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Enhancing Productivity by Optimizing Facility Layout in a Garment Manufacturing Company Using ProModel Simulation

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Abstract

The garment industry plays a crucial role in the economy's overall growth by manufacturing the quality of clothes being sold worldwide. But despite playing a crucial role in economic growth, the industry experiences idle Times that affects productivity. The goal of this study is to identify the factors that cause delays and propose an optimized facility layout that helps enhance the productivity and efficiency of the whole production. Moreover, this study offers a comprehensive analysis of the impact of facility layout on manufacturing productivity, specifically on garment manufacturing production of two-way colored shirts. Additionally, this study uses qualitative and quantitative research methodologies, including the time and motion study (T.M.S.) method and ProModel Simulation software, to analyze the production process. This paper observed and interviewed workers at garment manufacturing companies and validated the present and proposed facility layout for garment manufacturing companies using ProModel Simulation software. After simulating, the study indicates that the proposed production layout significantly increased production capacity, elevating the hourly production rate by 4.62 times. This means there is a significant increase in the production efficiency and output of garment manufacturing, with the ability to produce 231 shirts within an eight-hour shift compared to the previous 50 shirts. Future research of this study will consider other layouts theory approaches such as U-shaped layout and Cellular layout. This paper presents the crucial role of strategic facility layout planning in manufacturing processes, offers valuable insights for similar industries aiming to enhance their manufacturing productivity, and demonstrates the potential for substantial improvements in operational efficiency and output through layout optimization.

Keywords
Facility Layout, Manufacturing, Operational Efficiency, ProModel, Time and Motion Study

1.Introduction
The manufacturing industry plays a crucial role in boosting economies and employment opportunities. Notably, the garment industry is prominent in the economy's overall growth. Facility layout planning is a critical component of any company's operation strategies. It shapes the production systems and is essential for efficient operations (Perez-Gosendea et al., 2020). An efficient layout can result in idle Time and high production costs, positively impacting overall performance. In the sewing industry, optimizing the facility layout is crucial to enhance productivity and efficiency. It can reduce idle Time and improve overall performance by thoroughly arranging workstations and machines.

Consequently, garment manufacturing must have a properly designed facility layout to enhance productivity and efficiency. The garment manufacturing company is a sewing business that manufactures quality clothes for different customers and sells them across malls nationwide. Since its inception in 2016, it has expanded, opening branches in Angono, Rizal, Floodway, and Cainta. The company's one-story structure at the Angono branch has a production, finishing, and packing department where polo shirts, long sleeves, and combination shirts are made for both men and women.

In this study, the garment manufacturing assembly line and workstation arrangement is facing some challenges with bottleneck, congestion, work buildup, and disorganized storage. These issues have been causing idle Time and reduced productivity for the garment manufacturing company. According to Four Principles (n.d.), poor layout causes waste in transportation and movement between workstations, resulting in delays, overcomplicated storage systems, and unnecessary processing. To address this, the study has looked at the sewing, finishing, and packing departments to identify which area is causing the most production delays.

Moreover, the study recognized various factors influencing the company's productivity, including the spatial arrangement and workstation design. According to a study by Suhardi et al. (2019), a well-organized workstation is critical in avoiding delays and idle Time, ultimately contributing to increased productivity. This optimized facility layout will significantly enhance the company's productivity and efficiency. Thus, garment manufacturing can keep up with the growing product demand by reducing idle Time and improving overall performance.

1.1 Objectives

This paper aims to utilize Time and Motion Study (T.M.S.) and ProModel Simulation software to thoroughly analyze garment manufacturing's current production process and identify areas of inefficiency. Also, it aims to find out what factors are causing delays in the sewing, finishing, and packing departments of garment manufacturing. Moreover, which among the various factors influences the company's productivity? Lastly, by the end of this study, the study will propose a new facility layout that will help improve productivity, reduce travel distance, and minimize process time, which will be simulated using ProModel Simulation.

