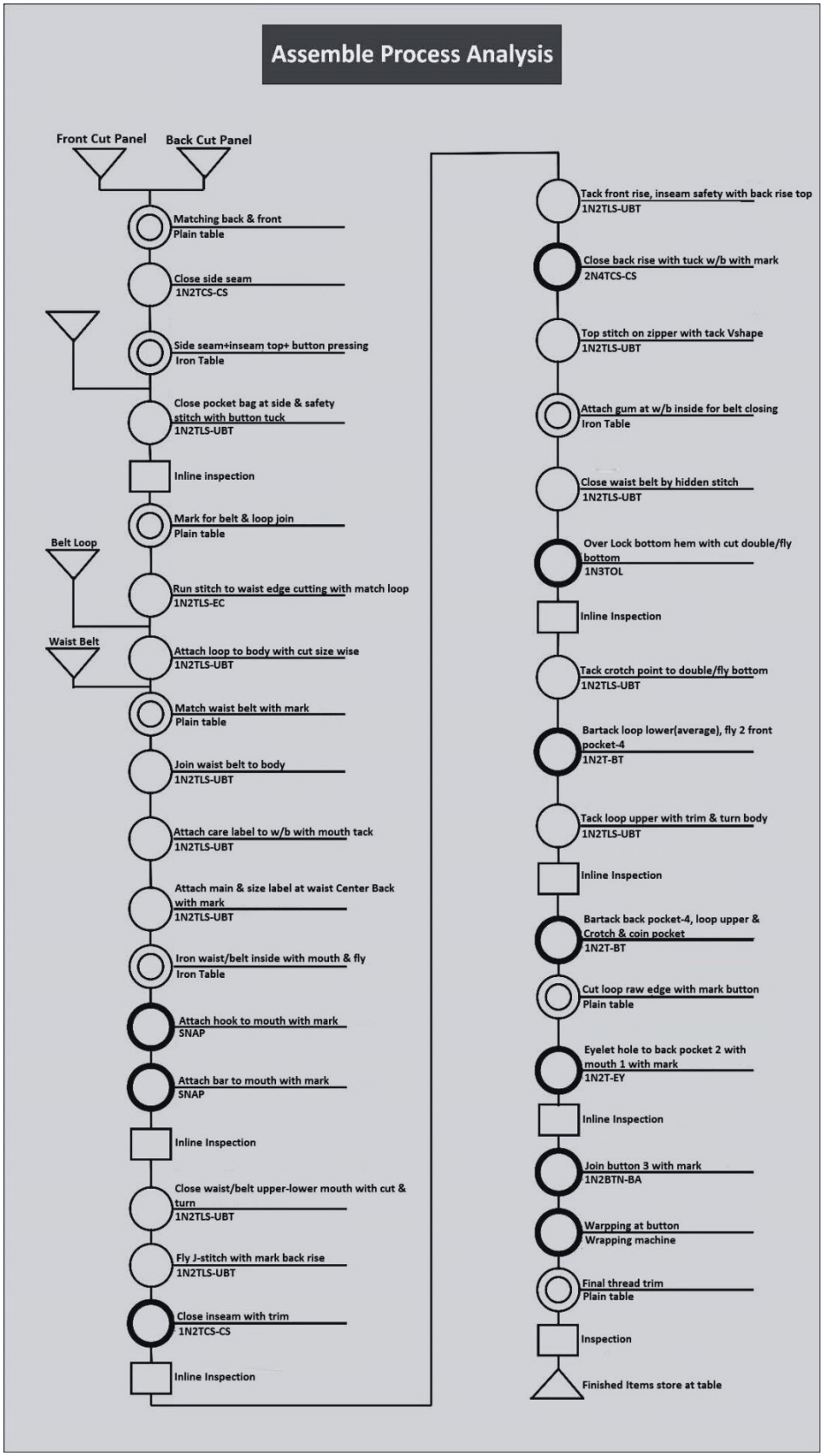

Diagram: Assembly (Dress Pants)

