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Research on Optimizing Sewing Processes for the Welt Pocket and Zipper of Jackets

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Abstract:
This study uses the MTM time measurement method and the GSD predetermined time system to conduct the construction of the machining time norms for the welt pocket and zipper of jackets. The use of automatic welting machine has significantly saved (35.4%) total operations and 31.06% total assembly time. The programming machine that is used saves most of the time in
processing the welt pockets and zipper up to 24.5%, especially integrating 2 stages of sewing the welt pocket and zipper in the same process with the machine. It saved 30% times of operations. Initial research results have provided data as the basis for solutions to increase labor productivity and quality of jacket production.

Keywords: *Jacket, automatic sewing machines, the GSD system*

1. Introduction

The jacket is a basic item of outerwear, which are mainly processed products in the garment industry with very large orders to fastidious markets. However, jackets are a product line with high requirements. The structural assemblies of the welt pocket and the zipper are typicalparts. They can be found in many different types of jackets. They require high technical and artistic quality. Manufacturers must always find ways to ensure the requirements but reduce production time, streamline the manufacturing process to bring economic efficiency. One of the improvement measures is to study the time norm and optimize the machining process of complex parts. A number of studies (GSD Practitioners manual - GSD (Corporate) Limited, Version 2018.7,) (Md. Syduzzaman, No.3 (June 2015)) have applied the MTM time measurement method and the GSD predetermined time system to construct the time norms for the operations in garment production. The GSD predetermined time system helps garment enterprises to understand the overall production process, costs, and production time. Based on MTM time measurement method and GSD predetermined time system, automatic equipment systems of the garment industry were born to support and optimize the machining process. Some garment corporations in Vietnam have applied modern equipment to industrial garment production such as Garment 10 Corporation, TNG Investment and Trading Joint Stock Company, Duc Giang Garment Corporation, General Corporation Nha Be Garment Company…

To demonstrate the superiority of modern equipment when applied in production practice, the research team carried out the topic 'Research on optimization of technological sewing process for the welt pocket and zipper of Jackets' with the desire to contribute to providing solutions to increase human productivity and quality of jackets.

2. Empirical research

2.1. Subjects

* *The seam diagrams of the welt pocket and zipper of the short jacket are shown in Figure 1 and Table 1.*

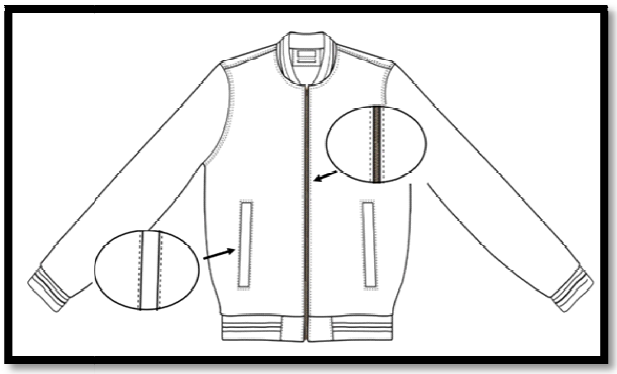


Figure 1. Short Jacket Description

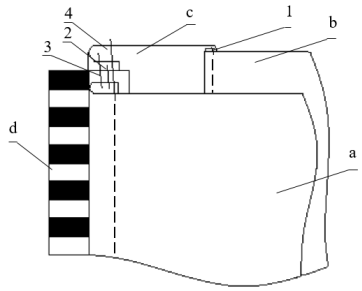
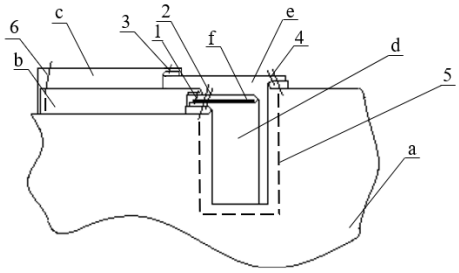
Element	Illustration Picture	Description of Operation
a- Jacket Front b- Front Lining c- Front Facing d- Zipper	 **Zipper**	• Sew the facing front with front lining • Sew the zipper with Jacket front • Sew the zipper, jacket front with front lining • Topstitch the zipper seam
a- Jacket Front b- Pocket Bag 1 c- Pocket Bag 2 d- Pocket Welt e- Pocket Facing f- Welt Interlining	 **Welt pocket**	• Sew pocket welt with pocket bag 1 • Sew pocket welt with jacket front • Sew pocket facing with pocket bag 2 • Sew pocket facing with jacket front • Topstitch around pocket opening • Sew the bottom of the pocket bag