2. Literature Review

A functional facility layout is crucial for a company's productivity. The ultimate goal of facility layout is to create an efficient arrangement for material handling that maximizes output. This requires consideration of various elements such as machinery, equipment, personnel, storage, and transportation. Riegel (2023) emphasizes the importance of facility design in enhancing productivity and effectiveness; strategically positioning equipment, such as machinery and workstations, can further optimize efficiency. Layout, size, accessibility, and safety contribute significantly to operational efficiency. The garment industry faces several challenges that affect its efficiency and performance. Common issues include low sewing efficiency, increasing delays and lead times, inefficiencies in production planning, resource allocation, and workflow management. These inefficiencies disrupt production schedules and order fulfillment, impacting the company's overall performance. Some common issues experienced by garment industries include low sewing efficiency in the production department due to increasing delays and lead times, which negatively affect the revenue and cost of manufacturing. Optimizing the layout can minimize motion, reduce waste, and enhance workflow efficiency and productivity Tareque et al. (2020).

Time study and motion study play crucial roles in improving productivity in the garment industry by analyzing and optimizing work processes. Using time and motion study, garment manufacturing can reduce idle Time, minimize delays, and improve overall productivity. By eliminating unnecessary motions and standardizing work processes, employees can work more effectively and contribute to higher output levels Subhashini et al. (2021). Productivity improvement refers to an organization's ability to increase output and efficacy using the same or fewer resources. Kumar and Malleswari (2022) highlight the role of plant layout design in improving material flow and eliminating unnecessary tasks, thereby saving Time and enhancing productivity. This allows companies to focus on the most efficient and effective processes that will boost their productivity and help them stay ahead of the competition. By thoroughly analyzing the existing layout, we can identify critical areas of improvement and take steps to enhance the facility's overall productivity. Computer simulation models provide valuable insights into production processes, enabling companies to optimize resource allocation, reduce downtime, and enhance overall efficiency (Yemane et al., 2020). Simulation tools help identify bottlenecks, test improvement strategies, and enhance decision-making for productivity improvement (Ivatury, 2022). ProModel is a simulation tool used in various industries, including sewing manufacturing, to optimize processes and improve productivity. It allows businesses to design, analyze, and evaluate ideas, alternative designs, and process maps before implementation. ProModel in sewing manufacturing can significantly improve efficiency and productivity (Mailan O. C et al. 2021). Various approaches in solving facility layout problems and optimization have been explored in the literature. Studies by Marcelo et al. (2016), Zhou et al. (2020), Mohamadi et al. (2019), Kromer et al. (2020), Matai and Singh (2021), Siregal et al. (2020), Molla et al. (2020), Navarro and Navarro (2016), Navarro et al. (2022, 2023), Cabusas et al (2023), are among them. Additionally, several studies aim to maximize production by employing relevant Design Trade-Off techniques (Duque et al., 2016; Sison et al., 2018; Palisoc et al., 2019; Navarro et al., 2022) and utilizing Pro Model simulation (Navarro et al., 2015; Bangayan et al., 2016, Abad e al., 2023)

This study aims to optimize facility layout to enhance productivity in garment manufacturing in creating a two-way colored t-shirt by providing a comprehensive analysis of the garment manufacturing process, identifying inefficiencies, and proposing a new facility layout. The above existing studies show there is a lack of comprehensive studies that integrate these elements to propose a holistic solution for productivity improvement in the garment industry. The role of human factors in successfully implementing these productivity improvement strategies needs to be better explored. Understanding how workers adapt to changes in facility layout or work processes and how to facilitate this transition could be crucial for achieving the desired productivity gains.

3. Methods

This paper used qualitative and quantitative research or mixed methods to analyze the factors influencing workplace performance and productivity to identify ways to improve the work environment and increase the company's overall revenue. To achieve this, descriptive-observational research design has been utilized to comprehensively understand the data collected, identify patterns, formulate hypotheses, and make informed decisions (Sirisilla, 2023). Also, the Time and Motion Study (T.M.S.) analyzes the standard Time taken to complete the process of making two-way colored shirts after identifying the computed standard Time of each process and the factors that cause delays that affect the productivity of the garment manufacturing company. Moreover, ProModel Simulation is used to analyze further and validate the proposed procedure for creating a consistent production process of two-way colored shirts. Moreover, to simulate the processing time in the model, these parameters are estimated using the Time and motion study data and entered into ProModel Simulation software as inputs.