Revised sewing line layout

Section: Front											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
1	CPU	OL front panel inseam with front rise, double/fly with trim	M	1N3TOL			0.5	120	1.02	1	1
2	CPU	Join facing pocket bag clean finish with double/fly make	M	1N2TLS-UBT	R 1/16"		0.48	125	0.98	1	1
3	CPU	Attach fuse at front pocket opening with double/fly iron	I	IRON TABLE			0.45	133	0.91	1	1
4	CPU	Join coin pocket bag with top stitch on coin pocket opening 1/16	M	1N2TLS-UBT	R 1/16"		0.52	115	1.06	1	1
5	CPU	Close coin pocket bag with trim & turn	M	1N5TOL			0.45	133	0.91	1	1
6	CPU	Join & top stitch single fly with zipper joint	M	1N2TLS-UBT	R 1/16"		0.36	167	0.73	1	1
7	CPU	Top on zip with label attach on double/fly	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
8	CPU	Join double/fly to zip & right panel join	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
9	CPU	Join Pocket bag at pocket opening with make double/fly	M	1N2TLS-UBT	Plain foot		0.5	120	1.02	1	1
10	CPU	Top Stitch on pocket opening 1/16 with trim	M	1N2TLS-UBT	R 1/16"		0.27	156	0.49	1	1
11	CPU	Top Stitch on pocket opening 1/4 wt trim	M	1N2TLS-UBT	R 1/4"		0.27	156	0.49	1	1
12	CPU	Close front pocket up facing with match pocket bag	M	1N2TLS-UBT			0.46	130	0.93	1	1
13	CPU	Tk front pocket top & bottom with double/fly turn	M	1N2TLS-UBT	Plain foot		0.48	125	0.98	1	1
14	CPU	Close front pocket bag with trim & turn	M	1N3TOL			0.52	115	1.06	1	1
15	CPU	Top stitch pocket bag 1/4 with turn	M	1N2TLS-UBT	R 1/4"		0.5	120	1.02	1	1
16	CPU	OL front panel side seam with trim	M	1N3TOL			0.5	120	1.02	1	1

Section: Back											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
17	CPU	Back part edge surging with trim	M	1N3TOL			0.55	109	1.12	1	1
18	CPU	Mark for make dart 4 with side seam	H	Plain table			0.4	150	0.81	1	1
19	CPU	Make back dart-4 with tuck pair	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
20	CPU	Attach fuse on back dart with W.B & match bon	I	Iron table			0.48	125	0.98	1	1
21	CPU	Join back pocket L/facing clean finish with button mark	M	1N2TLS-UBT	R 1/16"		0.48	125	0.98	1	1
22	CPU	Make welt pocket (2 pocket)	M	2N4TLS-APW			0.48	125	0.98	1	1
23	CPU	Trim & turn welt pocket	H	Plain table			0.46	130	0.93	1	1
24	CPU	Pressing welt pocket opening with turn welt pocket	I	Iron table			0.45	133	0.91	1	1
25	CPU	Tuck both side of welt pocket operation with close up facing	M	1N2TLS-UBT	Plain foot		0.55	109	1.12	1	1
26	CPU	Close back pocket bag with trim & turn	M	1N3TOL			0.55	109	1.12	1	1
27	CPU	Top stitch welt pocket upper inside with help to back pocket	M	1N2TLS-UBT	Zip guide		0.5	120	1.02	1	1
28	CPU	Top stitch pocket bag 1/4 with trim	M	1N2TLS-UBT	R 1/4"		0.6	100	1.22	1	1
29	CPU	Attach piping to back rise with Single/fly with piping tuck	M	1N2TLS-UBT		Folder	0.59	102	1.2	1	1
Section: Waist Belt											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
30	CPU	Tack waist belt for fusing	M	1N2TLS-UBT	Plain foot		0.25	240	0.51	0.5	1
31	CPU	Tack inner w/belt pocketing with trim	M	1N2TLS-EC			0.38	158	0.77	0.5	1
32	CPU	Make inner waist belt with trim & aside	M	2N4TCH		Folder	0.48	125	0.98	0.5	1
33	CPU	Join w/b inner-outer with trim, top stitch on w/b middle	M	1N2TLS-UBT	Plain foot	Folder	0.38	110	1.2	1	1
34	CPU	Iron waist belt, loop fusing	I	Iron Table			0.58	103	1.18	1	1
35	CPU	Make loop & cut size wise	M	1N1TBLS		Folder	0.28	214	0.57	0.5	1