Table 1: Description of Seam Diagram

** Equipments*

With the traditional manufacturing process, the project has used the following equipment: Juki DDL-8700-7B single needle sewing machine (DDL-8700-7, n.d.), and Silver Star ES-3200 steam iron (Eunsung-Silverstar/products/20536-ES-3200N, n.d.). As for the modern manufacturing process, the project has used one of the following devices: JUKI APW 896N automatic welt pocket machine (APW-895N-APW-896N, n.d.), ZY 9095 CNC Zoyer automatic programming machine (ZY9095CNC-zoyer-CNC-intelligence-templates-sewing-machine, n.d.).

2.2. Content

In this study, the authors carried out the contents: Research on time norms according to traditional machining processes (TMP) for welt pocket and zipper; Research on time norms according to modern machining processes (MMP) using the automatic welting machine for welt pocket or using the programming machine to simultaneously process the welt pocket and zipper. After that, compare and evaluate to choose the optimal solution for the process of machining welt pocket and zipper of the short jacket.

2.3. Methods

Both the operation analysis for the operations performed according to the TMP and the MMP on automatic devices use the MTM time measurement method and the GSD predetermined time system. The unit of time used is TMU. Define code and execution time through GSD encoding and MTM encoding (GSD Practitioners manual - GSD (Corporate) Limited, Version 2018.7,). In addition, the topic has also added some codes to facilitate the process of frequency statistics of activities. The base code table is shown in Table 2.

No	Code	Activity
1	G&P	Get and Put
2	M	Obtain and Match Part or Parts prior to sewing
3	A	Aligning and Adjusting in sewing
4	T	Trimming and tool use
5	F	Forming Shapes
6	A*	Aside parts after sewing
7	M*	Handling machine
8	AS	Auxiliary or supplement
9	S	Sewing
10	S*	Sewing with automatic machine

Table 2: Base Code for the Activities of the Human Body

- *The 'StudyTime' is used to calculate the machining time of automatic machines by using a stopwatch that determines the machine time through video (Europe, 2017) (Companies, 2019).
- *Statistical method is used to determine the frequency and duration of operations of machining operations. Unit conversion value 1 second = 27.8 TMU at 'Low task' and 1 second = 33.3 TMU at 'High Task' (GSD Practitioners manual - GSD (Corporate) Limited, Version 2018.7,) (modern machine operations). Then use Excel software to statistics the data.

3. Results and Discussion

3.1. Evaluation and Comparison of the Welt Pocket Processing between TMP and MMP

The comparison results of the MMP using the JUKI APW 896N automatic welting pocket machine and the TMP to process the welt pocket are presented in the tables and graphs below:

No	Code	Activity	Frequency (Times)		Time (TMU)	
			TMP	MMP	TMP	MMP
1	G&P	Get and Put	64	50	1192	1406
2	M	Obtain and Match Part or Parts prior to sewing	24	12	1464	594
3	A	Aligning and Adjusting in sewing	26	20	1070	704
4	T	Trimming and tool use	14	0	350	0
5	F	Forming Shapes	12	8	326	184
6	A*	Aside parts after sewing	16	8	520	222
7	M*	Handling machine	32	20	576	360
8	AS	Auxiliary or supplement	114	72	1226.96	722.28
9	S	Sewing	26	20	1337.2	1031.8
10	S*	Sewing with automatic machine	0	2	0	333.4
Total			328	212	8062.16	5557.48