This study took place at 1 Don Justo, Angono, Philippines, a garment manufacturing company that produces a variety of garments. In choosing this garment manufacturing company, this paper aimed to gain a deeper understanding of the challenges present in the workplace. After collecting data, the study analyzed it using various statistical procedures, including the weighted mean, average Time, and Standard Time. Equations 1 - 3 get the weighted mean, average, and standard Time. These methods were instrumental in helping the study calculate the average Time required for each process and identify areas for improvement.

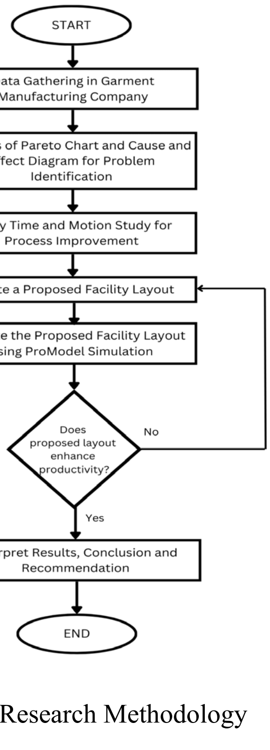


Figure 1. Research Methodology

The weighted mean represent by the equation:

$$WM = \frac{\Sigma FW}{N} \quad (1)$$

Where:
WM = weighted mean,
Σ = summation symbol
F = frequency for each option
W = assigned weight
N = total number of frequencies

The normal time represent by the equation:

$$NT = OT \; X \; RF \tag{2}$$

Where:
NT = normal time
OT = observed time
RF = rating factor

The standard time represent by the equation:

$$ST = NT\,(1 + AF) \tag{3}$$

Where:
ST = standard time
NT = average time
AF = allowance factor

4. Data Collection

This study utilized a combination of observation and interviews to address problems related to the what, when, where, and how of worker productivity. The study gathered data from various sources, allowing the study to delve deep into the production process, facility layout, and workers at the company to uncover the root causes behind their production inefficiencies. Furthermore, to gain valuable insights into the company's processes and challenges, the study has conducted direct observation, video recordings, and interviews with the owner, supervisors, and workers at Angono, Rizal, Philippines.

Both primary and secondary data were used to investigate the production efficiency of garment manufacturing. Primary data was collected from within and outside the company's plant after obtaining written consent from the chief operating officer (C.E.O.). Furthermore, to analyze the factors influencing efficiency, an initial assessment of the overall organizational productivity was conducted. Direct observation, videotaping, interaction with the concerned people, and tutorial programs were employed for collecting data. The paper focused on each part of the garment manufacturing process layout: combination, topping front body, joint shoulder, prep ribbing, attach ribbings, topping neckband, attach sleeves, hemming 1, hemming 2, logo, trim, quality control, tagging and packing. In addition, surveys and interviews were also conducted to determine the underlying reasons for the problem and to prescribe the most effective strategies to improve production efficiency. The data from the research literature and other relevant studies were also analyzed to determine the problems and develop strategies for improving production in garment manufacturing. Thus, the study can contribute significantly to developing solutions to address the problem of garment manufacturing companies.

5. Results and Discussion

The results section of this study provides valuable insights into the manufacturing process of two-way colored shirts in garment manufacturing. The section begins with an overview of the equations, including weighted mean, average Time, and Standard Time. The equations were used to calculate the manufacturing process's Time and analyze the factors affecting the process.

5.1 Numerical Results

The data in Table 1 and Table 2 with thirty (30) sample observations of individual processes are used to determine the observed Time per element, the average Time, and the standard Time each employee of a garment manufacturing company consumes in making a piece of two-way colored shirt. Moreover, the rating factor is also considered, as shown in Table 3. The rating factor assesses the worker's speed or the usual pace of creating two-way colored shirts. In this paper, the production process by each department to organize the process is divided. At the sewing department, the study allocated 100% to Operations 2, 3, and 4, 95% to Operations 5, 6, 10, and 11, 90% to Operations 8, and 85% to Operations 1 and 7.