Section: Assemble											
Sl.	**CPU/ Assembly**	**Operation Description**	**Category**	**Machine Code**	**Presser Foot**	**Attachment**	**SMV**	**Target/ Hour**	**Man Required**	**Allotted Man power**	**Plan work station**
36	Assembly	Matching back & front	H	Plain table			0.4	150	0.81	1	1
37	Assembly	Close side seam	M	1N2TCS-CS			0.65	92	1.32	1	1
38	Assembly	Side seam+inseam top+ button pressing	I	Iron Table			0.5	120	1.02	1	1
39	Assembly	Close pocket bag at side & safety stitch with button tuck	M	1N2TLS-UBT	Plain foot		0.75	80	1.52	2	2
40	Assembly	Mark for belt & loop join	H	Plain table			0.48	125	0.98	1	1
41	Assembly	Run stitch to waist edge cutting with match loop	M	1N2TLS-EC			0.5	120	1.02	1	1
42	Assembly	Attach loop to body with cut size wise	M	1N2TLS-UBT	Plain foot		0.48	125	0.98	1	1
43	Assembly	Match waist belt with mark	H	Plain table			0.45	133	0.91	1	1
44	Assembly	Join waist belt to body	M	1N2TLS-UBT	Plain foot		0.85	71	1.73	2	2
45	Assembly	Attach care label to waist/belt with mouth tack	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
46	Assembly	Attach main & size label at waist center back with mark	M	1N2TLS-UBT	Plain foot		0.45	133	0.91	1	1
47	Assembly	Iron waist/belt inside with mouth & fly	I	Iron Table			0.45	133	0.91	1	1
48	Assembly	Attach hook to mouth with mark and Attach bar to mouth with mark	M	SNAP			0.35	120	1.22	1	1
49	Assembly	Close waist/belt upper-lower mouth with cut & turn	M	1N2TLS-UBT			0.65	92	1.32	1	1
50	Assembly	Fly J-stitch with mark back rise	M	1N2TLS-UBT	R 1/16"		0.56	107	1.14	2	2
51	Assembly	Close inseam with trim	M	1N2TCS-CS	Plain foot		0.54	111	1.1	1	1
52	Assembly	Tack front rise, inseam safety with back rise top	M	1N2TLS-UBT			0.75	80	1.52	2	2
53	Assembly	Close back rise with tuck waist/belt with mark	M	2N4TCS-CS	Plain foot		0.56	107	1.14	1.5	1.5
54	Assembly	Top stitch on zipper with tack Vshape	M	1N2TLS-UBT			0.48	125	0.98	1	1
55	Assembly	Attach gum at waist/belt inside for belt closing	I	Iron Table	Zip guide		0.46	130	0.93	1	1
56	Assembly	Close waist belt by hidden stitch	M	1N2TLS-UBT	One side G.		0.6	100	1.22	1	1
57	Assembly	Over/Lock bottom hem with cut double/fly bottom	M	1N3TOL			0.37	162	0.75	1	1
58	Assembly	Tack crotch point to double/fly bottom	M	1N2TLS-UBT	Plain foot		0.48	125	0.98	1	1
59	Assembly	Bartack loop lower(average), fly 2 front pocket-4	M	1N2T-BT			0.55	109	1.12	1	1
60	Assembly	Tack loop upper with trim & turn body	M	1N2TLS-UBT	Plain foot		0.5	120	1.02	1	1

61	Assembly	Bartack back pocket-4, loop upper & Crotch & coin pocket	M	1N2T-BT			0.6	100	1.22	1	1
62	Assembly	Cut loop raw edge with mark button	H	Plain table			0.34	176	0.69	1	1
63	Assembly	Eyelet hole to back pocket 2 with mouth 1 with mark	M	1N2T-EY			0.4	150	0.81	1	1
64	Assembly	Join button 3 with mark	M	1N2BTN-BA			0.42	143	0.85	1	1
65	Assembly	Warpping at button	M	Wrapping machine			0.3	200	0.61	0.5	1
66	Assembly	Final thread trim	H	Plain table			0.95	63	1.93	1	1
										Total SMV:	**32.32**
										Allotted Man Power:	**68**
										Planned Workstation:	**69**