Table 3: Comparative Processing of the Welt Pocket between TMP and MMP

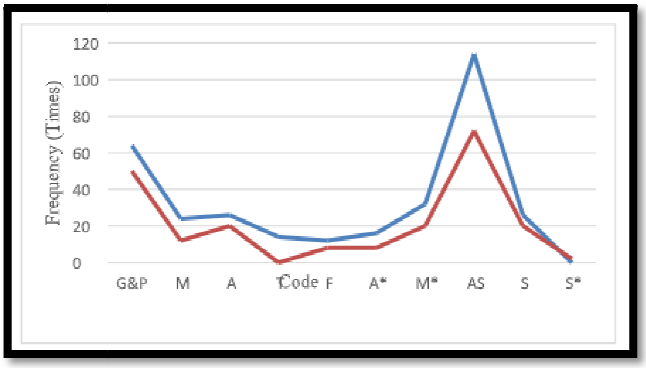


Figure 2: Comparison The Frequency of Each Code for Welt Pocket Processing According to TMP and MMP

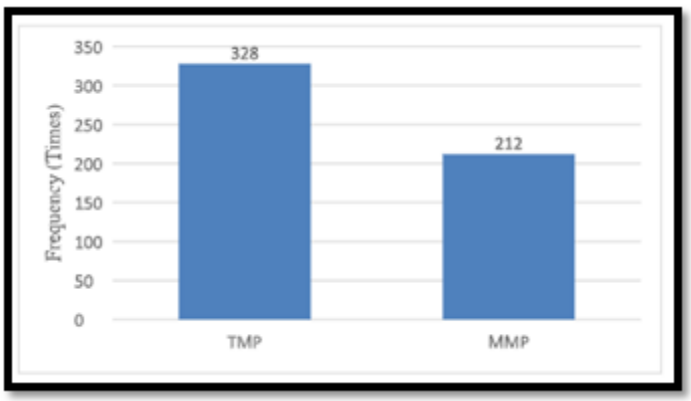


Figure 3: Comparison Total Frequency of the Codes for the Welt Pocket According to the TMP and the MMP

To demonstrate that the application of MMP is more effective than that of TMP, relative to the frequency of activities has been evaluated. The results of this comparison are presented in Table 4.

Through the graphs and table 4, we can see that the use of the automatic welting pocket machine has significantly saved the total number of operations up to 35.4%. The operation of holding, adjusting,... has been significantly shortened. In particular, cutting operations have been completely eliminated.

No	Activities	MMP vs TMP
1	Get and put (G&P)	21.9%
2	Obtain and Match Part or Parts prior to sewing (M)	50%
3	Aligning and Adjusting in sewing (A)	23.1%
4	Trimming (T)	100%
5	Forming Shapes (F)	33.3%
6	Aside parts after sewing (A*)	50%
7	Handling machine (M*)	37.5%
8	Auxiliary or supplement (AS)	36.8%
9	Sewing (S, S*)	15.4%
	Total	35.4%

Table 4: Relative Comparison of the Frequency of Operations According to the MMP and the TMP

The comparison of the execution time of the operations when the welt pocket assembly is presented as shown in Figure 4, 5.

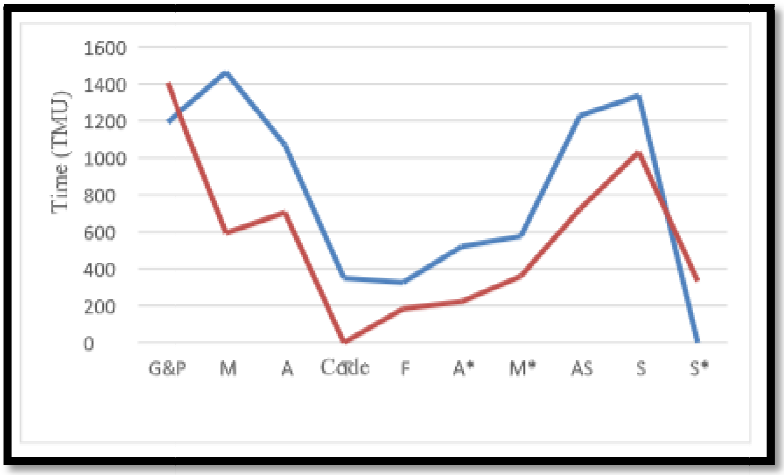


Figure 4: Comparison Time of Each Code for Processing Welt Pocket According to TMP and MMP