In the finishing and packing departments, 100% is allocated to Operation 14, 90% to 13, 85% to Operation 15, and 80% to trim. The allocated rating factors for each process were based on observing each process that has been conducted.

Table 1. Observation in Sewing a Garment of Two-way Colored Shirt

Elements	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
E1. Sewing Department																
Combination	24.75	25.34	28.34	28.12	28.67	29.19	29.11	24.36	28.43	25.76	26.15	25.10	24.98	25.12	28.13	28.18
Topping Front Body	9.12	10.35	7.27	8.62	9.80	10.25	10.67	10.31	10.34	8.68	11.13	8.13	11.04	8.33	8.47	9.97
Joint Shoulder	26.49	26.11	24.86	24.82	22.94	22.12	22.56	35.99	35.12	23.43	26.34	25.81	25.23	27.69	27.12	27.06
Prep Ribbings	10.20	10.11	8.53	8.52	7.26	7.34	7.59	8.34	8.30	8.11	10.08	12.14	12.45	10.21	10.23	6.87
Attach Ribbings	45.74	45.70	45.03	45.67	33.37	33.87	33.12	33.45	33.23	33.71	30.24	31.60	31.69	31.72	32.40	32.42
Topping Neckband	19.7	19.81	19.57	19.84	13.20	13.29	13.24	13.42	13.45	15.49	13.31	13.14	15.40	12.10	12.54	14.06
Attach Sleeves	119.20	117.34	97.73	118.23	98.16	98.14	99.47	99.26	98.34	87.69	88.73	89.56	89.66	95.35	115.56	85.13
Side Close	47.83	53.87	47.98	53.45	57.28	57.43	57.12	57.01	57.89	54.94	48.97	53.54	52.35	52.55	52.76	57.89
Hemming 1	55.45	55.01	55.69	55.64	56.92	56.87	56.12	56.98	56.34	37.62	34.30	31.64	31.65	31.60	31.69	38.37
Hemming 2	42.34	42.31	39.16	39.75	39.57	39.67	42.67	42.87	42.46	38.57	40.63	38.42	38.94	53.58	53.56	36.64
Logo	30.23	30.59	30.19	30.23	33.88	33.42	30.11	30.98	30.24	25.71	25,84	25.96	26.22	26.56	26.21	24.82
E2. Finishing Department																
Trim	125.32	125.89	109.47	109.23	126.93	109.34	125.35	124.45	123.34	103.06	104.43	123.45	116.43	116.22	91.03	99.74
Quality Control	55.23	55.67	54.87	55.52	34.20	34.12	34.78	40.34	40.69	44.78	31.91	46.70	31.99	21.21	21.11	22.56
E3. Packing Department																
Tagging	30.21	30.56	30.19	30.14	33.88	33.67	34.56	34.98	25.43	25.71	25.84	25.96	25.67	26.56	25.31	24.82
Packing	40.56	40.24	40.86	40.99	22.89	22.25	21.23	21.01	22.26	21.78	19.75	19.78	21.11	22.23	23.96	22.55