Study result on shirt's process breakdown, line layout, and SMV calculations

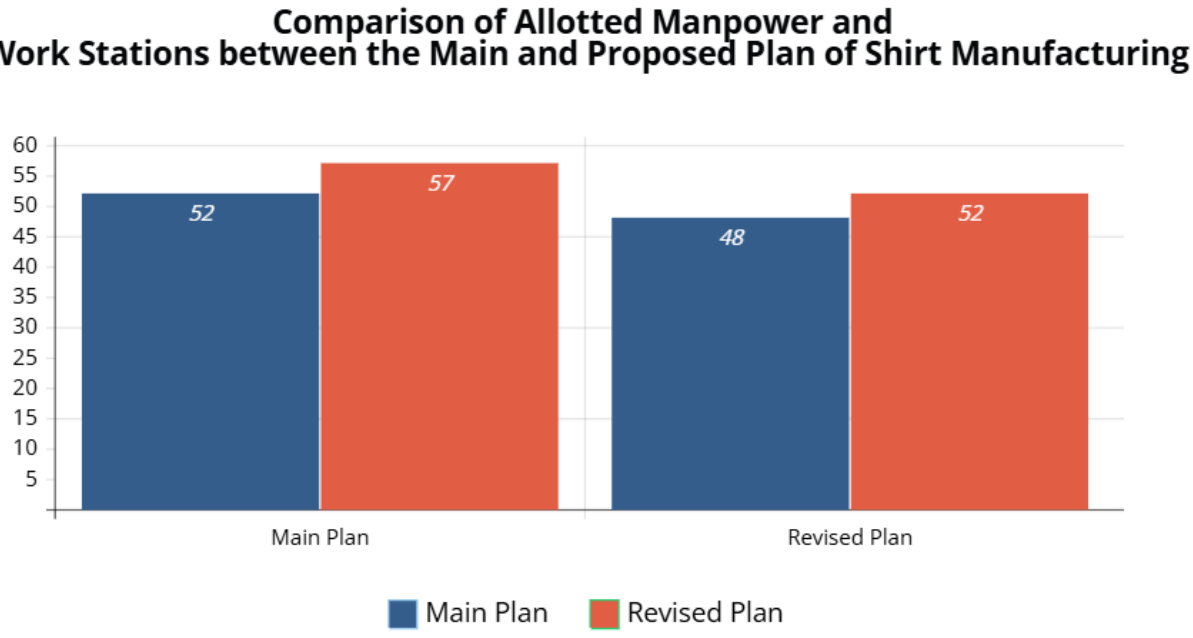

Chart 1

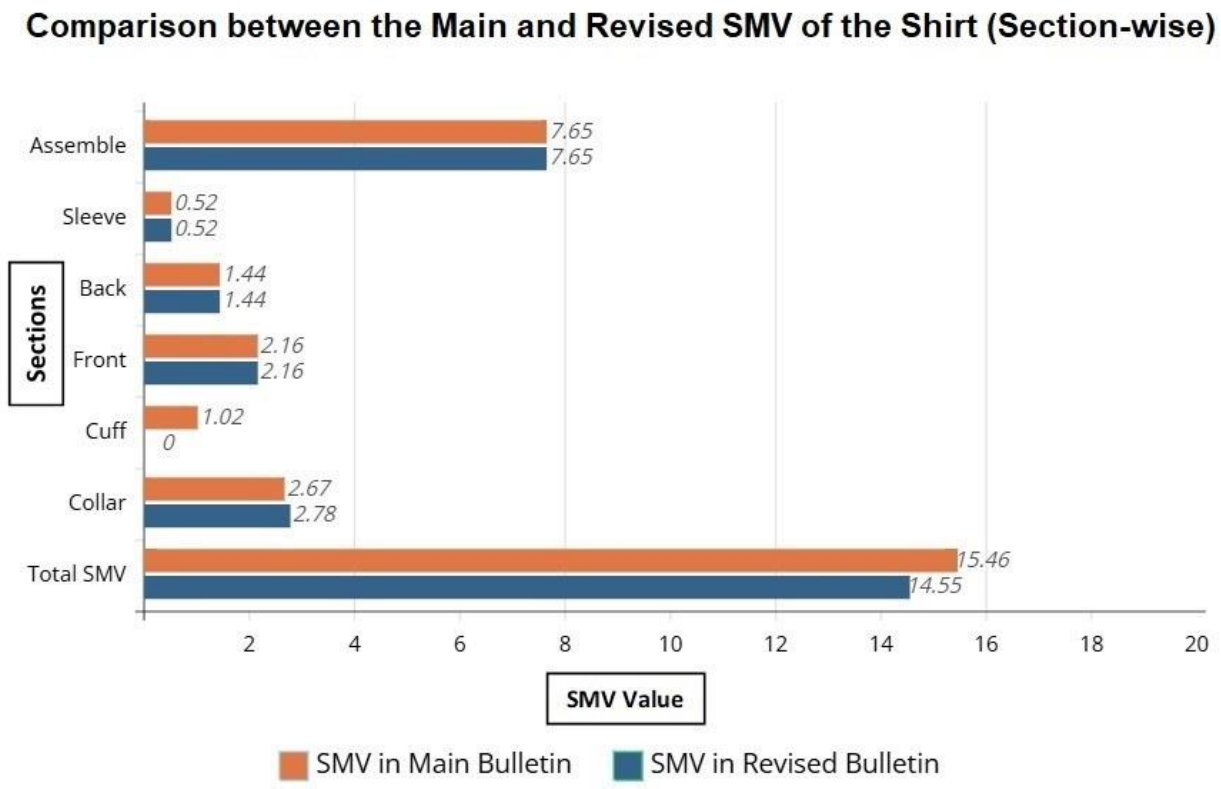

Chart 2

An explanation of the comparison of two different calculations of shirt manufacturing

The two charts above show how the shirt manufacturing process has changed. The actual plan, shown in chart 1, requires 57 workstations and 52 employees (operators + helpers). However, 48 employees (operators + helpers) and 52 workstations have been utilized in the updated plan. These figures clearly show that the updated plan may use five fewer pieces of machinery and save four labors cost. In contrast, the collar and cuff in Chart 2 took a total of 3.69 minutes in the original plan, and the revised plan integrated the two processes, and the total time was 2.78 minutes, which is 0.91 minutes shorter than the original plan. This appears to be a significant increase, and the effects of improving manufacturing efficiency will be obvious if we consider bulk production.

Study result on dress Pants process breakdown, line layout, and SMV calculations:

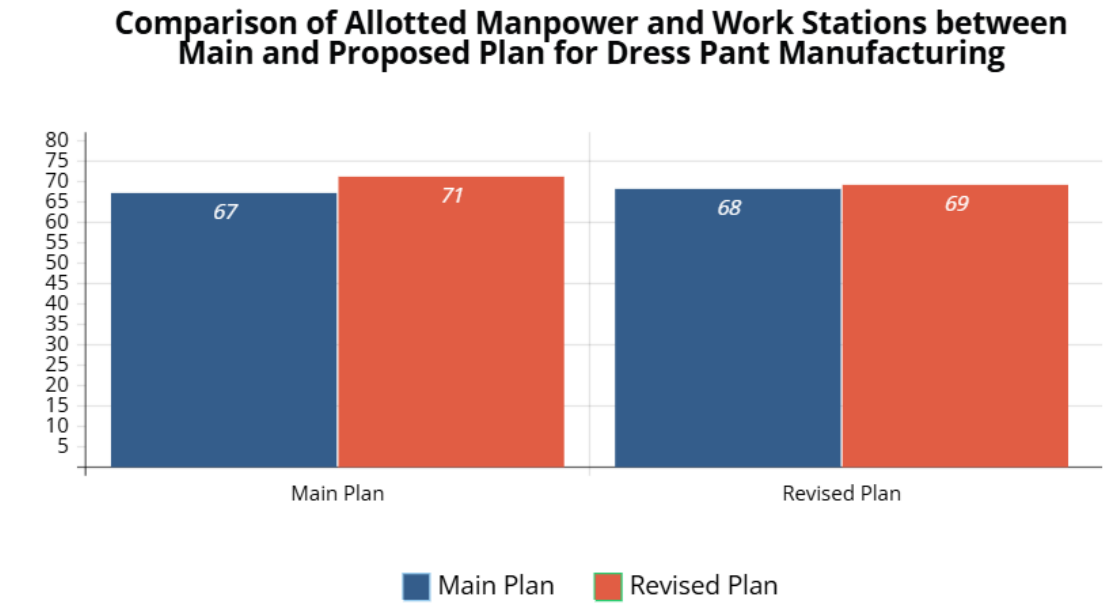

Chart 1

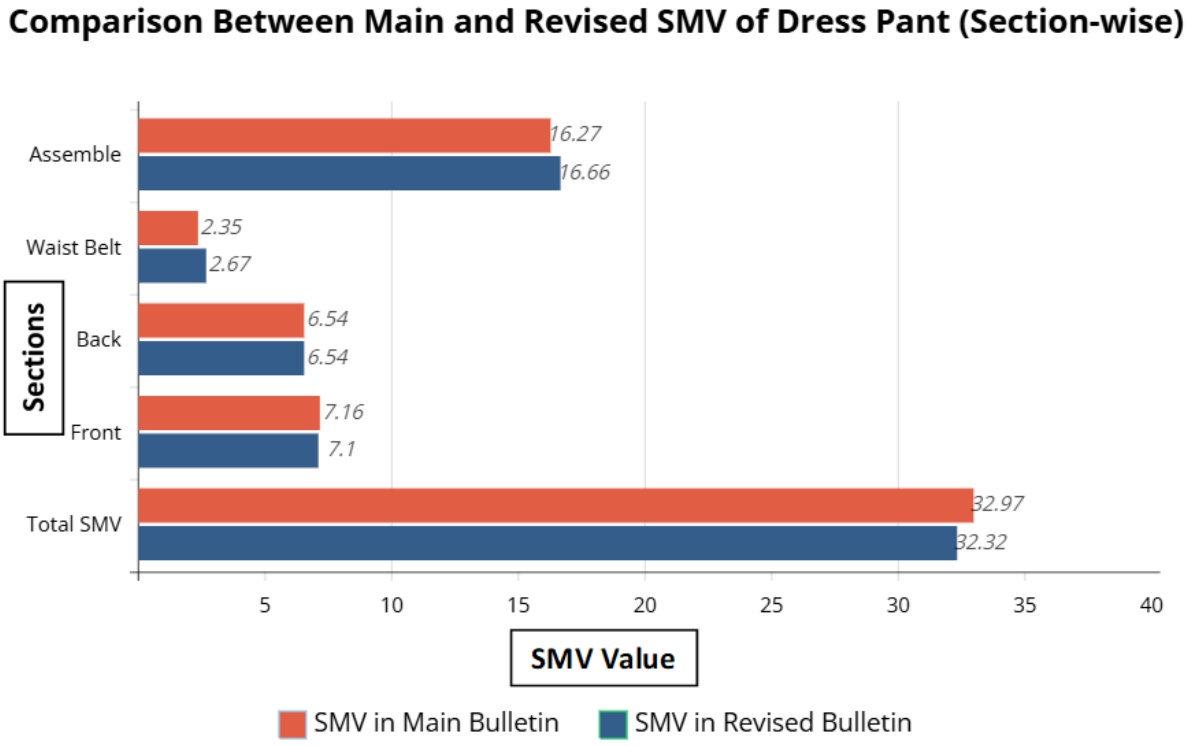

Chart 2

An explanation of the comparison of two different calculations of dress Pants manufacturing

Charts 1 and 2, describe the changes in mathematical figures of dress Pants manufacturing. In Chart 1, the manufacturer has utilized 67 workers (operators + helpers) and 71 workstations in the main plan. In the revised plan, they used 68 workers (operators + helpers) and 69 workstations. This data makes it quite evident that the updated plan can use 2 fewer pieces of machinery with an additional 1 labor costs. The critical processes of the front part took 7.1 minutes to complete in the main plan, as shown in Chart 2. However, it stood for 7.16 minutes, which is 0.06 minutes longer and takes a little longer. Critical processes for the back section took the same amount of time in both plans. Completing the waist belt crucial step, took 0.32 minutes shorter than planned. As we can see, the assembly took 0.39 minutes less than planned. This unit took 16.27 minutes under the new plan, compared to 16.66 minutes under the original plan. In general, decreasing SMV 0.65 might not result in significant enhancements for low-volume or single production. However, there will be an obvious effect to increase production efficiency when we consider large quantities, which have a significant amount.

Chapter-8: Conclusion

In conclusion, the study on improving efficiency in the sewing process of woven shirts and Dress Pants production involved a thorough breakdown of the sewing process, analysis of sewing line layout, and calculation of sewing SMV (standard minute value). By dissecting each step of the sewing process and optimizing the layout of the Sewing line, significant efficiency improvements can be achieved, leading to enhanced productivity and reduced manufacturing costs. These data can increase overall process efficiency and streamline operations in the clothing manufacturing industry.

Impact of the study

In the apparel industry, there are very few ways to decrease the manufacturing cost and make the industry profitable. Increasing efficiency through improving elements like process breakdown, line layout, and SMV calculation is the easiest way to decrease the manufacturing cost. In this way, we can easily increase efficiency by using less manpower and fewer pieces of machinery by utilizing them in the highest possible way.

Conflicts of Interest

Regarding the publishing of this paper, the authors state that they have no conflicts of interest.

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