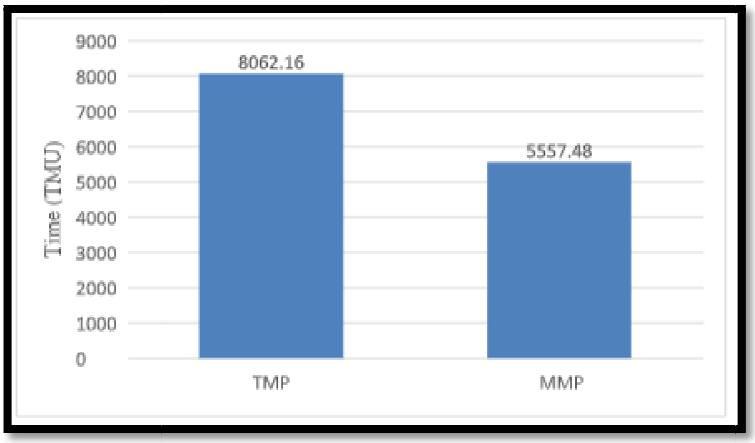


Figure 5: Comparison of the Total Processing Time of the Welt Pocket According to the TMP and the MMP

From the graphs of Figure 4,5 and Table 5, the automatic welting machine is used for the welt pocket process significantly saves the execution time up to 31.1%.Especially, saving 100% of the time of the cutting pocket opening stage (including cutting the center line and cutting a Y into each corner) thanks to the integrated operation of the automatic welting machine. Activities that have been saved a lot of time such as: stacking the part before sewing, taking the part out after sewing, shaping the part (eliminating the activities of folding pocket welt), auxiliary operations,... However, the time for getting and putting parts activities of the MMP is longer than that of the TMP because the process of putting the parts of the pocket into the templates requires more care and precision, so it takes more time. The sewing time of the MMP is slightly better than that of the TMP because the sewing process includes additional activities to cut the pocket opening.

No	Activities	MMP vs TMP
1	Get and put (G&P)	-17.9%
2	Obtain and Match Part or Parts prior to sewing (M)	59.4%
3	Aligning and Adjusting in sewing (A)	34.2%
4	Trimming (T)	100%
5	Forming Shapes (F)	43.6%
6	Aside parts after sewing (A*)	57.3%
7	Handling machine (M*)	37.5%
8	Auxiliary or supplement (AS)	41.1%
9	Sewing (S, S*)	-0.2%
	Total	31.1%

Table 5: Relative Comparison of Manufacturing Welt Pocket Time Between MMP and TMP

3.2. The Comparative TMP and MMP Using the ZY 9095 CNC Zoyer Programming Machine for Processing the Welt Pocket and Zipper

After analyzing and statistics of the base code of the machining operations of the welt pocket and zipper according to both TMP and MMP, the results are shown in Figures 6, 7 and Table 6.

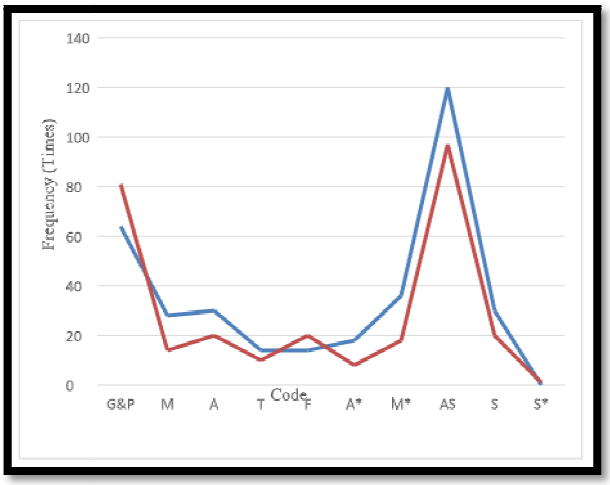


Figure 6: Frequency Comparison of Each Code for Processing the Welt Pocket and Zipper According to TMP and MMP