Table 2. Observation in Sewing of Two-way Colored Shirt

Elements	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total Observed Time
A. Sewing Department															
Combination	25.76	25.01	30	25.16	26.17	28.12	24.17	30	25.13	21.48	29.16	29.29	28.12	25.16	774.34
Topping Front Body	7.69	10.65	10.66	9.8	9.97	11.61	8.66	12.10	10.20	10.45	10.98	10.84	13.31	10.90	300.30
Joint Shoulder	24.37	24.30	24.58	25.10	24.47	26.51	26.12	21.72	31.16	32.23	27.31	27.34	28.76	23.83	791.49
Prep Ribbings	9.63	10.45	10.22	8.05	12.28	8.21	8.89	10.13	11.01	11.67	8.24	8.45	7.41	8.48	279.40
Attach Ribbings	37.54	40.84	40.97	40.54	34.27	32.97	35.23	35.61	30.71	35.45	35.55	34.53	34.34	34.80	1076.31
Topping Neckband	17.03	17.76	17.71	14.96	18.09	13.61	13.57	15.11	13.53	13.98	14.21	14.19	14.98	15.05	455.34
Attach Sleeves	79.25	115.34	113.35	90.96	92.90	98.02	98.95	93.88	94.63	99.66	87.97	99.62	90.80	102.02	2944.90
Side Close	57.57	57.24	57.98	47.90	55.38	43.55	55.23	55.25	41.87	41.09	43.66	41.34	39.83	56.91	1557.73
Hemming 1	30.30	31.78	31.98	33.20	34.01	34.84	32.56	34.38	68.95	68.98	30.25	68.94	41.02	34.84	1315.73
Hemming 2	38.22	38.23	38.33	37.79	37.41	39.08	39.67	42.03	36.08	36.34	38.76	38.23	37.05	40.08	1208.44
Logo	24.82	24.34	24.21	26.51	23.83	27.20	27.01	24.58	28.58	28.94	23.38	28.22	23.03	28.08	823.92
B. Finishing Department															
Trim	99.74	91.42	91.89	117.86	94.40	90.94	115.35	99.93	105.55	105.78	97.81	105.12	102.55	92.27	3269.09
Quality Control	29.34	21.45	21.56	22.47	27.54	23.42	27.65	34.65	41.83	41.42	12.13	12.16	21.82	20.53	983.65
C. Packing Department															
Tagging	24.76	30.12	30.01	26.51	23.83	27.2	27.23	24.58	28.58	28.43	23.38	23.56	23.03	28.08	832.79
Packing	22.55	22.23	22.43	22.53	28.88	19.18	29.26	22.10	28.06	28.01	22.73	22.98	22.65	20.66	757.47

Table 3. Normal Time of Each Processes (Seconds)

Elements	Total Observe Time	Average Time Consume	Rating Factor	Normal Time
A. Sewing Department				
Combination	774.34	26.70	85%	22.70
Topping Front Body	300.30	10.01	100%	10.01
Joint Shoulder	791.49	26.38	100%	26.38
Prep Ribbings	279.40	9.31	100%	9.31
Attach Ribbings	1076.31	35.88	95%	34.09
Topping Neckband	455.34	15.18	95%	14.42
Attach Sleeves	2944.90	98.16	85%	83.44
Side Close	1557.73	51.92	90%	46.73
Hemming 1	1315.92	43.86	85%	37.28
Hemming 2	1208.44	40.28	95%	38.27
Logo	823.92	27.48	95%	26.11
B. Finishing Department				
Trim	3269.09	108.97	80%	87.18
Quality Control	983.65	32.79	90%	29.51
C. Packing Department				
Tagging	832.79	27.76	100%	27.76
Packing	757.47	25.25	85%	21.46

Table 4. Normal and Standard Time of Each Processes (Seconds)

Operation	Activity	Present	
		Normal Time	Standard Time
A. Sewing Department			
1	Combination	22.70	26.09
2	Topping Front Body	10.01	11.51
3	Joint Shoulder	26.38	30.34
4	Prep Ribbing	9.31	10.71
5	Attach Ribbing	34.09	39.19
6	Topping Neckband	14.42	16.58
7	Attach Sleeves	83.45	95.95
8	Side Close	46.73	53.74
9	Hemming 1	37.28	42.87
10	Hemming 2	38.27	44.01
11	Logo	26.11	30.03
B. Finishing Department			
12	Trim	87.18	100.26
13	Quality Control	29.51	33.94
C. Packing Department			
14	Tagging	27.76	31.92
15	Packing	21.46	24.68

Normal Time (in minutes) = 8.5772 minutes

Standard Time (in minutes) = 9.4288 minutes

Table 5. Allowance Factor

Allowance Factors				
	Personal	Delay	Fatigue	Total
Men	7%	5%	3%	15%
Women	7%	5%	3%	15%

The standard Time is computed by multiplying the average observed Time by the allocated rating factors of each process shown in Table 4. The average Time for sewing a two-way colored shirt is calculated to be 8.58 minutes, as shown above. Then, the study identifies the allowance factor to be considered in completing the work that is important to employees who work in manufacturing companies, particularly employees who produce a high frequency of products and work repetitively.

In the paper, 15% is allotted as the total allowance factor for both men and women. The study allotted 7% for personal reasons, considering that 75% of the workers in the garment manufacturing company are females and 25% are males. The standard personal allowance factor for male workers is 5%, and for female workers is 7% (Farhad, 2022).

Moreover, the study also allocated 3% for fatigue. The acceptable allowance for fatigue regarding environmental humidity is 1%-10%, which may affect workers' productivity (Farhad, 2022). In addition, due to unforeseen and unexpected mistakes and delays, 5% is allocated to unavoidable delays. Using the allocated allowance factor in Table 5, standard Time is calculated by multiplying the average Time by the allowance factor plus 1. Moreover, with the identified allowance factor of 15%, the computed standard Time in manufacturing two-way colored shirts is 9.43 minutes.

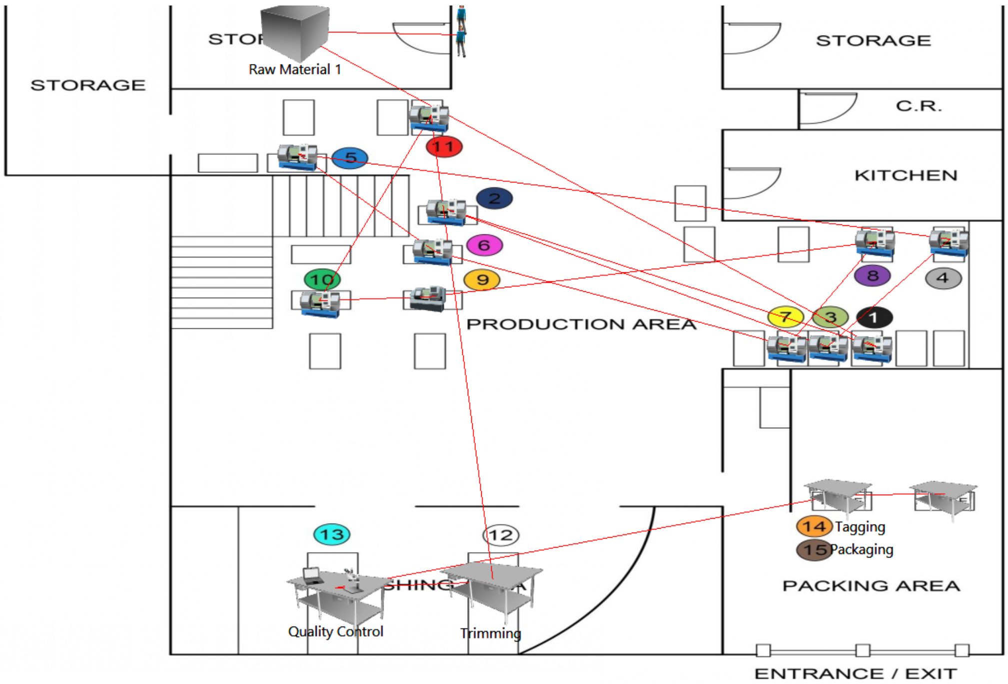
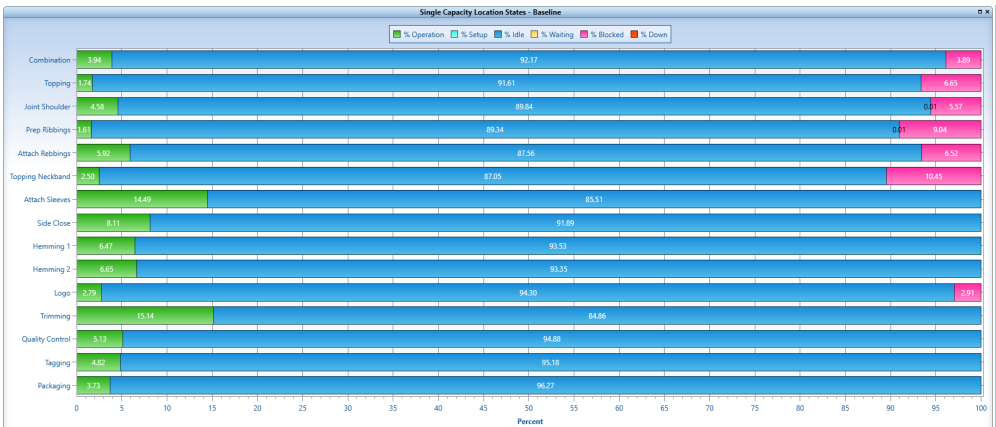
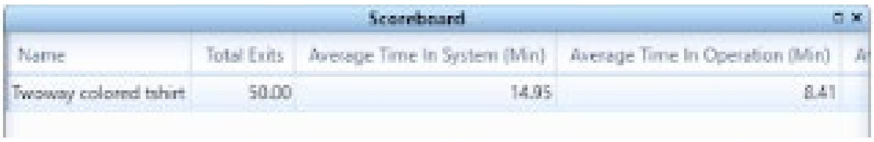