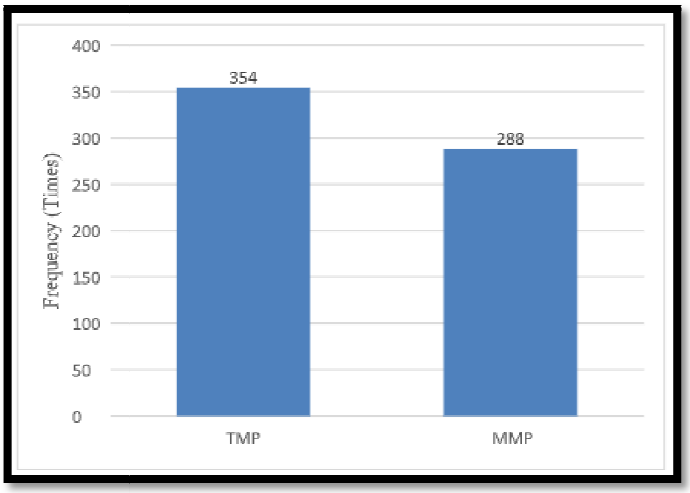


Figure 7: Comparison the Total Frequency of Codes for Processing the Welt Pocket and Zipper According to TMP and MMP

No	Code	Activity	Frequency (Times)		Time (TMU)	
			TMP	MMP	TMP	MMP
1	G&P	Get and Put	64	81	1192	2181
2	M	Obtain and Match Part or Parts prior to sewing	28	14	1754	630
3	A	Aligning and Adjusting in sewing	30	20	1314	704
4	T	Trimming and tool use	14	10	350	250
5	F	Forming Shapes	14	20	372	510
6	A*	Aside parts after sewing	18	8	604	222
7	M*	Handling machine	36	18	648	324
8	AS	Auxiliary or supplement	120	97	1280.96	1071.56
9	S	Sewing	30	20	1660.6	1031.8
10	S*	Sewing with automatic machine	0	1	0	1200
Total			354	288	9175.56	6924.36

Table 6: Comparison the Machining Operations of the Welt Pocket and Zipper Between TMP and MMP

The MMP using the programming machine is more optimal when the research data is presented in a comparative form relative to the TMP. The results are shown in Table 7 as a relative comparison of the frequencies of the codebase describing the operations.

Through graphs and tables, we can see that the programming machine is used for the processing of the welt pocket and zipper saves most of the operations compared to TMP by 18.6%. The operations that are most reduced are holding and stacking the parts before sewing, taking the parts out after sewing, and operating the machine because the sewing operations are performed by the programming machine. Cutting operations are saved by being integrated into the cutting the center line operation of the programming machine. Especially, saving up to 30% of sewing operations. However, the number of times of holding and shaping operations has increased more than that of TMP because it needs to be carefully prepared before the automatic machine executes.

No	Activities	MMP vs TMP
1	Get and put (G&P)	-26.6%
2	Obtain and Match Part or Parts prior to sewing (M)	50%
3	Aligning and Adjusting in sewing (A)	33.3%
4	Trimming (T)	28.6%
5	Forming Shapes (F)	-42.8%
6	Aside parts after sewing (A*)	55.6%
7	Handling machine (M*)	50%
8	Auxiliary or supplement (AS)	19.2%
9	Sewing (S, S*)	30%
Total		18.6%

Table 7: Frequency Relative Comparison of Welt Pocket and Zipper Processing Operations According to MMP and TMP