Figure 2. Present Facility Layout



	Combination	Topping	Joint Shoulder	Prep Ribbings	Attach Rebbings	Topping Neckband	Attach Sleeves	Side Close	Hemming 1	Hemming 2	Logo	Trimming	Quality Control	Tagging	Packaging
% Operation	3.94	1.74	4.58	1.61	5.92	2.50	14.49	8.11	6.47	6.65	2.79	15.14	5.13	4.82	3.73
% Setup															
% Idle	92.17	91.61	89.84	89.34	87.56	87.05	85.51	91.89	93.53	93.35	94.30	84.86	94.88	95.18	96.27
% Waiting			0.01	0.01											
% Blocked	3.89	6.65	5.57	9.04	6.52	10.45					2.91				
% Down															

Figure 3. Single Capacity Location States - Baseline Results Present Layout


Scoreboard

Name	Total Exits	Average Time In System (Min)	Average Time In Operation (Min)	A
Twoway colored tshirt	50.00	14.95	8.41	

Figure 4. Scoreboard of Present Layout

Figures 2 and 3 show the result of the ProModel simulation of the present layout of the garment manufacturing company. The present facility layout has 15 sections: Combination, Topping Front Body, Joint Shoulder, Prep Ribbings, Attach Ribbings, Topping Neckband, Attach Sleeves, Side Close, Hemming 1, Hemming 2, Logo, Trim, Quality Control, Tagging and Packing. The simulation shows the delays and efficiency of each process, which helps the study analyze and identify which of the three (3) departments causes more bottlenecks and which specific departments or processes need improvement that could help the garment manufacturing company increase production efficiency. Figure 4 shows the scoreboard or number of exits the garment manufacturing had in the present layout, which is 50 two-way colored shirts.

5.2 Proposed Improvements

Utilizing the ProModel Simulation presents the overall performance of the proposed production process in the garment manufacturing company. This simulation can show the system's efficiency, which will benefit the company by allowing possible improvement and resolution of its problems. Figure 5 shows the proposed facility layout of the garment manufacturing company.