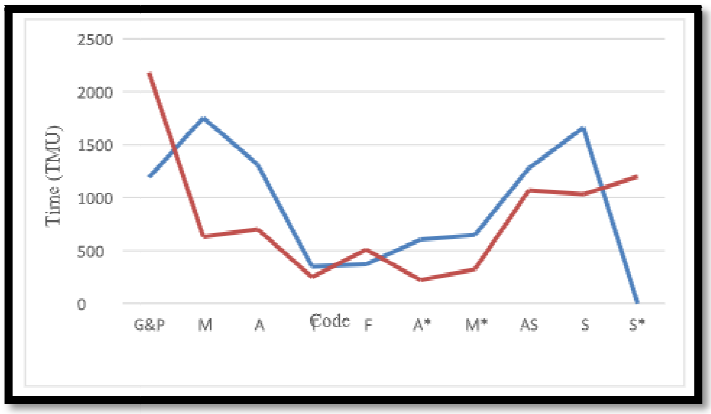


Figure 8: Comparison Time of Each Code for the Welt Pocket and Zipper Processing According to TMP and MMP

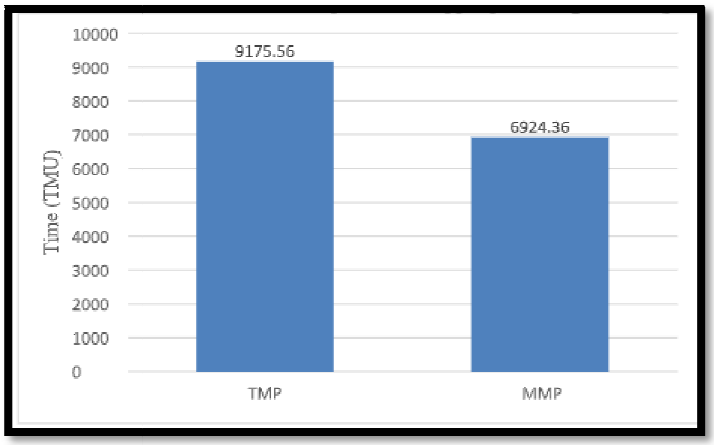


Figure 9: Comparison the Total Processing Time of the Welt Pocket and Zipper According to TMP and MMP

The comparison the execution time of the operations according to the TMP and the MMP using the programming machine is presented as shown in Figures 8 and 9. Table 8 shows the relative comparison between the time of the MMP and the TMP when processing the welt pocket and zipper.

No	Activities	MMP vs TMP
1	Get and put (G&P)	-83%
2	Obtain and Match Part or Parts prior to sewing (M)	64%
3	Aligning and Adjusting in sewing (A)	46.4%
4	Trimming (T)	28.6%
5	Forming Shapes (F)	-37%
6	Aside parts after sewing (A*)	63.24%
7	Handling machine (M*)	50%
8	Auxiliary or supplement (AS)	16.3%
9	Sewing (S, S*)	-34.4%
Total		24.5%

Table 8: Relative Comparison Time of Processing Operations for the Welt Pocket and Zipper According to MMP and TMP

The use of the programming machine saves most of the time to processing the welt pocket and zipper up to 24.5%, especially the integration of 2 stages of processing the welt pocket and zipper in the same stage of execution with the machine. The programming machine saves time optimally for the operations of stacking the part before sewing and taking the part out after sewing, adjusting the part, etc. However, there are many operations that take longer to be executed such as holding operations up to 83% larger or shaping the parts up to 37%. The reason for the time increase is that the interactions with the machine's template system are still relatively complicated. This is a point that needs research to improve.

4. Conclusion

From the above results, some conclusions can be drawn as follows:

- Established the processing time norm for the product's typical parts, which are the welt pocket and zipper according to the TMP and the MMP.
- The use of the automatic welting pocket machines has significantly saved (35.4%) the total operation, and 31.1% of the total assembly time. Activities have been saved a lot of time such as: stacking the part before sewing, taking the part out after sewing, shaping the part (eliminating activities of forming the pocket's parts), auxiliary operations .... Special has completely eliminated cutting operations.
- Using a programming machine saves most of the time processing the welt pocket and zipper up to 24.5%, especially integrating of 2 stages of sewing the welt pocket and zipper in the same stage as the machine. It saved 30% of operations. The programming machine saves time for operations of placing the part before sewing and taking the part out after sewing… However, the holding or reshaping operation takes a longer time than the TMP. The reason for the increase in time here is that the interactions with the machine's template system still relatively complex. This is a point that needs continued research to improve.

5. References

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