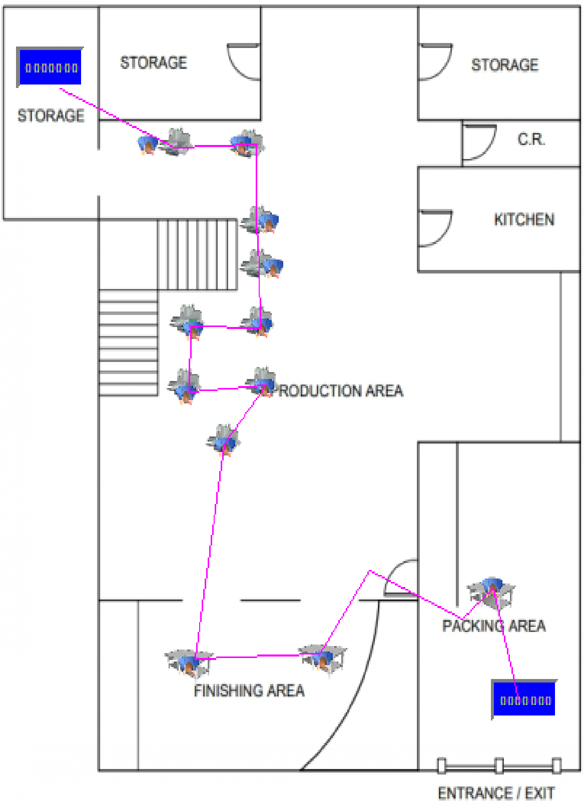


Figure 5. Proposed Facility Layout

Figure 6. Single Capacity Location States - Baseline Results Proposed Layout

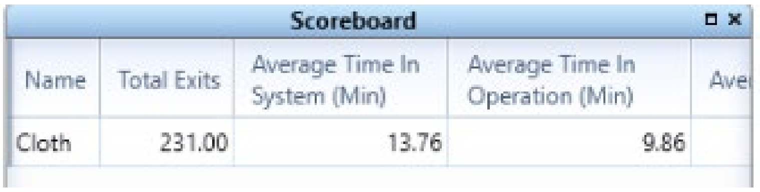


Figure 7. Scoreboard of Proposed Layout

The proposed facility layout has twelve (12) sections: the Combination, Joint Shoulder, Ribbings, Topping Neckband, Attach Sleeves, Side Close, Hemming 1, Hemming 2, Logo, Trim, Quality Control and Packing. In Figure 7, the twelve (12) operations, 30.06%, 22.67%, 38.78%, 12.58%, 78.07%, 45.05%, 31.87, 33.59%, 21.99%, 94.61%, 25.51%, 44.42%. Moreover, Combination, Joint Shoulder, Ribbings, Topping Neckband, and Logo are block by 6.37%, 21.89%, 18.35%, 47.17%, and 35.04% And lastly, all sections are idle by 63.57%, 55.44%, 42.87%, 40.25%, 21.93%, 54.95%, 68.13%, 66.41%, 42.97%, 5.39%, 74.49% and, 55.58%. Figure 7 shows the scoreboard of the proposed layout showing the number of exits; the proposed layout produced 231 two-way colored shirts. Thus, the study's results section provides valuable insights into the manufacturing process of two-way colored shirts at garment manufacturing and highlights the impact of changes made to the facility layout (Table 6).

Table 6. Cost-Benefit Analysis of Emerson Garments

Process	Price per Two-way colored shirt	Two-way colored shirt yield per day	Estimated Daily Sales in ₱	Estimated Monthly Sales in ₱	Estimated Annual Sales in ₱	Estimated Total Annual Cost in ₱	Estimate Total Profit in ₱
Present	599	50	29,950.00	778,700.00	9,344,400.00	2,426,400.00	6,918, 000.00
Proposed	599	231	138,369.00	3,597,594.00	43,171,128.00	6,564,800.00	36,606,328.00

6. Conclusion

The findings from the study compare the current layout to the proposed layout at garment manufacturing, demonstrating a significant improvement in the production process of making two-way colored shirts. The data revealed that the proposed layout led to a substantial increase in production output, with 231 shirts produced in 8 hours compared to 50 shirts in the current layout. Additionally, the average Time spent in the system and operation decreased in the proposed layout, indicating enhanced efficiency and productivity.

Moreover, to calculate the productivity increase, the study has determined the difference in the number of shirts produced per hour before and after the proposed layout. Before the change, garment manufacturing could produce 50 shirts in 8 hours, and its hourly production rate was 6.25 shirts per hour. In the proposed layout change, garment manufacturing can produce 231 shirts in 8 hours, and its hourly production rate is 29.375 shirts per hour. To find the productivity increase, we can calculate the ratio of your proposed hourly production rate to the current rate of 4.62. Therefore, the productivity increase is 4.62 fold.

The results of this study highlight the importance of optimizing facility layouts in manufacturing processes to achieve higher productivity levels. By implementing changes based on these findings, garment manufacturing can facilitate improvement in its operations, reduce production time, and increase output significantly. This paper provides valuable insights for similar industries looking to enhance their manufacturing processes through strategic facility layout improvements. Thus, the findings are a foundation for further enhancements and optimizations within garment manufacturing production processes, ultimately contributing to increased company competitiveness, output, and profitability.

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